Medical students' expectations and experience as learners in a problem-based curriculum: A 'mixed methods' research approach

Thesis submitted in accordance with the requirements of The University of Liverpool for the degree of Doctor of Medicine by Gillian Maudsley

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No portion of this work has been submitted in support of an application for degree or qualification of this or any other university or institute of learning. The work is my own unless stated otherwise.

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Abbreviations

A-level; GCSE	Advanced-level; General Certificate in Secondary Education
ACP	Kolb Adaptive Competency Scale
AE, CE, AC, RO	active experimentation, concrete experience, abstract conceptualization, reflective observation *[Kolb]*
ADHD	Attention Deficit Hyperactivity Disorder
ALV	Allport Vernon-Lindzey Study of Values
AMED	Allied & Complementary Medicine *[electronic database]*
AMEE	Association for Medical Education in Europe (AMEE)
ANOVA	analysis of variance
ASI	Approaches to Studying Inventory *[Entwistle et al]*
ASME	Association for the Study of Medical Education
ASSIST	Approaches and Study Skills Inventory for Students *[Entwistle et al]*
BEME	Best Evidence Medical Education *[The BEME collaboration]*
BNI	British Nursing Index
CINAHL	Cumulative Index to Nursing & Allied Health Literature *[electronic database]*
CSA	Cambridge Scientific Abstracts
DREEM	Dundee Ready Education Environment Measure
EC	European Community
ERIC	'Educational Resources Information Center' *[electronic database]*
GMC	General Medical Council
GP	general practitioner
GPA	grade point average *[in US undergraduate medical curricula]*
GPEP	General Professional Education of the Physician *[US report]*
IGS	Individuals, Groups & Society theme *[Liverpool MBChB]*
InQ	Inquiry Mode Survey *[cognitive style inventory]*
ISI	Institute for Scientific Information
KMO	Kaiser-Meyer-Olkin Measure of Sampling Adequacy
LEQ	Learning Environment Questionnaire
LSI	Learning Styles Inventory *[Kolb]*
MACL	Multiple Adjectival Check-List
MCAT	Medical College Admissions Test *[in US undergraduate medical curricula]*
MCQ	multiple-choice question
MeSH	Medical Subject Heading
MIMAS	Manchester Information & Associated Services *[for postcode analysis]*
MSEQ	Medical Schools Environment Questionnaire *[Wakeford] (MSEI Medical School Environment Inventory)*
MSLES	Medical School Learning Environment Survey *[Marshall, Chicago]*
NBME	National Board Medical Examinations *[in US]*
NHS	National Health Service
OSCE	objective structured clinical examination
ONS	Office for National Statistics
OPCS	Office of Population Censuses & Surveys
PBL	problem-based learning
PNCDO	Physician–Nurse Collaborative Decision-making Opinionnaire
PP	Population Perspective theme *[Liverpool MBChB]*
PPD	Professional & Personal Development theme *[Liverpool MBChB]... was Professional Values & Personal Growth*
Q	question
RASI	Revised Approaches to Studying Inventory *[Entwistle et al, 18-item short version: the 'short RASI']*
S&F	Structure & Function in Health & Disease theme *[Liverpool MBChB]*
SIV	Survey of Interpersonal Values
SOLAT/HIP	Style of Learning and Thinking C/Human Information Processing (HIP) Survey *[cognitive style inventory]*
SOLO	Structure of the Observed Learning Outcome *[Biggs taxonomy]*
SPIDER	Student Programmes, Information, Degrees, Examinations and Registration *[The University of Liverpool]*
SPQ	Study Process Questionnaire *[Biggs]*
SPSS 11.0	Statistical Package for Social Science [for Windows] 11.0
SSC	special study component
UCAS	Universities and Colleges Admission Service
UK	United Kingdom
US; USMLE	United States; United States Medical Licensing Examination
WWW	World-Wide Web

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Abstract

"Medical students' expectations and experience as learners in a problem-based curriculum: A 'mixed methods' research approach": *Gillian Maudsley* *[430 words]*

Background

The evidence-base about *medical students' learning in problem-based curricula* is cautiously optimistic about benefits, but there is less evidence about how students' learning approaches relate to their expectations, attainment, and career plans. More longitudinal data are needed, and more use could be made of *mixed methods research* (blending quantitative and qualitative approaches) into problem-based learning (PBL).

Overall aim

The exploration of medical students' expectations and experiences of learning to be a doctor within a problem-based curriculum from admission to assessment.

Overall research questions

How do medical students in a problem-based curriculum perceive their learning and tutors? How do their learning approaches and allied learning expectations and experiences relate to their stage in the curriculum, performance in assessments, vocational perspective, and appreciation of a population health perspective?

Methods

Setting: The University of Liverpool MBChB programme. *Design & approach:* cross-sectional and longitudinal; a 'pragmatic' mixed methods research approach. *Data collection:* Six sequential study-elements, each using a different postal questionnaire, generated qualitative and/or quantitative data on the 1999 and 2001 entry-cohorts of medical students (n=228; n=283; both start/end of Year (Y) 1 and mid-Y3 for former) and the 2001/02 interviewee cohort (n=1,064): Open items explored: views of learning, PBL, tutors, medicine, and population perspective learning. Closed items included: career intention; ranking good doctor themes; Likert scales about good tutors, curriculum satisfaction, and Entwistle learning approaches (18-item). *Data analysis:* Qualitative analysis: derived and counted key themes by iterative, inductive analysis, some of which informed analysis of similar items in other study-elements or the design of closed items. Quantitative analysis: used frequencies and crosstabulations, multiple/logistic regression, and principal components analysis.

Results

Response: 61.2%-77.9% of students (91.4% of interviewee candidates). Findings within *six key strands* include: ▪*A good learning history:* Many students' schooling involved much teacher-directed learning. ▪*A good doctor:* Responders ranked compassion and communication highly. ▪*A good career:* Only 9.5%-17.7% intended to be general practitioners. Students describing population perspective learning negatively scored statistically significantly higher on surface learning. ▪*A good learning and tutor experience:* Students saw the potential of PBL, valued non-dominating tutors who knew when and how to intervene, and found tutor or student over- or under-contribution frustrating. Strategic learning increased significantly over Year 1. ▪*A good curriculum:* Greater satisfaction related significantly to strategic learning and to valuing certain attributes of the good doctor. ▪*A good outcome:* Students still in-cohort after Y1 or Y4 scored significantly lower on surface or higher on deep learning, respectively, if they had passed all examinations without retakes.

Discussion/Conclusions

Selection, support, and success in problem-based curricula should heed links between learning approaches, and expectations of tutors, career, and population perspective. Questionnaires deserve more recognition for qualitative/quantitative mixing.

Chapter 1: Introduction, aim, literature search strategies

Introduction

How best to produce doctors who are clinically competent, compassionate, and critical thinkers, with a community conscience, is crucial to workforce development. Medical education research is, however, at the fringes of health services research let alone mainstream clinical research. This thesis mixes methods to explore relationships between various determinants of student attainment and satisfaction in a problem-based curriculum, a setting that provides much potential for integrating a wider view of health and health services for the medical workforce.

International priorities in undergraduate medical education research include improving *medical students' learning* to be good doctors. In 2001, Wolf *et al* reported the priorities for systematic reviews of 'best evidence' in medical education set by the (North American) Society of Directors of Research in Medical Education[1]. Thirty-five key stakeholders in medical education research (including the president of the United Kingdom (UK)-based Association for the Study of Medical Education (ASME)) participated. Each of three groups generated a priority list then, within group, individuals voted for their top three. All topics receiving at least 3 votes within any group fell under seven broad priority headings, i.e. how best to:

- ●evaluate medical education outcomes ●measure effectiveness of instructional approaches ●implications of overload on retention, transfer, generalizability of learning ●evaluate various types of curriculum change ●establish optimal student assessment and its effect on learning, cognition, motivation ●deliver medical education via technology ●produce a competent doctor

Prystowsky and Bordage explored what medical education publications *had* prioritized, using content analysis of three leading journals (Academic Medicine and Teaching & Learning in Medicine (North America); Medical Education (UK)). Performance or satisfaction of students or junior doctors dominated published research 'outcomes' – about 60% of data-driven articles[2]. Another researcher's personal impression was that the literature focused on: teaching and learning in hospital and community settings, specialty choice and role modelling, programme evaluation, problem-based learning (PBL), and curriculum development processes[3].

A substantial wave of curriculum change in UK medical schools over the 1990s included the problem-based transformation of the Liverpool curriculum in 1996. This was consistent with the General Medical Council's (GMC's) 1993 *Tomorrow's Doctors* recommendations to: use 'modern educational theory' to reorientate undergraduate medical curricula, reduce factual overload, and develop medical students as learners[4]. Implementation of problem-based curriculum design should continue to be evidence- and theory-based and make best use of the PBL process at each level of student progression, producing doctors with a diverse but relevant professional knowledge-base, who fulfil their own learning potential.

There is a substantial literature about how students in higher education learn and how this affects academic performance, but specific research about how *medical students* approach 'learning to be a doctor' in a problem-based curriculum, and their satisfaction and success is less well-established. Longitudinal analyses and UK examples are particularly under-represented. Crucial potential factors influencing medical students' educational and vocational development are their previous experience, reasons for choosing Medicine, expectations of learning to be a doctor and the doctor's role, initial perceptions of 'a good doctor', preferred learning approaches and motivation; the learning environment; and more fixed attributes such as age, sex, and personality. Two early premises for preliminary work were that:

- Firstly, medical students' initial perceptions of their future role ('a good doctor' and the 'pre-registration house officer' output of the curriculum) might be important influences on their progression.
- Secondly, medical students may well develop perceptions about the PBL environment in Year 1 that are crucial to progression.

Overview of thesis

This thesis explores the following research questions and aim **(p18)**, underpinned by two comprehensive literature reviews (current evidence; possible research approaches) **(p19)**. **Chapter 2** provides background about medical students' learning and educational setting of the study-elements, while **Chapter 3** explores the medical education research context relevant to this research. **Chapters 4 and 5** provide the Methods and Results, respectively, **Chapter 6** discusses design strengths and weakness, interprets the findings given current evidence, and raises implications for further research and development. The Discussion synthesizes and interprets the findings under the six main strands of the overall study objective (overleaf): a good learning history; a good doctor; a good career; a good learning experience with good tutoring; a good curriculum; and a good outcome. **Chapter 7** reflects briefly on matters of note.

Three key concepts in this thesis

The following are working explanations of three key concepts that recur in this thesis:

- **Problem-based learning (PBL) (p25)** is a method whereby students working in groups of 7-8 decide for themselves what they need to learn to understand a paper clinical case-scenario, helped but not directed by a tutor. From active discussion of the scenario in an initial session, students identify gaps in the group's knowledge, decide what is relevant to go away and study, and then come back at subsequent discussion sessions and explain out loud what they have learnt without using notes. They evaluate their progress and group process by discussion at the end of each session. As a philosophy for organizing the whole curriculum, PBL also means that all other parts of the curriculum should support students' *active* learning, e.g. the timetable should allow them time to learn the PBL tasks that they set themselves, and input from subject experts via traditional lectures should be used sparingly.
- **Learning approach (p51)** combines a learner's intention, motivation, and preferred ways of receiving and dealing with information (i.e. instructional preferences and information-processing). The term conveys more flexibility than 'learning style' as the learner might change approach according to the context in which (s)he is trying to learn.
- **Mixed methods research (Chapter 3, p104)** attempts to reconcile two potentially conflicting philosophies about how and what to research and whether the 'truth' can be found, i.e. quantitative (focused mostly on testing hypotheses and analysing numerical data), and qualitative (focused mostly on exploring meaning and analysing textual data). Mixed methods research takes a pragmatic 'horses for courses' approach, focused on researching in a way that answers the research question that is asked. Quantitative and qualitative approaches may be 'mixed' in the research design, instrument, and/or data analysis and interpretation.

Aim

Overall aim

✧ The exploration of medical students' expectations and experiences of learning to be a doctor within a problem-based curriculum from admission to assessment

Overall research questions

How do medical students in a problem-based curriculum perceive their learning and tutors? How do their learning approaches and allied learning expectations and experiences relate to their stage in the curriculum, performance in assessments, vocational perspective, and appreciation of a population health perspective?

Overall objective

✧ To describe the diversity and distribution (trends and patterns) of medical students' expectations and experiences in a problem-based curriculum related to six key strands: learning history; a good doctor; career; learning and tutor experience; satisfaction with the curriculum; and assessment outcome

Objectives [1999 (Red) Cohort: S1, S2, S5] [2001 (Blue) Cohort: S3, S6] [2002 (Green) Cohort: S4]

✧ To explore medical students':

- notions of learning at school/college before medical school and expectations of university study (Study-element (S): S1); and factors related to admission (S4)
- conceptual baseline and development about the defining characteristics of a 'good doctor' (S1, S2, S5; S6), and the views of interview candidates (S4)
- notions of their initial work as a doctor (S1); career motivation (S3); career intentions (S1, S2, S5; S3, S6; S4) and how they change (S1, S2, S5; S3, S6); and how a population perspective fits with such views of the future (S5; S6)
- learning approaches (S1, S2, S5), how they change (S3, S6) (what they were pre-admission (S4)); and related notions of learning, tutors (S2, S5; S3, S6), and critical incidents concerning effectiveness (S3, S6) in a problem-based curriculum

✧ To explore how specific factors from above plus demographic variables (compared within and between cohorts) impact on students':

- satisfaction with the curriculum
- examination performance

Literature search strategies

The literature searches used several electronic databases, followed guidance on systematic searching[5,6] (to define question(s) iteratively, identify key concepts, and set the inclusion/exclusion scope of queries), and were completed *after* data collection.

What is mixed methods research, and how does it relate to medical education research?

The main focus was a free-text literature search of Web of Science to Sep' 2004 (Science Citation Index Expanded, 1945-; Social Sciences Citation Index, 1956-; Arts & Humanities Citation Index, 1975-), augmented by Medline, 1966-, and checked against other health and education literature databases **(Box 1)**. Search terms combined ---mixed method*[i] *with* '(medical) education* (research)'--- medical education *with* qualitative, *or with* quantitative, or mixed, *or with* evidence-based, *or with* research paradigm. Medline searches used Medical Subject Headings (MeSH) mapping. Other searches used thesauri checks if feasible. Only English Language titles were searched for suitability (checking abstracts if required). Selected articles reviewed the theory/ practice of such research or examples in health care education (mostly undergraduate medical) or allied settings. The University of Liverpool electronic Library Catalogue was searched for 'mixed methods' books. Ancestry searching (from reference-lists of articles), ad hoc 'finds', personal collection, and 2004/05 handsearching of *Medical Education* and *Medical Teacher* journals also gave references.

What is known about medical students' conceptions, in problem-based curricula, of their learning, knowledge, and career (and how these relate to examination outcomes and learning about population health)?

This search used the main four databases, years, and approaches (with thesauri and MeSH), thus excluding CINAHL, AMED, BNI[ii], 'International ERIC (CD-ROM)' (discontinued) and Sociological Abstracts **(Box 2)**. Search terms combined: ---medical student/undergraduate medical education *with* cognitive/academic/intellectual development or learning approaches/perceptions; *or with* problem-based learning/curriculum/programme *and* predicting assessment/selection outcomes; *or with* perceptions of learning a population health perspective or its role as predictor.

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[i] where * denotes variations found using the 'wildcard' character(s) function

[ii] CINAHL=Cumulative Index to Nursing & Allied Health Literature; AMED=Allied & Complementary Medicine; BNI=British Nursing Index; ERIC= 'Educational Resources Information Center'

Box 1: Literature search strategy: What is mixed methods research, and how does it relate to medical education research?

Service	Electronic database**	*Years*	Terms	Comment
ISI Web of Science	▪ Science Citation Index Expanded (SCI-expanded) ▪ Social Sciences Citation Index (SSCI) ▪ Arts & Humanities Citation Index (A&HCI)	*1945-Sep' 2004,* at W3 *1956-Sep' 2004,* at W3 *1975-Sep' 2004,* at W3	■ mixed method* + ((education* research) or (medical education research) or (medical education)) ■ evidence-based medical education ■ medical education + research paradigm ■ medical education + qualitative + quantitative + mixed ■	General search in topic field (of title, abstract, keyword lists); all documents
Ovid	▪ Medline	*1966-Sep' 2004* (W3)	■ mixed method$ as keyword + (exp. EDUCATION/mt, og, st, td) ■ *MEDICAL EDUCATION*/mt, og, st, td + exp. EMPIRICAL RESEARCH [plus rerun with paradigm as keyword] ■ *MEDICAL EDUCATION*/mt, og, st, td + evidence-based medicine/mt, ed, og, st, td [plus rerun with paradigm as keyword]■	Advanced search in keywords box (of title, abstract, MeSH heading for keywords); all documents; Eng. only NB MAIN MESH; *SUBMAIN MeSH*
	▪ Cumulative Index to Nursing & Allied Health Literature (CINAHL)	*1982-Sep' 2004* (W3)	■ Medline search rerun on each, separately ■	
	▪ Allied & Complementary Medicine (AMED)	*1985-Sep' 2004,* at W3		
	▪ British Nursing Index	*1985-Sep' 2004,* at W3		
ERIC (CSA)	▪ Current Index to Journals in Education (CIJE) & Resources in Education (RIE)	*1966-Sep'2004,* at W3	■ mixed method* + ((education* research) or (medical education research) or (medical education)) ■ evidence-based medical education ■ medical education + research paradigm ■ medical education + qualitative + quantitative + mixed ■	Advanced search in topic field, keywords as exact phrase; Eng. only; no THESAURUS TERMS there
International ERIC (CD-ROM)	▪ British Educational Index	*1976-Mar' 2004,* at W3, *Sep'2004*	■ evidence-based ■	Keyword search
CSA	▪ Sociological abstracts (Sociofile)	*1963-Sep'2004,* at W4	■ mixed method* + ((education* research) or (medical education research) or (medical education)) ■	Advanced search in topic field, keywords as exact phrase; Eng. only
Ovid ERL WEbSPIRS	▪ PsychINFO	*1971-Sep' 2004,* at W4	■ mixed method* + ((education* research) or (medical education research) or (medical education)) ■	Advanced search in terms boxes (major/ minor descriptors); Eng. only

Eng. only: English Language only; ISI: Institute for Scientific Information; W: week; MeSH: Medical Subject Heading; exp: expanded; ERIC: 'Educational Resources Information Center'; CSA: Cambridge Scientific Abstracts

Subheadings to qualify MeSH: mt: methods; ed: education; og: organization & administration; st: standards; td: trends

* or $ wildcard; **World-Wide Web-based unless stated otherwise Where possible, keywords checked against subject-headings/thesauri

■ shows boundaries of each search; terms combined with: + (AND) / or or (OR) Reference Manager software was used

Box 2: Literature search strategy: What is known about medical students' conceptions, in problem-based curricula, of their learning, knowledge, and career (and their relationship to examination outcomes and to perceptions of learning about population health)?

Service	Electronic database**	*Years*	Terms	Comment
ISI Web of Science	▪ Science Citation Index Expanded (SCI-expanded) ▪ Social Sciences Citation Index (SSCI) ▪ Arts & Humanities Citation Index (A&HCI)	*1945-Sep' 2004,* at W4 *1956-Sep' 2004,* at W4 *1975-Sep' 2004,* at W4	■ ((medical school*/student*/curricul*/education) or (undergraduate medical))... ... + ((cognitive development/strateg*/style) or (learning style*/ approach*) or (epistemolog*) or (intellectual/professional/student/ academic/vocational development) or (perception*/conception* of learning/knowledge/teach*/tutor*)) ■ ... + (outcome*/performance/admission*/selection*/career*) + (risk factor*/predict*/determinant*) + (problem-based learning/curriculum/ programme) ■ ... + ((population health/perspective) or (public health/epidemiology)) + (perception*/conception*/attitud*/outcome*/performance/risk factor*/ predict*/determinant*) ■	Advanced search in topic field (of title, abstract, keyword lists); all documents
Ovid	▪ Medline	*1966-Sep' 2004* (W4)	■ (*(STUDENTS, MEDICAL)* or *(EDUCATION, MEDICAL, UNDERGRADUATE*/mt, og, st, sn, td) or (*SCHOOLS, MEDICAL*/og, ed, st, sn, sd, td))... ... + (*(LEARNING*/cl, ed, es, st) or *(LEARNING DISORDERS*/cl, ed, ep) or (cognitive/intellectual/professional/student/academic/vocational development as keywords) or (cognitive strateg$/cognitive style$/ learning style$/ earning approach$) or ((perception$/conception$ of learning/knowledge/teach$/tutor$) as keywords) or (COGNITION/cl, es) or (INTELLIGENCE/cl) or (epistemology as keyword or *KNOWLEDGE/*)) ■ ... + (outcome$/performance/selection/ as keywords) or *(ACHIEVEMENT/)* or (SCHOOL ADMISSION CRITERIA/ st, sn, mt, td) or (CAREER CHOICE/) + (or *RISK FACTORS/)* or (predict$/determinant$ as keywords) + *PROBLEM-BASED LEARNING*/cl, mt, og, es, st, sn, td or problem-based learning/curriculum/programme as keywords ■ ■ (*(STUDENTS, MEDICAL)* or *(EDUCATION, MEDICAL, UNDERGRADUATE/*) or (*SCHOOLS, MEDICAL*/og, ed, st, sn, sd, td))... ... + (*(HEALTH SERVICES ADMINISTRATION/* or *COMMUNITY MEDICINE/* or *EPIDEMIOLOGY/* or *PREVENTIVE MEDICINE/* or *PUBLIC HEALTH/)* or (population health/perspective as keywords)) + ((perception$/outcome/performance as keywords) or ATTITUDE/) ■	Advanced search in keywords box (of title, abstract, MeSH heading for keywords); all documents; Eng only NB MAIN MESH; *SUBMAIN MeSH*
ERIC (CSA)	▪ Current Index to Journals in Education (CIJE) & Resources in Education (RIE)	*1966-Oct'2004,* at W3	■ (MEDICAL STUDENTS as descriptor)... ... +((ANDRAGOGY or EDUCATIONAL ENVIRONMENT or ACADEMIC ASPIRATION or VOCATIONAL MATURITY or EMOTIONAL INTELLIGENCE or COGNITIVE ABILITY or INTELLECTUAL DEVELOPMENT/EXPERIENCE or INTELLIGENCE QUOTIENT or TRANSFORMATIVE/ EXPERIENTIAL LEARNING or EPISTEMOLOGY or LEARNING EXPERIENCE/STRATEGIES or COGNITIVE STYLE or COGNITIVE DEVELOPMENT/PROCESSES or LEARNING MOTIVATION or METACOGNITION or STUDY/THINKING SKILLS or TRANSFER OF TRAINING as descriptor) or (conception*/ perception* of learning/knowledge/teach*/tutor* as keywords) ■ ... +((OCCUPATIONAL ASPIRATION or CAREER CHOICE or STUDENT EVALUATION or PERFORMANCE FACTORS or ADMISSION-SCHOOL or COLLEGE APPLICANTS or ACADEMIC ABILITY or ACADEMIC ACHIEVEMENT or ACADEMIC APTITUDE or COLLEGE ENTRANCE EXAMINATIONS or HIGH RISK STUDENTS as descriptor) or (assessment outcome or evaluation outcome or student achievement as keywords) + (problem-based learning/curriculum/program*) ■	Advanced search in topic field, keywords as exact phrase; Eng. only THESAURUS TERMS
Ovid ERL WEbSPIRS	▪ PsychINFO	*1971-Oct'2004,* at W1	■ (ACADEMIC-SELF-CONCEPT or EPISTEMOLOGY or VOCATIONAL-MATURITY or INTELLECTUAL-DEVELOPMENT or INTELLECTUALISM- or INTELLECTUALIZATION- or INTELLIGENCE- or INTELLIGENCE-QUOTIENT or CLASSIFICATION-COGNITIVE-PROCESS or COGNITIVE-ABILITY/-DEVELOPMENT/-MAPS/-PROCESSES/-STYLE or ADULT-/COOPERATIVE-/EXPERIENTIAL-/INCIDENTAL-/TRANSFER-LEARNING or LEARNING- or LEARNING-ABILITY/-DISORDERS/-STRATEGIES/-THEORY in MJ/MN) or (concept*/perception* of teach*/tutor*/learning/knowledge anywhere) + ((medical student*) as key concepts) ■	Advanced search in terms boxes (major/ minor descriptors); Eng. only

Eng. only: English Language only; ISI: Institute for Scientific Information; W: week; MeSH: Medical Subject Heading; exp: expanded; ERIC: 'Educational Resources Information Center'; CSA: Cambridge Scientific Abstracts; MJ/MN: major/minor descriptors

Subheadings to qualify MeSH: cl: classification; mt: methods; ed: education; ep: epidemiology; es: ethics; og: organization & administration; st: standards; sn: statistics & numerical data; sd: supply & distribution; td: trends

* or $ wildcard; **World-Wide Web-based unless stated otherwise Where possible, keywords checked against subject-headings/thesauri

■ shows boundaries of each search; terms combined with: + (AND) / or or (OR) Reference Manager software was used

Chapter 2: Learning to be a doctor: evidence and theory

Learning to be a doctor involves major personal challenges to intellect, capability, identity, motivation, culture, stamina, and wellbeing. This chapter therefore explores evidence, theory, and commentary about:

- the contemporary context for undergraduate medical education
- processes and challenges in professional development as a medical student
- learning 'styles', approaches, and environments relevant to medical students
- learning to be a doctor in a problem-based curriculum, and related issues about assessment, satisfaction, and the role of the PBL tutor, ending with generic issues about selection, career intentions, and population perspective learning

Undergraduate medical context

International

McGuire noted universal needs that undergraduate medical education should address[7]:

- *societal:* ageing populations, harmful behavioural choices, increasing environmental pollution, and spiralling technology
- *professional:* variable medical decision-making, the knowledge explosion, bureaucratization of medical practice, diminished autonomy, intensification of ethical dilemmas, and spiralling litigation
- *individual:* changes in the population willing and suitable for entry to medical education (adapting curricula to the widening participation agenda)

National calls for reform have included: the Karmel Report of 1973 (about expanding medical education in Australia)[8], the General Professional Education of the Physician 'GPEP' Report of 1984 (United States (US))[9], and the GMC Tomorrow's Doctors recommendations of 1993 and 2003 (UK)[4,10]. Finucane *et al* highlighted the extent of Australian innovation: *"...by the year 2000, more than 50% of Australia's doctors will have graduated from schools with PBL-based curricula"*[11p445].

Recurrent laments of malaise in undergraduate medical education include how it can promote antagonism to science and the intellect, and a self-centredness and hedonism that undermine the profession[12]. Lack of humanity (let alone lack of humanities) has been highlighted. Various stresses potentially affect the physical and psychological health of all medical students, not only those struggling academically. Hospital educators can easily demoralize medical students with constant criticism. Indeed, Linzer reassured his medical students with an 'area under the curve' analogy to summarize any doctor's knowledge across his/her own and other specialties[13]. *"The total area under the curve for the generalist and the specialist are the same. Neither one has more brain than the other; they've just chosen to distribute their knowledge differently"*[13p1,769]. Informally, he found that his medical students had expected three times the specialist's or generalist's total area under the curve: *"You mean I don't need to know everything about everything, and everyone doesn't know everything about everything?"*[13p1,769]. As Linzer commented, *"They were back from the doldrums of excess expectations, a place many of us visit quite often"*[13p1,769]. He hoped that colleagues would gain comfort and modesty from this analogy.

Other laments involve insufficient translation of evidence-based medicine back into undergraduate curriculum reform, despite support from the quality improvement agenda[14]. The UK reform agenda has encompassed various issues, including humanizing the curriculum and being realistic about what needs learning.

National

GMC's Tomorrow's Doctors, of 1993, reinforced by the 2003 update, gave clear recommendations goals for what knowledge, skills, and attitudes student should learn, how they should be learned and assessed, and to integrate behavioural, population, and professional perspectives **(Box 3)**[4]. The 2003 recommendations stressed that medical student selection, education, and assessment must be free from unfair discrimination. Complementary recommendations for improving pre-registration house officer (PRHO) education reinforced the mood for change[15,16], particularly to change the difficult working conditions characterizing PRHO year[17]. A continuing challenge is to prepare graduates mostly for generalist practice, and promote primary care careers. The UK Medical Careers Research Group found general practice to be the career choice of only 25% of 1999-2000 graduates (similar for Liverpool[18]), albeit an improvement on the 1996 low of 20.0% (but nowhere near the 40-50% of the 1970s/1980s)[19,20].

The Tomorrow's Doctors reforms were far-reaching with, for example, 'special study' components (SSCs) becoming universal as alternative learning environments for allowing choice, exploration, in-depth study, and broader horizons. Yates *et al* highlighted the opportunities, for example, for 230 Year 2 Leeds medical students whose third SSCs were in topics outwith mainstream medical education, including foreign language skills, medicine and the police, and writing with wit and wisdom[21].

Box 3: The General Medical Council's (GMC's) main recommendations on undergraduate medical education [paraphrased] from 1993 and 2003[4,10]

1993	2003
Decreasing – factual overload	Promoting – *attitudes* and behaviour suitable for a doctor; qualities appropriate to future responsibilities to patients, colleagues and society in general
Promoting – learning through *curiosity*, exploring knowledge, self-directed learning, and critically appraising evidence	– *core curriculum* of essential knowledge, skills and attitudes must have by graduation
– *attitudes* appropriate to a doctor's responsibilities	– a series of *student-selected components* for in-depth study in areas of interest
– essential skills for *pre-registration year*	– work together between clinicians, basic scientists and medical educationalists on core curriculum *to integrate* and achieve a common purpose
– a *core curriculum* of knowledge, attitudes, and skills for pre-registration ('house officer') year	Decreasing – *factual information* to essential minimum needed at this stage
– *special study modules* to enhance the core curriculum, questioning, and a self-critical approach	Promoting – *learning* opportunities to help explore knowledge, and evaluate and integrate evidence critically, and motivate for and help develop self-directed learning skills
– *integration* of basic sciences and clinical concepts in the core curriculum (decreasing the preclinical/clinical divide and solely department-based courses), and focus on body systems	– *essential skills* gained under supervision and competence assessed
– *communication skills*	– *communication skills* and the other essential skills
– *public health medicine* as a prominent theme	– *the health and safety of the public* as an important part of the curriculum
– clinical education adapted to *changing patterns* of health care (primary, community, and hospital)	– clinical education reflecting *changing patterns of healthcare* and provide experience in various clinical settings
– education based on *modern educational theory*, technological resources, and sharing good practice	– *teaching and learning systems* based on educational theory and research, using effective modern technologies
– *student assessment* that encourages appropriate learning not uncritical fact acquisition	– *schemes of assessment* based on best practice, which support curriculum and assess the intended curricular outcomes appropriately
– effective *supervisory structures*	– effective *supervisory structures* for design, implementation, and continuous review of curriculum using an appropriate range of expertise and knowledge
…And – *reporting regularly* on progress to the GMC	– selection, teaching, and assessment that is *free from unfair discrimination*

Local: Liverpool problem-based learning

In 1996, the Liverpool MBChB programme underwent problem-based transformation (at the same time as Glasgow and a year after Manchester) accepting its first 208 entrants. The conventional curriculum had comprised two preclinical followed by three clinical years (with little community-orientation) and much subject-based teaching, via lectures, and much assessment, mostly departmentally managed. A 2-week Public Health Medicine course, for a third of Year 3 at a time, was not examined summatively until 2-2.5 years later (end-of-Year 5 Finals).

The problem-based curriculum was integrated horizontally (between subjects) and vertically (between preclinical/clinical). There were fewer assessments, and these were coordinated. PBL became the vehicle for the knowledge-base under four core themes, which subsumed subject boundaries:

- *Structure & Function in Health & Disease* (S&F)
- *Individuals, Groups & Society* (IGS)
- *Population Perspective* (PP)
- *Professional and Personal Development* (PPD)

Compulsory clinical and communication skills training and, subsequently, clinical placements complemented these, but other contact-hours were minimal. Plenaries (non-compulsory) were most prevalent in Year 1 at one/day. Further key features included Faculty-level management (under a Director of Medical Studies), six 4-week special study modules, and more community-orientation (about 30% of clinical placement time with general practitioners (GPs) rather than hospital-based).

In this curriculum, PBL meant 'problem-first learning' whereby students generated their own learning objectives from paper problem-scenarios in small-groupwork facilitated by a tutor, in a wider curriculum supporting this philosophy, and adhering to certain 'ground-rules'[22]. Based on the Maastricht Seven Steps **(Box 4a)**[23,24], PBL tutors facilitated clear in-session '***LIVER**pool*' goals. These comprised[25]:

- ***L**ook for phenomena requiring explanation*
- ***I**nvestigate prior knowledge and experience*
- ***V**olunteer shared learning objectives*
- ***E**xplain the essence of the case scenario*
- ***R**eflect and evaluate.*

Box 4a: The ground-rules of problem-based learning (PBL) sessions in the Liverpool problem-based MBChB curriculum and the goals for tutors to facilitate (adapted from Maastricht Seven Steps)

Ground-rules:

- *"method and philosophy, curriculum-wide, supported by all curricular elements;*
- *aimed at efficient acquisition and structuring of knowledge arising out of working through (in an active, iterative, and self-directed way) a progressive framework of problems providing context, relevance, and motivation;*
- *built on prior knowledge, integration, critical thinking, reflection on learning, enjoyment;*
- *achieved via facilitated small-groupwork and independent study; and possibly*
- *related to problem-solving only insofar as knowledge becomes more accessible"* **(Maudsley, 1999)[22p184]**

Student goals in sessions **after summarizing case scenario in own words**:

- *"Look for phenomena requiring explanation:* by 'brainstorming' their ideas to generate and analyse concepts and questions that relate to characters, characteristics, processes, and events in the scenario
- *Investigate prior knowledge and experience:* by suggesting, connecting, and evaluating explanations for these phenomena, and discussing (activating, elaborating) and appraising what they already know that is relevant
- *Volunteer shared learning objectives:* by identifying shared gaps in their understanding of the scenario and prioritising what is feasible to pursue; and, *[after] researching* these objectives between sessions
- *Explain the essence of the case scenario:* by sharing, applying, and synthesising prior and new knowledge, evaluating critically the evidence collected, and then through separate discussion
- *Reflect and evaluate:* by discussing the group process and learning, and personal contributions and achievements (including those of the tutor)"

Maastricht Seven Steps comprised (Schmidt & Bouhuijs, 1980; Schmidt, 1983)[23,24]:

1. clarify and agree working definitions of unclear terms/concepts
2. define the problem(s), agreeing the phenomena to explain
3. analyse components, implications, suggested explanations (through 'brainstorming'), and develop working hypotheses;
4. discuss, evaluate, arrange the possible explanations/working hypotheses
5. generate and prioritize learning objectives
6. go away and research these objectives between sessions
7. report back at next session, synthesizing a comprehensive explanation of 'the phenomena', reapplying synthesized newly acquired information to the problem(s)

In three compulsory 2-hour sessions per 2-week Year 1 scenario ('module'), core activities were thus: brainstorming, activating prior knowledge, explaining (without notes; orally, diagrammatically); critically analysing; synthesizing; evaluating. In Session 1, students generated learning objectives to fill group knowledge gaps under all four themes **(Box 4b, Box 4c)**, reporting back on objectives and clarifying misunderstandings in Session 2. They completed discussing the scenario/objectives, elaborating and justifying explanations, challenging each other, and synthesizing prior and new knowledge with the scenario in Session 3. A Seven Pointers framework guided learning under the *Population Perspective* theme, which had triggers in each scenario, related to several Pointers (paraphrased in **Box 4b**, verbatim in **Box 4c**).

Box 4b: The four core curriculum themes in Liverpool problem-based MBChB curriculum

- ***Structure and Function in Health and Disease* (S&F)**
  i.e. basic and clinical science
  (Anatomy, Physiology, Biochemistry, Pharmacology, Histopathology, Immunology, Medical Microbiology, Clinical Chemistry, etc.):
  e.g. What is normal human structure and function, how do these interrelate, how did they develop and why, and what are normal variations? What happens to structure and function in disease/ill-health and what defence and repair are possible? What mechanisms are involved in the development of the disease and the patient's response to treatment? What are the various treatment options and why?
- ***Individuals, Groups, and Society* (IGS)**
  i.e. behavioural science
  (Psychology, Sociology):
  e.g. How do people perceive their health and ill-health? Why do people make the decisions that they make about their health in this scenario? What psychosocial factors affect the development of disease, how patients cope with that disease and its treatment, and recovery from ill-health? What psychosocial theories can help improve understanding of the patient's perspective and his/her treatment?
- ***Population Perspective* (PP)**
  i.e. population health science
  (Public Health, Epidemiology, & Data Handling):
  e.g. Is there a problem for the public's health? How common is a disease/condition and what are its determinants? What are the population health needs related to this disease/condition? How can disease be prevented/health promoted? How can services best be delivered for health needs? How good is the evidence about risk factors and treatments (critical appraisal; study design)? What health policy could make a difference?
- ***Professional and Personal Development* (PPD)**
  i.e. legal, ethical, and professional practice issues; and self-awareness
  e.g. How do the General Medical Council's Duties of a Doctor relate to the scenario and the doctor's role? What legal issues/requirements and ethical issues/morals and principles relate to this scenario for the doctor, other health professionals, and other people involved? From a historical perspective, what examples might help you to understand this scenario/situation better? What personal beliefs/assumptions might affect how well you understand this scenario/situation, and what personal development do you need?

Briefing document (GM) for Liverpool MBChB Admissions Conference 2005

Tutors were mostly basic scientists or doctors, but could be neither. Some were appointed as sessional PBL tutors only, particularly for their facilitation skills. Tutors underwent 1.5 days of initial training and met for monthly tutor development sessions. The tutor's role focused on process (guided by 'generic' content-expertise), ***not***: answering questions, commenting on accuracy of students' comments, or arbitrating between conflicting understandings. Students led ('chaired', e.g. timekeeping) and 'scribed' (on flip-charts/whiteboards) their own sessions. They were *not* to receive the Faculty indicative objectives.

Each group comprised about eight students and retained the same tutor for one semester, then groups and tutors changed. In each Session 3, using paper questionnaires, students evaluated that module then, mid-semester, evaluated the tutor and self-assessed their PBL performance (for comparison with the tutor's formative assessment of the same). There was no critical incident reporting.

Box 4c: An example of a Year 1 problem-based learning (PBL) scenario----A Sudden Onset of Weakness----in Liverpool problem-based MBChB curriculum, with *Population Perspective* (PP) triggers underlined

Mr Jack Potter, a 60-year-old printer, is talking (on the 3rd floor landing of their block of flats) to his retired neighbour, Mr Joe Whittingham, about the night his wife had suddenly gone weak down one side and collapsed. *"She had a 'funny turn' the month before, only for a few minutes, but this was much worse. I was desperate for help, and phoned 999"*, he says. *"I know the hospital is always going to be busy just after Friday night 'closing time', but Mavis was terribly embarrassed at being examined in the corridor. She's back home now, but can't get out from up here and I'm having to do quite a lot for her."* Mr Whittingham asks, "*How are you coping Jack – bit of a change for you isn't it? Mavis usually runs around after you with your bad back*".

Dr David Ebuwa reads Mrs Mavis Potter's discharge letter: "*...Her peripheral reflexes were brisk... ...neurological examination was consistent with thrombosis in the left middle cerebral artery. ...The 'MRI scan' confirmed this and also showed a small saccular (berry) aneurysm in the Circle of Willis... CSF was not examined...*".

Mrs Potter is referred for community-based rehabilitation but is unsure what to expect. Dr Ebuwa ensures that a physiotherapist and speech therapist visit her as part of her home care plan. After four weeks, the visiting social worker reassesses her, and indicates that the Potters may not be eligible for any social support. Dr Ebuwa visits Mrs Potter at home. Mr Potter is very distressed: *"This sounds bad, but Mavis is becoming such a burden. She says her face still feels funny, and her speech is so difficult to follow, we both get frustrated. She cannot move well and even finds swallowing her food and medicine difficult. We are not seeing our friends as much. Living up here is such a handicap, let alone the stroke. I'm losing too much time off work."* While there, Dr Ebuwa checks Mr Potter's blood pressure - he has been feeling *"a bit faint. Mavis is a big woman to lift."* *"We don't want you ill as well. This lifting is not going to be doing your spine much good"*, says Dr Ebuwa. The Potters' reduced quality of life is clear and he feels he must find more help to 'limit damage' any further. He asks Mrs Potter if he can discuss her case urgently with Social Services.

Dr Ebuwa discusses Mrs Potter with his partner, Dr Jason Kent. They discuss cohort study evidence giving a relative risk of 4.0 (95% confidence interval 1.6 to 8.2) for stroke in high-risk groups. Dr Ebuwa is encouraged that Mrs Potter survived. *"Our local stroke-specific SMR is so high. Material deprivation and high unemployment make things worse around here. Could her stroke have been prevented? Patients like Mrs Potter can be such a challenge."* Dr Kent says, *"Is that SMR adjusted for social class? What routine data would describe the long-term prospects for post-stroke disability?"*

This is the 2004/05 version of the scenario for a long-standing module, reworked each year; used with permission

For Official Use Only: Faculty indicative outcomes for PP for this scenario:

- To define confounding, standardization, and standardized mortality ratio (versus standardized mortality rate), interpreting them, and referring to confidence intervals and statistical significance ✸
- To illustrate differences between definitions of impairment, disability, handicap, and participation and their population measurement ☆☆
- To outline primary, secondary (including screening), and tertiary levels of disease prevention, and relate to health promotion ☆

Seven pointers to a *Population Perspective* on health (to track spiral strands of progression through theme)

☆1 What public health issues are raised by this problem?
☆2 How does this problem affect the population (who, when, where, by how much, & why)?
☆3 What are the health needs of the population in relation to this problem?
☆4 How can the burden of this problem be reduced?
☆5 How should health (and other) services be organized and delivered to address this problem?
☆6 What are the main research & development issues raised by the problem?
☆7 What are the main public health policy implications of this problem?

Key to colour-coding of Faculty indicative outcomes:

☆ identifying main public health issues
☆ appreciating commonness (diseases/conditions/events/determinants/risk factors)
☆ considering health needs/demands and costs (and other economic concepts), etc.
☆ improving health and reducing health problems (health promotion: disease prevention, health education, health protection) and health inequalities
☆ organizing/evaluating services (indicators of quality: effectiveness, efficiency, equity, accessibility, acceptability, appropriateness), including economic considerations
☆ designing studies, critically appraising evidence, studying causation
✸ handling/interpreting data, using epidemiological and statistical measures/concepts (of frequency, risk, adjustment, etc.)
✧ identifying/using routine data sources
☆ identifying health policy implications (e.g. concerning health inequalities)

Student assessment under examination conditions comprised written papers on all four themes and examinations of clinical/communication skills, without compensation between distinct elements. There were three levels:

1. Year 1: formative (January) then summative (May/June)
2. Year 3: summative (November) (after two Year 2 formatives)
3. Year 4: formative (February) then summative (June)

Theory and evidence related to this local context is now explored.

Learning and assessment

Learning

– *"...greatest comfort can be drawn from the fact that medical students appear to perform remarkably well despite the methods used to 'teach' them."* **(Lloyd, 1991)[26p148]**

Learning involves acquisition, retention, and retrieval[27], i.e. not mere transmission (filling empty vessels with facts; or knowledge as bricks in a wall[28]). *"They must know that because I told them that in the lecture"*, is a non sequitur. As Perry noted:

– *"Professors of Arts and Sciences on both sides of the Atlantic long shared a conviction that all the arts are subject to intellectual analysis - all the arts but one: that of teaching in higher education. This art was held sacred to the individual. The good lecturer was one who knew his subject and gave a clear exposition of it enlivened by his own personal style. Though many a conscientious lecturer wondered how so many students managed not to learn what he explained so clearly, he had little to comfort him but the thought that students differ in their aptitude."* **(Perry, 1983)[29pi]**

According to Mehta, *"Learning is the acquisition, through insight, of cognitive structure"*[30p121]. From the behavioural perspective, learning is a person's observed reaction to an observable stimulus (including the view that cognitive behaviour is just another type of reaction)[31], but the era of 'adult learning theory', interrupted behaviourists' domination. Key learning theories now include cognitive psychology and the relational model (wherein learning quality depends on relationships between learner, environment, task, educational approach, and assessment)[32]. Marton and Säljö argued for describing learning by what is learned rather than by behaviourists' 'how much' approach[33]. There was a reminder that, the verb 'to teach' takes two accusatives (you teach someone something), and the verb 'to learn' also has a subject (the learner) and object (what to learn)[34]. Knowles' seminal book was a reminder to humanize learning research[35]. Knowles' adult learner: knows why (s)he needs to know, is internally motivated, is ready to learn, takes responsibility for his/her own learning, builds on his/her experience, and uses life-centred, task-centred, problem-centred approaches. Knowles' assumptions were that a system to promote lifelong learning encompasses learning for change; active learning; learner-learner interaction; a process-orientation; competences for 'life situations', meets the diverse needs of learners, links learners with resources, and should help traditionally educated learners.

Norman acknowledged that Knowles' theory accommodated the learner's intentions, but was alarmed at its ingrained acceptance without an evidence-base (e.g. at what age does pedagogy become andragogy and is this due to nature and/or nurture?):

- *"In hindsight, it is not surprising that this approach was attractive to sensible, liberal educators. Psychology and education were still very much in the clutches of the behaviorists, with their rats, pigeons, behavioural objectives, and all manner of thought control"* **(Norman, 1999)**[36p886]

Indeed, Norman considered Knowles' assumptions to be axioms not assumptions. Further, he proposed that, left alone, adult learners will pursue what they enjoy, with 'wants' overshadowing 'needs'.

There are, however, some empirically-based statements about learning, as in Mårtenson's summary[37]:

- Learners... learn at different speeds; remember 'understood principles' better than 'memorized detail'; and have study skills, study approaches, and learning preferences that impact on what/how to learn. They need to: perceive material to be meaningful; connect new things to prior knowledge; receive constructive feedback; have some control; be challenged by the task and about what they know; have learning theory integrated *properly* with practice

Beyond their 'intelligence', what and how students learn therefore depend on many interconnected factors. These include their learning approach, cognitive style and conceptions of learning and knowledge, personality[38], previous educational experience and stage in intellectual development, the learning environment, the task and its importance, how they feel, and the curriculum and its assessment.

Assessment drives learning

Students adapt the 'what and how' of learning to perceived assessment requirements. Assessment and perceived expectations of what should be learnt contribute strongly to the 'hidden curriculum'[39], and drive learning[40,41,42,43,44] (as does the curriculum[42]):

- *"The fundamental importance of recognising the necessary link between the level of processing adopted by the student and the level of understanding reached cannot be overstated. Students adopt an approach determined by their expectations of what is required of them"* **(Marton & Säljö, 1976)**[40p125]

Besides steering student learning, assessment can certify competence and safety, provide feedback to students and staff, and monitor the curriculum[45]. Spencer and Jordan indicated how undergraduate and postgraduate medical student *"assessment has been heavily influenced by prejudice, hunch, and ignorance"*[46p43], despite a strong evidence-base. Opposing the *"continuing tyrrany"*[45p765] of medical undergraduate examinations, Godfrey highlighted some adverse effects:

- creating a hurdle-jumping mentality to learning
- restricting learning to perceived examination content (the 'hidden curriculum')
- humiliating and demoralizing the failing student
- giving unrealistic career expectations to prizewinners, and
- promoting potentially damaging competitive behaviour

Concerning the 'hidden curriculum', Johnson and Abrahamson reported what happened when an assessment changed for several cohorts of Years 1-3 Southern Californian medical students (in a 4-year programme; 1968)[47]. The previous 5-letter outcome grading became 'satisfactory-unsatisfactory', and examination load decreased to one only per 'course'. Lack of 'before' data on most outcomes severely limited the results. Nevertheless, there was indirect evidence, via students' self-reports from questionnaires and interviews, of students becoming more orientated to learning rather than examinations. The students reported more unassigned reading, more work beyond an examination-focus, and less class-skipping in other subjects directly before examinations. Johnson and Abrahamson *did* measure attitudes to self-directed learning pre- and post-change, and, inexplicably, these worsened (statistically significantly). Disentangling the confounding effects of year-group (growing maturity) and year-on-year curriculum variation was not possible.

Besides assessment messages, the 'hidden curriculum' conveys strongly prevailing norms for professional behaviour – *"how to be a good doctor"*[48p205], and both formal and informal curricula challenge medical students to conform and to cope.

Learning to be a doctor: identity, role models, professionalism, and coping

The hidden curriculum

In 1982, Haas and Shaffir described the 'hidden curriculum'[49] of professionalization *"the moral and symbolic transformation of a lay person..."*[p135] at McMaster medical school, using participant observation and interviews[50], building on classic work like Becker *et al*'s 'Boys in White'[51]. (Sometimes such history gets lost in the literature, e.g. Ginsburg *et al*[52] attributing the first medical education description to Hafferty and Franks in 1994[53].) Cribb and Bignold summarized the effects as *"loss of idealism, the ritual attainment of professional identity, emotional socialisation and mental health [problems]"*[48p197], and the hidden curriculum can fall short on ethical standards[54]. Attempts to formalize professionalization include white coat and oath-swearing ceremonies and even symbolic lapel-pins[55], but the 'unwritten rules' are context-specific and cannot necessarily be meaningfully formalized[56].

The medical student trajectory

Slotnick used the 'trajectory' metaphor from the lifespan development literature to summarize how doctors learn across the 'medical school-through-practice trajectory'. Influences on medical student learning then become ontogenetic (biological and psychosocial), contextual (where and when in the trajectory), and 'accidental' (e.g. serious illness, one-off opportunities, advice from a charismatic educator)[57]. Slotnick related learning to the two parts of the medical student's/doctor's identity, i.e. 'what one does' (personal ontology, epistemology, and methods) and 'who one associates with' (colleagues, patients, organizations, etc.)[57]. Both parts develop over a career, underpinning 'physician-as-healer' and 'physician-as-professional'. For '<u>what one does</u>', Slotnick referred to the three psychosocial needs in Maslow's hierarchy of needs, concluding that[57]:

- Medical students learn what satisfies immediate needs ('security'), while learning in anticipation for future practice ('affiliation' and 'self-esteem'). Nonetheless, knowledge and skills learned early in the trajectory, with specific expectations, need reconsidering/relearning later as expectations refine.
- Experience is crucial to progressing along the trajectory.
- According to what maintains their attention, medical students, then doctors, combine intellectual pruning (forgetting unused skills/knowledge) and intellectual growth (of regularly used skills/knowledge) to improve at managing the type of problems that they encounter regularly.

At any stage, 'who one associates with' shapes responsibilities and expectations of medical students/doctors, i.e. to meet the three Maslowian psychosocial needs (security, affiliation, self-esteem)[57]. Slotnick highlighted how medical curricula are seeking ways of including basic science in simulated and applied clinical frameworks, thus leaving behind the Flexnerian[58,iii] view of scientists as doctors' role models. Role modelling[59] generally is intriguing and largely uncontrolled.

Role modelling

Role modelling tends to be less intentional, less conscious, more informal, and more intermittent than mentoring, and eludes formal standards[60]. It can be positive[39,61,62] or negative. Of six attributes important in selecting role models, graduating McGill (Montreal) medical students ranked 'personality', 'clinical skills and competence', and 'teaching ability' as the top three, and a clear gap to the others: 'specialty', 'research experience and publications', and position/academic rank[63]. For outstanding doctor role models, they named on average four. Faculty role models, identified by Washington and North Carolina medical students, considered that enthusiasm for their specialty, enthusiasm for their education role, and compassion were the most important things to model, and they tended not to *try* recruiting to their specialty[64]. Schwind *et al* found that, in the operating theatre (Southern Illinois), for example, the consultant being a positive role model was easily the strongest factor affecting students' perceptions of the theatre atmosphere being conducive to learning[65]. Negative role modelling wears students down through, for example, poor care or negative comments about medicine generally or particular specialties[60].

If educators are to become role models for 'learning how to be' (as Kenny *et al* phrased the moral enculturation of professional character), they need to influence by example and model the 'good professional'[60]. Kenny *et al* highlighted that undergraduate medical ethics education, by mostly focusing on ethical dilemmas and relational skills (e.g. obtaining informed consent), has neglected role modelling. To them, this historical background of *"moral authority…rooted in scientific competence"*[60p1,205] detracts from optimal professional development.

Spencer and Jordan considered learning to be inextricably linked with leadership and that all educators are role models, with a duty to lead[46]. Summarizing the professional development literature, Howe noted the need for a considered blend of explicit values, repeated examples in the learning environment, role modelling, a clear curriculum model of emotional *and* cognitive development, summative assessment, and formative mentoring[66]. (Assessment is a key challenge to get right in this domain[67], to avoid reductionism, for example[68,69].) She reasoned that medical schools should stop debating the benefits of explicit professional development components in their curricula – more pertinent is how they could justify *not* humanizing their curricula[66]. To Mawardi, the major query about improving human qualities in medicine is whether to go for selection or socialization (a query remaining unanswered nearly four decades later)[70]. There have been various attempts to theorize, identify, and measure core components of medical students' professional development[71,72], to warn that role modelling alone is insufficient[72], and to convince that it is *"not just hair-spray for the already fuzzy-headed"*[73p622].

Learning professional practice and attitudes

Understanding how best to influence medical students' professional development is a particular challenge[69,73,74], hampered by tensions between 'humanizing' and 'objectifying' their professional socialization[48] (from which innovative curricula are not immune[50]). Wear and Castellani considered professional development to be obstructed by the notion that 'thinking like a doctor' invariably involves objectivity, replicability, and generalizability[72]. Wear highlighted the irony of a profession apparently needing an open mind but whose education reinforces young entrants'

[iii] The North American Flexner Report (1910) introduced the preclinical-clinical structure of the undergraduate medical curriculum.

"inevitably narrow human viewpoints"[75p1,057]. She argued that the fundamental problem is not the 'them' and 'us' mentality (for such tribalism is human nature), but more what medicine implicitly conveys to medical students about the status and nature of them, us, and their relationship. Students can also miss, for example, the connection between academic integrity in their studies (e.g. not plagiarizing or colluding) and future professional practice[76], and be 'aware of' but rather 'uninformed about' malpractice[77].

Medical students' attitudes to the curriculum, medicine, and wider issues may well change, with implications for professional development. A study of all Years 3-4 medical students in Pennsylvania's six medical schools showed that encountering ethical dilemmas was common in clinical studies and often detrimental to ethical self-identity[78]. More hours of ethics education was not protective and did not reduce unethical behaviour. In terms of attitude change, medical school has been shown to increase cynicism[79], increase negativity (more so in males) to patients with psychological problems[80], be anxiety-provoking[81], cause ethical erosion, and stamp on idealism. Nevertheless, Baldwin *et al*'s cross-sectional evidence found Years 1-4 medical students' moral reasoning to increase (and females to outperform males) in each successive year[82]. There have, however, been few studies about how attitudes to broad ethical concepts change throughout medical school.

By cross-sectional study of Queensland medical students, Price *et al* reported substantial changes in attitudes to moral dilemmas over the first four years of a traditional curriculum with little change beyond this[83]. In a questionnaire completed outwith class hours, responders (from early Years 1 and 5, and late Year 6) chose '1 from 4' closed attitudinal responses to each of 25 scenarios. The researchers had pre-scored how each possible response mapped to any of 23 broad ethical statements about what doctors ought to do in broad domains of justice, beneficence, autonomy, morality, doctors' rights/ obligations/interests, and unacceptable or reprehensible conduct. (Of Deschamps and Childress's four ethical principles[84,iv], Price *et al* omitted non-maleficence.) By Years 5-6, students' largest shifts in ethical attitudes were in becoming: less litigation-minded, more accepting of patients as they were,

---

[iv] justice, beneficence, respect for autonomy, non-maleficence

less accepting of overriding societal obligations, and more supportive of confidentiality and of telling patients the truth. From an annual intake of about 230 students, Price *et al*'s response rates were approximately 59% (early Year 1), 54% (early Year 5), and 54% (late Year 6). This baseline study preceded Queensland's traditional curriculum having a formal ethics component, and students' attitudinal shifts were tentatively attributed to exposure to practising clinicians.

Possibly undergraduate medical curricula are not well designed for students to learn how to incorporate knowledge and skills into good medical practice underpinned by professionalism. Stephenson *et al* reviewed ways to incorporate learning professionalism[85]. These included improvements in: student selection, the informal (presumably hidden) curriculum, role modelling by educators, diversity and cultural aspects of the curriculum, and teamwork.

Dall'Alba reported case studies (observation and interview) of ten Karolinska medical students in Stockholm clinical placements, near the end of 5½ years of (presumably) traditional medical studies[86]. Their understanding of medical practice ranged from something that the doctor does to the patient's body to something that the doctor does to improve a person's health and quality of life through cooperation and mutual respect. As Dall'Alba noted, students following the 'same' programme encounter different staff, different patients, and different hospitals/clinics, while bringing different prior experiences. Like Stephenson, she considered their curricula unlikely to promote understanding of how to develop good medical practice from the knowledge and skills gained, as these were divorced from the understanding needed to successfully incorporate them.

Wilkes *et al* studied the role of prior experience of health care. Nine preclinical Year 2 medical students (previously without such experience) underwent 24-30 hour hospitalization the University of California, Los Angeles (UCLA) with simulated complaints[87]. The participants reported (via a 21-item questionnaire, debriefing, and formal discussion with the year-group) a dramatic impact on how they now expected to practise, especially after they experienced dehumanization and poor communication skills from the medical staff during their hospital stay. Only each consultant involved knew about the exercise, except that one consultant disagreed with the deception and told his team and the corresponding student reported an experience of little utility.

Schön promoted the idea of the reflective practitioner to counter the positivistic stance ('technical rationality') dominating a 'scientific' view of professional knowledge[88,89,90]. For him, professional artistry and 'reflection-in-action' underpin how clinical professionals practise under uncertain conditions. Tensions permeate the art and/or science characterizations of clinical decision-making (and the science---medicine relationship generally[91]), but medical school must prepare doctors able to practise professionally despite uncertainty and variable evidence[92]. Habitual self-conscious monitoring of learning should help[92], and acquiring and practising the skills for lifelong learning are crucial to professionalism.

Critical incident analysis can introduce conscious deliberation for reflective practice. Flanagan defined the critical incident as an observable human activity with clear purpose and effects. In his 1954 review, he charted the recent development of critical incident technique by the US Airforce Aviation Psychology Program and its successor the American Institute for Research, University of Pittsburgh[93]. They developed it to research reasons for failing to learn to fly, failed bombing missions, effective combat leadership, disorientation while flying, etc., and developed its applications, including: measuring typical performance; training, selection, motivation and leadership; and counselling and psychotherapy. Applications have involved the exploration of PBL group effectiveness[94] and promoting reflection on professionalism (for which a one-to-one interview was more effective than a written report)[95]. Through qualitative study of a general practice short course on critical incident analysis for medical students, Henderson *et al*'s twelve tips to promote good reflection were[96]:

- •Plan the exercise; •present it as a lifelong learning tool; •give a framework.
- •Ensure that students are: aware that the language is from education, •that they may feel uncomfortable, and •that there is no right/wrong answer.
- •Ensure student ownership.
- •Ensure that tutors are briefed adequately, •promote a trusting environment, and •discuss their own critical incidents.
- •Ensure that students discuss incidents in a peer-group, and •help them see how the exercise helps coping with difficult situations.

Nevertheless, Niemi found no clear, linear association between early signs of reflection from 90 Turku (Finland) medical students' learning logs (n=110 in Year 1) and their professional identity from interviews at the end of preclinical education (n=92)[97]. The students fell relatively evenly between four reflection groups, but the most reflective group (committed reflectors) were slightly less common at 16%:

- *committed reflectors:* showed personal stances and perspective-taking
- *emotional explorers:* showed little of personal stances or perspective-taking
- *objective reporters:* reported only what happened
- *scant/avoidant reporters:* reported superficially

Emotional explorers and scant reporters were statistically significantly more likely to have considered quitting medicine. For identity status, the students split relatively evenly across four groups:

- *achieved professional identity:* has career plan(s)
- *active explorers of specific alternatives:* is still considering specific option(s) commonest at 32%
- *vague fantasies and tentative ideas:* no clear commitment or exploration
- *diffuse identity:* has not considered career plans yet

Almost half the students were in a state of vague or diffuse professional identity 2.5 years into their curriculum, attributed by Niemi to the traditional preclinical environment hampering professional development.

Ginsberg *et al* used grounded theory analysis of interviews to explore 18 Year 4 Toronto medical students' reasoning faced with professional dilemmas in five videotaped scenarios[52]. The students justified their decisions with a general principle, an implication, or an emotion (affect). The principles invoked, however, were mainly *'unavowed'* (i.e. not from formal guidance, and probably from the hidden curriculum), e.g. obedience, allegiance, deference, education versus *'avowed'* (i.e. openly declared), e.g. patient care/fairness, patient comfort, disclosure, honesty, duty, resource use. Moreover, most implications were self-referenced and not for patients, i.e. 'disavowed' reasons that the profession clearly denies, disclaims, or denounces:

- *"The notion of altruism does not require turning a blind eye to implications for self – rather, it requires self-reflection and self-conscious rationalization."* **(Ginsburg *et al*, 2003)**[52p1,021]

Unsurprisingly, navigating the mixed messages and professional cues to achieve professional competence requires the medical student to cope with various stresses. Moreover, doctors may well show *"poverty of health in the face of plenty"*[98p776], neglecting their own heath needs[99], possibly pressurized by professional culture.

Coping as a medical student

– *"In an earlier, more brutal educational era, the first year of medical school was the hardest and the motivation of individuals was tested by a physically and spiritually demanding freshman curriculum."* **(Sapira, 1979)**[100p1,454]

The first year of medical school remains quite challenging to physical and mental health[101], and coping strategies develop with progression[102]. Park and Adler studied incoming California medical students with the Center for Epidemiological Studies Depression Scale, the Positive States of Mind Scale, and Short-Form-36 (Emotional Health, Mental Health, Social Functioning, and Vitality; plus General Health and Physical Health)[101]. While only 71/139 students responded at baseline and only 51/71 responded at the end of Year 1, the data appeared robust. Principal components analysis of all eight scales showed the last two loading on 'physical health' and the rest loading on 'psychological wellbeing'. Even in this relatively healthy population, both components deteriorated over Year 1. Nevertheless, the more they used 'problem-focused coping' or 'approach emotion-focused coping' rather than 'avoidant emotion-focused coping', students' physical health deteriorated statistically significantly less. Students' coping style did not, however, predict change in psychological well-being.

Tooth *et al* studied the St Mary's 1986 entry-cohort longitudinally for anxiety, stress, and arousal (at six points during Year 1, using the Multiple Adjectival Check-List (MACL))[81]. They measured study habits at two points with Biggs' Study Process Questionnaire (SPQ). All 106 students consented, 73%-97% responded to the various elements at the various stages, and 77% had previously responded to a postal SPQ and State Trait Anxiety Inventory (STAI) immediately before and after selection interview. Arousal levels showed no statistically significant changes throughout the year. Assuming that anxiety equates to stress (failure to cope) plus arousal (physiological condition of high sympathetic activity), Tooth *et al* attributed changes in anxiety to stress, peaking in the run-up to sessional and end-of-year examinations.

Pitkala and Mantyranta analysed qualitative data from 22 Years 3-4 Helsinki medical students in their first clinical year, and were surprised at how authoritarian staff and humiliation (and fear of it) persisted so much in medical school culture[103]. Pitkala and Mantyranta explored students' inner feelings in their professional development portfolios from a voluntary one-year reflection course (rather than taking the sociological approach of deriving professionalization experiences from behaviours). Via learning diaries, writings on specific themes, logbooks, self-evaluations, and staff feedback, Pitkala and Mantyranta found that students had *"willingly and humbly assumed the position of apprentice"*[103p156], and had initially felt like outsiders who lacked credibility with patients *("I felt that I was in the nurses' way"*[103p157]). Their self-image as a doctor had, however, increased rapidly over the year. Overall, the intense stress involved apparently related more to strong emotional experiences than what they needed to learn. Of note, male students had an easier time with the hospital culture, and were surprised how willingly nursing staff served them.

Some medical students have to cope with extra challenges, e.g. language[104], personal circumstances related to ethnicity, etc[105,106]. The US literature refers to medical students coping with 'learning disability'. Banks *et al* studied 66 medical students and 20 doctors referred to the Marshall University, West Virginia, Higher Education Learning Problems HELP---programme from 27 US medical schools (reporting in 1995 from an unspecified 7-year period and denominator)[107]. Lack of medical school success, failing 'medical board' or specialty examinations, or being 'at risk' of academic failure triggered referral. Of 86 participants, 78% had learning disabilities or attention deficit hyperactivity disorder (ADHD), 24% a reading disability, 24% a visual/spatial learning problem, 12% ADHD, and 17% a reading disability plus ADHD. The rest had no detectable disorder. Furthermore, all bar two participants achieved their next assessment with the programme's support. Where available, Medical College Admissions Test (MCAT) overall scores (and on all six subtests) were statistically significantly lower than 'population means'. Participants with ADHD apparently had lower MCAT scores, but this was not statistically significant.

Moving from professionalization, medical students' approach to learning gives crucial clues to sustaining their momentum and supporting those at risk of going off-track.

Learning approaches

'Styles' related to learning

Curry discussed how all human actions combine substance (what happens) with style (how it is done), defining the latter as being consistently and *"spontaneously demonstrated without conscious awareness or choice across a wide variety of situations"*[108p409]. A style is a pattern in how a person tackles a task (part of a broader pattern of adaptation[109]), possibly prompting the comment, *"That's just **the way he is**"*[110pix]. There are also age- and sex-specific style differences[111]. For educational tasks, understanding the 'styles'/approaches of individual students might help predict how they perceive, behave, and misunderstand[110]. Educators could then play to students' strengths and address weaknesses, or at least *"avoid inadvertently preying upon personal weaknesses"*[110pxiii]. Curry differentiated style (not task-specific like an *ability*, and *not* value directional, i.e. not necessarily good/bad) from strategy (a conscious choice between alternatives) and ability (specific competence that *is* value directional, i.e. more is better)[108].

Three main types of style relate to education, and overlap[108]:

- affective (expressive, responsive, defensive)
- cognitive (*perceiving and judging:* e.g. impulsive versus reflective; *remembering:* e.g. levelling versus sharpening; *thinking:* e.g. many differentiated concepts versus a few basic concepts)
- learning (combining motivation, task engagement, and cognitive processing[111])

'Learning style' is a specific cognitive style, i.e. how a person tackles acquiring and using information in learning and/or solving problems[112]. Influences include affect, personality, conceptions of learning, and learning environment. To fulfil a learning outcome, learning style needs both specific knowledge plus metacognitive skills (e.g. self-assessment)[111]. When students with similar academic results perform worse than expected at the next level, i.e. apparently academically able students fail unexpectedly, this questions whether their style/approach clashed with the educational task. Therein lay the importance of cognitive and learning styles for Curry, i.e. improving learning outcomes by matching with learning and education environment. She argued that achievement variations amongst 'select' groups like medical students probably reflect mismatches with that environment more than ability[108].

Entwistle summarized the overlapping and sometimes confusing terminology[113]:

- educational orientation: reasons for undertaking a higher education course (i.e. 'intention': vocational, academic, or personal, and each with intrinsic and extrinsic elements (adapted from Taylor)[28])
- learning conception: what adults believe learning entails
- learning style and strategy: clear preferences in how to learn, with style more task-specific (though Curry disagreed[108], maybe just about level of specificity) and trait-like[111,114]; and strategy more general (cross-situational[111,115]) akin to cognitive style; both are misused and not as stable as implied
- learning approach: deep, strategic, surface (which are more context-dependent than 'style' per se[43])
- perception of course/learning environments
- study orchestration: combines learning approach and perception of course/learning environment

He also indicated how some inventories combine approaches, styles, motivations, and study methods into the broader factors called study orientations[116], and that the 'non-academic orientation' ('study pathology') is less consistently defined[28]. From the experiential (or phenomenological) perspective, learners define learning through their own experience, i.e. 'conceptions of learning'[31]. From this perspective, learning skills should improve if used more deliberately and appropriately rather than automatically[31]. How a person perceives a situation sets a frame of mind (persona), subsequently accounting for the style-like consistency in behaviour[31].

Reviewing cognitive and learning styles generally, Curry noted the North American research focus on learning styles and cognition versus a European and Australian focus on learning styles and motivation[108]. The latter literature highlighted three such orientations shaped by *motivation*, i.e. to pass tests; to use learned information; and to understand underlying principles. Mann considered how medical education depends on medical students' motivation, i.e.:

- *"...we look for their motivations to learn, to be altruistic, to be dutiful, to be skillful, and to be knowledgeable... and to accept personal responsibility for lifelong learning"* **(Mann, 1999)**[117p237]

From expectancy-value theory, Keller's ARCS model of motivation for instructional design comprised: value (interest *and* relevance), expectancy of success, and outcomes reinforced. Motivation thus needs: Attention---Relevance---Confidence---Satisfaction[118]. From educational theory, Mann summarized ways of enhancing motivation, i.e. addressing[117]:

- context, students' experiences, the hidden curriculum, clear goals, match assessment/rewards with those goals, feedback on progress, self-efficacy, enjoyment, and learning and education strategies that inherently motivate

Perrot *et al* administered an in-class Modified Archer's Health Professions Motivation Scale to Arkansas medical, nursing, and pharmacy students (overall n=240, representing 95% response)[119]. They confirmed Archer's construct of motivation having three goal orientations: mastery (task/learning-orientated), performance (extrinsic goals/image-orientated), and alienation (interests and self-esteem from outwith the classroom)[120]. Mastery students were more likely to prefer the metacognitive learning strategies essential to lifelong learning.

Curry emphasized the conceptual confusion, with over 100 published measurement tools, and poor study design (e.g. overgeneralizing from single measurements, not adjusting for confounders or interactions) in this literature, but acknowledged similar flaws in the wider education and even clinical trials literature anyway[108]. With such caveats, cognitive and learning styles provide a useful insight into medical students' experience and expectations of learning and how to support them.

Cognitive style: implications for academic performance

The most studied cognitive style is field-dependence/independence, i.e. value-neutral styles affecting perceptual functioning and interpersonal behaviour[121]. With field-independence, information-acquisition is active, mediated, or hypothesis-testing, and such learners have cognitive restructuring ability, whereas field-dependent learners are more passive or intuitive spectators, accept structure, but invest more in the socio-personal domain[121]. Scott *et al* matched instructional materials to these styles (measuring cognitive restructuring by the Group Embedded Figures Test) in Wayne State (Detroit) medical students but found it not to affect their learning about diagnosing colorectal cancer[122]. Nevertheless, Goodenough *et al* found that New York field-independent pre-medical students were more likely to gain admission to medical school[121]. Furthermore, medical students subsequently entering surgery or radiology were more field-independent and those entering psychiatry or internal medicine were more field-dependent[121].

Other cognitive styles feature in the medical literature. Spiro *et al*'s value-neutral 'epistemic worldviews' relate to tackling complex tasks, i.e.: reductive (trying to explain things with a single system) versus expansive flexible (acknowledges messiness of knowledge, actively constructs learning)[123]. Spiro *et al* demonstrated these using their Cognitive Flexibility Inventory with Southern Illinois medical students. Cognitive style also includes *"the mercurial paradigm of hemispheric dominance"*[124p447], i.e. analytical or holistic tendencies. In medical and other students, Hartman and Hylton found the Myers Briggs Type Indicator (MBTI) to sample many of the associated behaviours on its dichotomous scales for personality types: extraverted-introverted; sensing-intuiting; thinking-feeling; judging-perceiving[124,125]. MBTI thus reflects learning tendencies via this link with cognitive style[125]. Roessler *et al* found personality variables to enhance greatly the predictive ability of cognitive variables for medical students' basic sciences attainment in the traditional curriculum at Baylor College of Medicine, Houston, and more so than in the National Board Medical Examinations (NBME)[126]. Those variables with most explanatory power mostly related to psychological health, e.g. high ego strength and low need for change. Roessler *et al* received written permission from 189 study participants to link personality tests, taken around interview time, with subsequent performance (i.e. from 69% and 43% of their 1974 and 1975 entry-cohorts). Roessler *et al* did not explain the lower response rate in the second cohort, and did not clarify whether those tests were for admissions assessment or solely research purposes.

Kienholz and Hritzuk compared cognitive styles between Calgary architecture students (59/78 participated) and medical students (50 participated from 60 randomly selected from 216 total) using two inventories of style[127]:

- Style of Learning and Thinking (SOLAT) Form C/Human Information Processing (HIP) Survey: on the continuum of right cerebral dominance (visuospatial, nonlinear, holistic), left cerebral dominance (verbal, analytical, sequential), or right-left cerebral integration
- Inquiry Mode Survey (InQ): on the dimensions of synthesist, idealist, analyst, realist, and pragmatist.

Statistically significant differences between the groups involved architecture students preferring idealism (focused on processes, values, and aspirations) and right-brain styles, and medical students preferring realism (focused on 'immediately apprehended facts' from realities and resources) and left-brain style, respectively. The analyst-realist combined and individual scores predicted left-brain style, and the synthesist-idealist combined (but not the individual) scores predicted right-brain style.

From interviews with Brazilian internal medicine academics, De Camargo even described doctors as a 'thought collective', in their way of selecting information to use. Their 'thought style' was a *"largely intuitive, pragmatic, result-orientated search of relevant... information selected from sources with sufficient academic credibility"*[128p850], favouring practical experience and being sceptical, and bordering on cynical.

Learning style/approach: implications for curriculum, attainment, and career intentions

The learning styles/approaches evidence supports making student assessment multifaceted, gives educators an insight into what they should be doing to try reaching all types of learners[30], and gives students an insight about how to improve their studying. Ways of measuring learning styles include focusing on preferences about instruction and about acquiring and processing information. Popular examples include the inventories of Kolb (information-processing) and of Entwistle *et al* (instruction and information-processing, plus affective elements).

The Kolb Learning Style Inventory (LSI)

Kolb's Learning Style Inventory (LSI) is based on experiential learning[129]. A pair of conflicting modes form the ends of each of two dimensions/axes of style (abstract-concrete and active-reflective) of learning and/or problem-solving. Strengths and weaknesses on concrete experience (CE), active experimentation (AE), abstract conceptualization (AC), and reflective observation (RO) then characterize a person with one of four styles, and tend to be stable over years[130]. These are the[112,130]:

- *converger* (AC-AE), reported to prefer practical application of ideas, to excel on conventional intelligence tests with one right answer, and typify engineers

- *diverger* (CE-RO) (opposite to converger), reported to favour viewing concrete situations from numerous perspectives and be typified by managers with humanities and liberal arts backgrounds
- *assimilator* (AC-RO), reported to like inductive reasoning in synthesizing diverse observations into a coherent theory, be more likely to disregard or re-examine the data when the plan/theory does not fit, but be less concerned with practical implications of abstract concepts, thus typified in the planning/research department in industry and by basic versus applied scientists
- *accommodator* (CE-AE) (opposite to the assimilator), is reported to like doing things, implementing plans/experiments, and gaining new experiences, but when the plan/theory does not fit is likely to discard it, thus typified by action-orientated jobs like marketing or sales

The Kolb-based evidence, mostly US-based, raises interesting points about medical students, albeit with various contradictions and concerns about construct validity[131].

One way of using Kolb's learning preferences is to explore generalist-specialist imbalances in the medical workforce's career choices. As the first to study learning style related to medical students' career choices, Plovnick found an association with Kolb's learning style[112], which has been much quoted, sometimes exploited, yet also criticized for small sample size, anomalies in study design, and no statistical tests. He studied responders from Year 1 (64, 64%) and Year 4 (72, 68%) medical students at a large Eastern US medical school, but focused only on the 47/136 reporting career choice with certainty, giving only about a dozen students for each Kolb style.

In the 'certain group', of the 'concrete' accommodators and divergers, 43% and 30%, respectively, favoured family medicine/primary care. They were also more likely (45% and 54%, respectively) to be frustrated by the abstractions of the preclinical curriculum. In contrast, of the assimilators, only 17% chose family medicine/primary care, versus academic medicine (25%), internal medicine (25%), pathology (17%). Least popular were surgery and psychiatry. Of convergers, most (55%) chose internal medicine. Therefore, those scoring high on abstraction, were overrepresented amongst allegedly more 'scientific' career choices. Divergers were possibly more likely to choose psychiatry (but still only 10%).

Plovnick's accompanying interviews with a random sample 27 Year 4 students (of unspecified denominator) about choosing careers revealed that work experience and *one* positive role model influenced the accommodators and divergers most[112]. Coursework mostly influenced assimilators' choices, and convergers mostly heeded *various* role models. Those abandoning an initial interest in family medicine/primary care for specialty practice tended towards obstetrics/gynaecology or paediatrics. Plovnick saw medical students' career choices arising from the medical education process as well as the candidates selected. He suggested more experience in primary care settings, more contact with primary care doctors, and more experiential relevance in preclinical curricula to promote this career choice, especially to those with the complementary learning style, plus advising all groups more explicitly.

Wunderlich explored Plovnick's findings because of the small sample, lack of statistical testing, and the non-conventional way of classifying Kolb types (which shifted some convergers into the other three categories)[132]. His findings contradicted Plovnick's. He posted the Kolb LSI to 200 randomly selected doctors (from the Hartford, Connecticut, telephone-book) and all 270 residents training at the University of Connecticut, with disparate response rates (55% and 23%, respectively). Nevertheless, questionably, he combined them into an overall final sample of 172. Surveying, additionally, 66 Year 4 Connecticut medical students, he achieved a 67% response, and a re-test study at 6 weeks (55% response rate) showed reasonably stability. The overall results contradicted Plovnick's findings about career choice. In medical students (with 56% as convergers) and doctors, convergers predominated for all career choices (family medicine, internal medicine, paediatrics, surgery, obstetrics and gynaecology, other), except psychiatry.

Finding no evidence on significance testing or discriminant analysis, Wunderlich questioned whether Kolb learning style related *at all* to career choice[132], a view that remains possible given the vagaries of the literature. The pattern of Kolb types varies among different medical student/doctor subgroups. Baker *et al*, for example, used Kolb's LSI with 39 South Carolina surgical residents and consultants (of undisclosed denominator, mode of administration, etc.), finding most (46%) to be convergers, then accommodators (20%), i.e. the active experimenters/'doers'[133], but the predominant pattern does not hold across the literature. Nevertheless, links with preferred education formats and outcomes appear less equivocal.

Sadler *et al* classified postgraduates by Kolb's LSI using Plovnick's controversial cut-off points, and generally supported his findings (but Plovnick was a co-author). They studied 108 residents completing five New Jersey and three other US family practice programmes between 1976-80 (78% response rate)[134]. As with Plovnick's medical students choosing family medicine, Sadler *et al* found accommodator predominating (40% versus Plovnick's 50%), but with 31% as convergers (versus Plovnick's 8%). Sadler *et al* attributed the difference to Plovnick's small sample size, studying students (not doctors), and exclusively students who were certain of career choice. They noted that, if Plovnick had included 'uncertain' students, 20% would have been convergers, but the raw data were not in Plovnick's paper. Sadler *et al* also surveyed 15 faculty staff, without specifying whom, why 15, the response rate, or selection technique. They found *"53%"* to be convergers and the group to be more abstract and reflective (i.e. more assimilative) than residents, but with the same percentage of assimilators (13%). Such literature might prompt 'So what?' questions, e.g. assimilation typifies certain academics, but it is unclear if responders were from family medicine or even clinical. To Sadler *et al*, if those choosing family medicine liked learning by active participation and concrete examples, role-play and simulation might be relevant (as Kolb style predicts initial attraction to specific formats[135]). How staff adapt to deliver formats outwith their own preferred style might be problematic.

The postgraduate literature reminds educators to heed mismatched Kolb styles between educators and those in training[136]. After an occupational mental health workshop for Dutch occupational health doctors in-training, Smits *et al* found that Kolb accommodators scored worse on knowledge. Assimilators predominated (40%), but style did not affect performance indicators[137]. Females' knowledge *and* performance improved more than males, independent of Kolb style, and a 'problem-based' format improved performance, but not knowledge, compared with lectures. Robinson explored the 'learner style↔education' match with 304 Portsmouth and South-East Hampshire GPs via a cross-sectional postal questionnaire survey, with an impressive (90%) response rate[138]. He explored if their learning styles suggested ideal education formats. Assimilators predominated (44%) and predictably preferred less 'hands-on' formats. GPs scoring highly on 'Pearson risk-taking propensity' were statistically significantly more likely to be male, and to be Kolb accommodators (doing-feeling) or convergers (doing-thinking) than divergers (feeling-watching) or assimilators (watching-thinking).

Newland and Woelfl found that sophomore medical students with the abstract Kolb styles performed better on clinical science and pathology courses compared with those with more concrete styles, and preferred learning about pathology in a 'problem-solving' format[139]. Indeed, those with more concrete preferences might find it difficult to transfer learning to other settings. Lynch *et al* (including Woelfl) reported a statistically significant positive correlation between Kolb abstraction and their performance on certain assessments in 227 Year 4 Nebraska medical students (with an impressive 90% response over two cohorts)[140]. The assessments comprised US Medical Licensing Examination Step 1 (USMLE 1) or the NBME multiple choice surgical subject examination, but not the computer-based case simulations. Here, most medical students were convergers (45%) and assimilators (26%).

Markert studied Year 2 Wright State (Ohio) medical students taking a biometrics examination of mostly multiple-choice questions (MCQs), and found, of those completing the Kolb LSI (95/97, 98%), convergers were statistically significantly more likely to perform outstandingly[141]. This confirmed Kolb's previous work on other groups undertaking MCQ examinations[141]. Geller found the Kolb LSI's test-retest reliability, at 31 days, to be fair[131]. (Optimum test-retest intervals are elusive, i.e. too soon and participants might remember their first set of answers; too long and other variables might intervene; and hardly worth pursuing if outcomes are unstable over time, e.g. mood[142].) Geller considered the Kolb LSI to need further work after studying a sample of 48 male and 2 female US students, from external medical schools, attending a revision course for national Part 1 NBME examinations. The reliability indices (square roots of the estimated reliability coefficients) ranged from 0.72 (RO) to 0.78 (AE), and the scales' interdependence complicated interpretation.

West studied the 48 Year 1 medical student entrants to Quillen-Dishner College of Medicine (East Tennessee State University), and 42 completed four inventories: three on personality (MBTI; Survey of Interpersonal Values (SIV); Omnibus Personality Inventory) plus Kolb's LSI[143]. Principal axis factor analysis of the personality measures distilled seven factors: theoretical orientation, social acceptance, benevolence, internal control, extroversion, aestheticism, and independence. The only statistically significant difference between these and Kolb style opposed expectations, i.e. convergers scored statistically significantly higher than divergers (not lower) on the social acceptability factor. West thus queried the validity of Kolb's depictions but, again, on an inadequate sample. The strength was linking with other inventories.

Thompson and Bing-You interviewed seven attendees one month after a 3-hour medical education workshop at which they had reflected on their Kolb style, Myers-Briggs Type Indicator, and Hemispheric Mode Indicator[144]. The five doctors and two non-medical educators all agreed that the concepts of learning style and personality helped them be less judgemental of others, and that, particularly for Kolb's LSI, the three areas of application were: patient care and education, practice management and education, and medical education. The doctors noted specific medical education opportunities, i.e. adapting their educational approach to that of students; seeing why students struggle to understand; counselling students in difficulties; and improving student assessment outcomes and their own self-assessment as educators. Despite another small sample, even for semi-structured interviews, their qualitative analysis raised issues for further work, e.g. the feasibility of applying such styles in practice.

Laschinger and Weston used adaptations of the Kolb LSI to explore Year 1 and Year 4 Western Ontario medical and nursing students' perceptions of each other's roles, i.e. the Kolb Adaptive Competency Scale (ACP) and Kolb Environmental Press Questionnaire (medical and nursing versions)[145]. Medical (n=64, n=34) and nursing (n=50, n=59) students completed the questionnaires in class. For this 'convenience sample', the unspecified denominator was probably less relevant but the applicability of that sampling here is unclear. Nevertheless, the findings were intriguing. Nursing students' perceptions of competencies important for medicine were more congruent with those of the medical students than vice versa. The largest gap in perceived nursing competencies was for abstract subscales, with medical students considering these less important for nursing. Both sets of students rated themselves highest on diverger skills (e.g. being sensitive to people's feelings) and lowest on assimilative skills (e.g. building conceptual models). The higher that students self-rated on people skills (diverger and accommodator subscales), the more positive the attitudes to shared doctor-nurse decision-making on the Physician–Nurse Collaborative Decision-making Opinionnaire (PNCDO), and this was statistically significant. Moreover, in both groups, as inter-group gap scores for perceived competencies decreased, positive attitudes to shared decision-making increased statistically significantly. This work showed novel ways to use learning style to explore professional development.

The Kolb perspective clearly captured researchers' imaginations, and it has been much used and quoted. It is difficult, however, to make sense of what styles predominate in career subgroups, mostly through small samples and transferability issues with the mainly US setting.

The Entwistle et al Approaches to Learning (Lancaster Inventory)

Entwistle *et al* provided the other main way of studying learning approach, a questionnaire, for population studies, combining intention and motivation with information-processing and instructional preferences. Although not designed specifically for medical students, this research has often involved them. Entwistle and Ramsden's 5-year Social Science Research Council research programme[146], beginning in 1976, built on their earlier work at Lancaster[38,147] (and Aberdeen[148]). This highlighted the effect on academic performance of study processes, 'teaching', and assessment context over relatively stable personality characteristics[116]. Entwistle outlined how this inventory explored 'approaches to studying' and 'styles of learning', incorporating study methods, motivation[115], and vital work by:

- Marton and Säljö on Gothenburg university students, 1976, using qualitative research to describe deep and surface learning[33,40]; and
- Pask[149], 1976, using heavily controlled conditions to describe the learning strategies of serialists (operation learners), holists (comprehension learners), and versatile learners able to do both

The Approaches to Studying Inventory (ASI-64-item) used in the Entwistle research programme[116], then in medical/health care education[150,151], and in other languages[152] developed from a 120-item pilot format through 106 items. (ASI-64 had 16 subscales in four orientations[116,148], but Meyer and Parsons argued that, starting anew, they could only confirm the meaning and reproducing orientations amongst Cape Town higher education students[153]). Shorter versions have been used variously[154], e.g.:

- 30-item format: four orientations; three principal (achieving; reproducing/surface; meaning/deep) and four supplementary elements (comprehension-, operation-, versatile-, and pathological- learning)[114] (with Richardson claiming an allegedly better 32-item version confined to meaning and reproducing, each with four subscales[155])
- 18-item format: 'short, revised ASI' ('short RASI') in Approaches and Study Skills Inventory for Students (ASSIST), from redeveloping the ASI[148,156,157]), has yet to appear in published medical education research.

Entwistle and Ramsden stressed that exploring individual student preferences did not mean that there was a single best combination of individual features for successful learning, *"or that 'good' and 'weak' students remain unchanged by the teaching and courses they encounter"*[116p3]. Individual differences interact subtly and continuously with the university environment. Understanding student learning needs both aspects. Biggs's independent, parallel work, from a different theoretical basis, built on Marton and Säljö's work[33], and supported Entwistle *et al*'s conceptual framework[44]. His SPQ instrument (and short version[158]) became a popular alternative to the ASI. Biggs combined affective (motivation) and cognitive (strategy) components to identify internalizing (deep), achieving (strategic), and utilizing (surface) study processes, and assessed quality of learning with his Structure of the Observed Learning Outcome (SOLO) taxonomy. The latter focused on 'performative understanding', i.e. articulating what the learner should be able to do to show understanding[159].

There are three main Entwistle (non-pathological) learning approaches[28,43,157]:

- *deep*: relates and organizes ideas, is intrinsically interested in course content and/or recognizes its vocational relevance, uses evidence, looks for underlying principles, critically examines logic and assertions; intends to understand
- *strategic*: monitors studying, is determined to do well, is organized in studying, applies constant effort to studying, is alert to assessment requirements, is alert to preferences of staff
- *surface* (sometimes *apathetic* subset is used): is syllabus-bound, feels unduly pressurized, lacks purpose/confidence, is motivated by fear of failure or simply completing the course, routinely memorizes, views content as separate elements and misses guiding principles, struggles to make sense of new

concepts (summarized by Marton and Säljö as focusing on the *sign*, i.e. the actual words, rather than what it *signifies*[33]); intends to reproduce content

Educational environment influences learning approaches[160]. In higher education, learning approaches predict academic performance fairly consistently[116,157], i.e.:

- positive correlations with strategic approach (particularly in Year 1 science and with fact-orientated assessment) and with deep approach (for later years and where conceptual understanding is assessed), and
- negative correlations with surface and apathetic approaches

In some struggling students, expected patterns disintegrate between learning approaches and perceptions of learning environment[161,162]. Clarke noted that medical students' long studies and professional socialization might also cause differences[163].

Considering the epidemiological concept of 'ecological fallacy', it is unsurprising that the general group-level associations do not necessarily hold for predicting individual behaviour and outcomes from learning approaches. In 2000, from a study across higher education, Entwistle *et al* reported dissonant response patterns[157]. Their responders were students from three 'pre-1992' and three 'post-1992' British universities (n=1,284; mainly Year 1; arts or science subjects), a Scottish technological university (n=466; Year 1), and students from a 'historically disadvantaged' South African university, i.e. Western Cape (n=219)[157]. Not unusual in this literature, denominators and methods/modes of administration were unspecified, but the analysis was comprehensive. This version of ASSIST incorporated an adaptation of ASI-64 to reveal the main three learning approaches. Further sections covered learning orientations, conceptions of learning, preparation for higher education, learning and study skills, influences on studying, and preferences for deep or surface features of the learning environment. A substantial subgroup attained poorly and scored highly on both deep *and* surface (and low on strategic) approaches, i.e. a dissonant response. Entwistle *et al* attributed their low attainment to seeking deep outcomes that they then could not achieve or, at least, not within that learning environment (or external assessment requirements).

The literature on medical students' Entwistle learning approaches involves various curriculum types (often not delineated). The evidence-base is more cross-sectional than longitudinal, and struggles to show deep learning improving consistently with progression, often attributed to distortion by ill-suited assessment. Associations with performance are inconclusive, possibly as most studies cannot account for the diverse social and educational settings in which students learn within a single curriculum.

Newble and Gordon used the Entwistle ASI-64 cross-sectionally with Year 1 Adelaide medical students, showing relatively high scores on reproducing orientation and low scores on meaning orientation, akin to UK Arts students in Entwistle's data[164]. Duckwall *et al* surveyed entrants to the 6-year Missouri-Kansas combined baccalaureate/medical programme in 1988 (n=100), and at end of Year 1 and start/end of Year 2, using a 30-item Entwistle *et al* inventory[114,165] (seven dimensions as above plus 'prediction of study success'). Duckwall *et al* did not state the mode of administration for their high response rates (94%-98%). They reported that mean *scores at entry* (not shown) resembled existing evidence (often quoted), i.e. for:

- reproducing and meaning orientations, versatile style, and learning pathology resembled those in the conventional British programme in Coles's study[166]
- 'prediction of study success' as in a problem-based European school (Coles's study[166]) and the new integrated Karolinska programme (Mårtenson's study, which followed only 36/244 entrants from start to end of Year 1, but without detail of administration)[167].

They likened their results to similar 'baccalaureate-degree' programmes, presumably meaning 'entry from school' programmes. Duckwall *et al*'s longitudinal data showed mean scores decreasing over time in achievement motivation, meaning orientation, versatile style, and 'prediction of study success', and increasing in reproducing orientation and learning pathology, as in Coles's work[166] and Mårtenson's[167]. Regression analysis showed that achievement orientation (well-organized study, competitiveness, strategic approach) best predicted semester grade point average (GPA) and grades of selected science courses. In the Newcastle (New South Wales) problem-based curriculum, Clarke found no cross-sectional changes between Years 1, 3, and 5 with an adapted ASI-64, except more negative study attitudes (predictive of poor performance) and less syllabus-boundness and achievement motivation[163].

For students considered to be on-track or off-track at 18 months, Duckwall *et al* found a statistically significant difference between mean comprehension orientation scores only, i.e. comprehension and globetrotting (hasty generalization from insufficient evidence). Off-track students were possibly scoring higher on globetrotting. While all four surveys showed females scoring higher on pathological style and lower on versatile style and 'prediction of study success', these sex-specific differences were not statistically significant. The relationships between learning approach and assessment outcomes appeared relatively stable over time.

Earlier work by Chessell reported on the ASI-30 with Year 1 Aberdeen medical students (with 100% response from 124 students in a lecture, but was at an unspecified point in the year and without statistical testing)[168]. Those students scored:

- higher on achieving, meaning, versatility, comprehension, operation ('by logic') learning, and 'prediction of study success' than Entwistle's 2,208 Science, Arts, or Social Science students[114]
- lower on reproducing score than Science but more than the others
- lower on learning pathologies than Social Science but more than the others

Clarke and McKenzie[169] used Newble *et al*'s (including Entwistle) Adelaide Diagnostic Learning Inventory (ADLIMS)[170]. This was specifically designed to detect learning problems in medical students (but was apparently better for general research on correlates in groups than individual prediction[171]). Amongst 112 Monash (Melbourne) medical students (representing 81% response), ADLIMS learning style accounted for 49% of the variance in Year 3 preclinical examination performance. Furthermore, a surface approach was statistically significantly associated with a poorer performance, but with no association for deep approach.

As noted previously, Coles' Southampton medical students showed poor learning approaches by the end of Year 1[166]. He also reported (by conference abstract), that this Year 1 learning decay was non-linear, began quite early, and affected males and younger students more, with possible selection implications[172]. Meaning and motivation orientations deteriorated in term 1 well before the term 2 increase in reproducing orientation. Montecinos *et al* found a downward trend in meaning approach, using ASI-64 with Temuco (Chile) medical students in a conventional curriculum, between end of Years 1, 3, 5, and 7 ('Year 2 internship'), but this was not statistically significant[173]. Moreover, meaning approach continued to predominate throughout, prompting Montecinos *et al* to query a Hawthorne-type effect (i.e.

someone showing interest in your behaviour might change it[142]). All four samples together gave only modest numbers (n=143) anyway.

Stiernborg *et al* found no cross-sectional differences in the meaning and reproducing orientations of Sydney University nursing students across Years 1-3 (using ASI-64, n=316, for a 67% response)[174]. From Sydney medical students (conventional curriculum), however, Stiernborg and Bandaranayake found cross-sectional differences, i.e. quite high mean Year 1 meaning score (70% of available score), lower for Years 2-4 and baseline recovery in Years 5-6[175]. This used ASI-32 (from Richardson[155]), with n=806 for a 77% response. Mean reproducing score was quite low in Year 1 (53% of available score), high for Years 2-4, and recovered for Years 5-6[175]. The highest correlation with academic performance for meaning score was r=0.13 and for reproducing r= -0.21 (both Year 6)[175], akin to nursing students[174]. Lindemann *et al* found California medical students' relatively high meaning orientation at entry (compared with dental students) to remain by graduation, despite increased reproducing orientation[176]. Dental scores closed in on the medical scores[176].

McManus *et al* explored the role of learning approach in the complex relationship between *clinical* experience and performance. Clinical experience did not have a direct predictive relationship with performance in traditional finals examinations (for various possible reasons[177]), but strategic learning (via Biggs' SPQ[44]) *was* positively predictive[178]. Martin *et al* again found no direct relationship between clinical exposure in Year 4 Leeds medical students and objective structured clinical examination (OSCE) performance, but well-organized and strategic learning approaches (ASI-30) appeared to confer added value to benefiting from clinical experience and were associated with better OSCE performance[179].

These examples show the difficulty synthesizing the evidence on medical students' learning approaches. The inventories appear suitably robust, having undergone much development and testing, but the context-specificity of medical curricula (generally and of specific types, e.g. problem-based) and certain student subgroups (e.g. struggling students) make overall summary and transferability subject to various caveats. A 'one size fits all' summary is not feasible. Deep learning remains a goal though, despite Hounsell's note that *"this ideal – of a quintessential homo academicus"*[180p466] is unrealistic or undesirable for all.

Other aspects of learning style/approach

Instruments developed specifically for medical students include Mitchell's Cognitive Behaviour Survey (with conceptualization, memorization, reflection, and positive learning scales), for Harvard's problem-based 'New Pathway' curriculum[181], and the Preferred Learning Style Index[182]. Despite diverse perspectives on style, the Kolb, Entwistle, and Briggs instruments remain the most popular. Psychology students under test conditions have provided further evidence, e.g.:

- Busato *et al* explored the 'big five personality traits' (extraversion, agreeableness/sociability, conscientiousness, neuroticism, and openness to experience [intellect/culture]) versus Vermunt's learning styles: undirected; reproduction-directed; application-directed, and meaning-directed in about 900 Amsterdam students[183]. Extraversion, for example, correlated with all bar undirected learning. Busato *et al* suggested that unsuccessful study might cause more neuroticism and sense of failure, and less conscientious studying, openness for studying, and achievement motivation. In over 400 more students, they found undirected learning consistently to be a negative predictor of academic success but meaning-direction *not* to be a positive predictor[184].
- Van Rossum and Schenck classified Tilburg (Netherlands) students' (n=69) approach to studying a text as deep or surface, if they focused on the text itself or the author's intention, respectively, and demonstrated a link with learning conception and quality of learning outcome[185].

Related ways of studying learning style include the Felder-Silverman model of dichotomous learning dimensions (Felder-Soloman ILS questionnaire). This explores how students prefer to perceive (sensing---intuitive; from Jung, and part of MBTI), take in (visual---verbal), organize (inductive---deductive), and process information (active---reflective; from Kolb) and how they acquire understanding (sequential---global)[186]. Felder and Silverman outlined how mismatches between these five types and 'teaching styles' could alienate engineering students and needed consideration[186]. Overall, Laight found, for example, that the dichotomous learning styles of BSc and MPharm undergraduates did *not* influence their attitudes to using 'concept maps' as an 'innovative' addition to large lectures (n=89; unspecified response rate and mode of administration)[187]. The exception was, however, that students with moderate-strong versus mild verbalizing learning style were *less* likely (statistically significantly) to find concept maps useful. They would probably prefer lectures to remain in traditional format. Here, Laight was using learning style to find ways of 'teaching to all types'.

Sapira mused that medical students *should* find medical school difficult[100] because, above a certain threshold of intellect and motivation, such difficulty lay more with negotiating a change in 'learning style' to become a doctor. His anecdotal account came from lecturing physical examination to Alabama medical students in 1978. He described how a 'college style' of memorizing and regurgitating pre-digested notes from 'the teacher' must give way to a 'mastery style' of mastering discipline-orientation in basic sciences by prioritizing concepts without much spoonfeeding (but incidentally accruing many minutiae). Sapira considered a third learning style to be needed in clinical practice, i.e. to translate patients' presenting complaints into what to study from what book without much guidance. In this opinion piece, Sapira made a familiar observation, i.e. students expecting 'handouts' get stuck in that first dependent learning style, and thus are disadvantaged when they must see patients:

- *"...I believe an excessive reliance on handouts – again, material pre-digested by the faculty and intended for student memorization – is producing large numbers of students who do not possess the ability to listen to a lecture and note the salient points for themselves.*
  ...when there are...excellent lectures without 'handouts', I am impressed by the number of students who are not taking notes, but rather seem to be examining their shoe tops." **(Sapira, 1979)**[100p1,455]

'Passivity' emerged in Dolan *et al's* study of Maryland (US) medical students needing to repeat Years 1-2 examinations or not, matched for major demographic and admissions variables[188]. Staff had consistently identified 70% of cases versus 15% of controls as 'passive learners' in PBL, laboratory, or other small-group discussion. Dolan *et al* did not, however, exploit the strengths of their case-control design (not labelled or analysed as such), omitting to report odds ratios or significance-testing.

In the ample literature relevant to medical students' learning styles/approaches, the less typical studies and opinion-pieces, as above, still give interesting alternative ways of conceptualizing issues of importance. A recurring issue tending to elude thorough empirical study is medical students' *attitudes* to learning to be a doctor.

General attitudes to learning

Thurstone's 1928 definition of attitude involves the extent of negative or positive affect or feeling associated with a psychological object ("*...symbol, person, phrase, slogan, or idea*"[189p39], irrespective of whether its meaning differs between people or indeed whether it exists at all). Using Thurstone's definition of attitude, Linn *et al* considered interest in a specialty to be an attitude in itself[190], but attitudes to learning generally are, however, more pertinent here. Konefal *et al* claimed to report the first longitudinal study of how medical students' attitudes towards learning change over the years[191]. They studied Miami medical school entrants on Day 1 (1977), end of Year 1, and end of programme (Year 4) with a new questionnaire of Likert-type items. They hypothesized that medical students, pressurized by curriculum demands, would lose their idealistic 'initial perspective'[192], where students try hard to learn everything (as in Becker *et al*'s classic 'Boys in White'[51]). Questionnaire response fell from almost 100%, Day 1, to 64%, Year 4 (giving n=136, n=130, n=83), which Konefal *et al* ascribed to posting the Year 4 questionnaire. Responders' cynicism increased over Year 1 but they resumed many of their initial attitudes by Year 4. Despite reporting overall group trends (and not paired data for individual students or statistical tests), the results were noteworthy. Of 24 statements, and only three closed responses: not necessary, necessary, very necessary, examples included[191]:

- *"To apply knowledge gained in classroom to clinical situation"*: not necessary changed from 2%→11%→1%
- *"To be creative"*: not necessary changed from 7%→16%→4%

One statement to which negativity increased was:

- *"To learn mathematics"*: 'not necessary' changed from 45%→49%→68%

Konefal *et al* suggested that staff might promote Year 1 students' negativity. Indeed, staff hindering students resurfaces when considering intellectual development.

Intellectual development and conceptions of knowledge and learning

Doctors must manage patient care despite uncertainty from incomplete or conflicting evidence[193,194,195] (exploiting uncertainty rather than fearing it[194]). How education, thinking, reasoning, and judgement inter-relate therefore becomes crucial[193]. Hunter described the tensions between general biological principles and patients' specific presentations as *"the starting point for clinical practice... and the constant preoccupation of clinical education"*[196p235], yet not usually addressed specifically.

Reviewing the medical maxim *"When you hear hoofbeats, don't think zebras"*, Hunter suggested that academic medicine might ask *"Why would an aspiring young physician not want to think about the zebras?"*, even if the answer were clearly *"...because they are rare"*[196p227]. Indeed, she argued that students have perverse incentives to *"Think zebras!"* to survive their supervisors and educators, their assessments, and the *"nail-'em-to-the-wall, pseudo-Socratic custom called 'pimping'"*[196p227], referring to Brancati's **(p63)** 'pimping' treatise[197]. ('Pimping' is a practice central to medical socialization in US programmes[198].) The paradox that *"Physicians think zebras as they think not to think them"*[196p228] did not escape her, and neither did other contradictory epistemological maxims, e.g.:

- *"Avoid the anecdotal"* versus *"Pay attention to stories"*[196p231]
- *"The research shows..."* versus *"In my experience..."*[196p233]
- *"Medicine is a science"* versus *"Medicine is an art"*[196p234]

These illustrated doctors as scientifically educated and applying science *but*, unlike mainstream scientific method, applying it to people's lives involves great uncertainty:

- *"The traditional Flexnerian organization of medical education into two halves was originally designed to make scientists of clinicians, but it now has the goal of turning students of science into physicians who will be capable of making wise decisions in situations of uncertainty."* **(Hunter, 1996)**[196p234]

For Hunter, educating medical students as if certainty were just around the corner might benefit their next assessments, next year of training, etc., but raising their awareness about clinical epistemology might be more humane. She considered though the remote possibility that *"for physicians an awareness of their interpretive method, like the centipede's attempt to study its gait, might turn out to be crippling"*[196p239].

Perry's nine stages (forms) of college students' intellectual development, from annual interviews over their four Harvard or Radcliffe years, are broadly summarized as[199]:

- initially accepts facts from authority; a *dualistic* 'right-wrong' view→
- is confused about the nature of knowledge and belief→
- recognises that evidence needs appraisal and tolerates other people's different interpretations; a *relativistic* view of knowledge →
- *personal commitment to relativism*; interpretation of pertinent evidence

This was landmark work in knowledge conceptions. Perry noted how college students must give up on the all-knowing authority figure at school, appraise various data for order and meaning, and trust and commit to their *own* judgement[200]

- *"Assisting the student to discover and develop in himself this disciplined independence of mind cannot be 'taught', it cannot be demanded, demonstrated or simply allowed; it can only be discovered. The discovery may be sudden or gradual, but the student must make it himself, and the duty of the college staff is to provide a setting where the discovery is most likely."* **(Perry, 1977)[200p121]**

Klackzynski demonstrated the context-dependence of intellectual development in medical students, with Year 1 focusing on 'getting by' and Year 4 focusing on 'adjustment and preparation' for residency[192].

Benbassat and Cohen warned that the very teaching style that some students favoured, i.e. authoritarian, might delay cognitive development[193]. They cited Perry's study[200] as evidence that students develop better when educators share uncertainty with them, and wondered if basic science education reinforces 'right-wrong dualism' rather than cognitive development. Miller and Parlett studied how cues about assessment affected students' learning, likening 'cue-consciousness' (but not actively seeking cues), 'cue-deafness' (oblivious to cues), and 'cue-seeking' (aware of and actively seeking cues) to three of Perry' stages (dualistic, relativistic, personal commitment to relativistic)[201]. Lonka and Lindblom-Ylänne showed dualism to relate to surface learning and lack of self-regulation[202]. Using the Rezler Learning Preference Inventory (LPI), Paul *et al* found that United Arab Emirates medical students' 'learning preferences' (Years 1, 2, and 4) involved strongly teacher-structured and concrete situations/conditions (versus abstract; student-structured; interpersonal; individual)[203]. Possibly, this reflected rote learning in their pre-university education, but it changed little over medical school. Tekian *et al* found cognitive measures *not* to account for most of the underperformance in examinations of underrepresented minority Illinois medical students[105].

In other key work, Säljö (Gothenberg) found that people ranged from conceiving learning as 'taken-for-granted' to its being worthy of reflection ('thematized')[204]. In vital qualitative research complementing Perry's work, Marton *et al* built on Säljö's original five-level hierarchy to describe six learning conceptions[205]. Students might focus on either or both parts of a learning conception, i.e. a way of seeing what is learned and how. Marton *et al* interviewed 29 Open University (OU) undergraduate students entering Social Science in 1980, at the start and end of Year 1, then at the end of each year in which participants studied, over six years[205]. Initially asking, *"What exactly do you mean by 'learning'?"*, interviewers then used less formal prompts. (Of 17 students passing Year 1, 15 lived close enough for home interview; 10 passed their second course of which 8 gained their degrees - a familiar pattern for OU mature students returning to education.) Marton *et al*'s six conceptions emerged with a phenomenographic approach, combining intent with the process used to tackle the learning task. Conceptions A-C (reproductive) highlighted what was learnt, tending towards 'consumption' metaphors of 'picking up, taking in, and storing' knowledge. Conceptions D-F (transformative) highlighted how it was learnt, tending towards visual metaphors of 'looking into things', 'taking a view':

- A: increasing one's knowledge (strongly quantitative; knowledge is factual; no notion of using what is learned)
- B: memorizing and reproducing (quantitative notion about exact reproduction (by rote), for a test or other performance)
- C: applying (retrieving what has been learnt to use it)
- D: understanding (gaining meaning about what is learnt)
- E: seeing things in a different way (changes way of thinking about something)
- F: changing as a person (adding an existential element)

Marton *et al* indicated that they developed Conception F and the elaborations of A-E, unaware that van Rossum and Taylor[206] had also built similarly on Säljö's work a decade previously (to which Entwistle alerted them).

Concerning medical students specifically, McLean interviewed Year 2 students in the Natal (Durban) problem-based undergraduate curriculum representing four groups of achievement in mid-year assessments on physiology, biochemistry, and histology (n=32/120)[207]. On phenomenographic analysis for Marton *et al*'s conceptions, high achieving students gave more transformative conceptions of learning than less academically accomplished students, who relied more on memorization and recall. For example, statistically significantly more Conceptions E and F appeared in the two best performing groups (combined) compared with the other two groups (combined). Raising students' awareness of their conceptions might be worthwhile.

Becker *et al*'s classic 'Boys in White' study suggested that medical students worried much about what to learn and being assessed[51]. Benbassat and Cohen argued that these observations showed *medical* students also moving through the Perry transitions from right/wrong dualism to decision-making while acknowledging uncertainty (reinforced by Friedman *et al* (including Benbassat)[208])[193]. They suggested that the authoritarian educational environment of many university hospitals may well impede students' cognitive development, reinforcing right-wrong dualism[193]. They recalled anecdotally some examples from ward-rounds, seminars, and clinical conferences that reinforced 'we good, they bad' attitudes (which is Perry's Position 1 of 9[199]) about adhering to proper methods and discipline and about other schools or specialties, e.g.:

- *"[overheard] You may choose laboratory research of course, but surgery is the real thing. Research is fine, particularly for those who cannot be trusted with patients."* **(Benbassat & Cohen, 1982)**[193p96]

Gardner's theory of multiple intelligences means that students will have strengths and weaknesses amongst the seven[27]: •verbal-linguistic; •logical-mathematical; •visual-spatial; •bodily-kinaesthetic; •musical; •interpersonal; •intrapersonal. Educators should address this diversity, but not slavishly as, for example, these seven plus four Kolb styles would produce 28 potential combinations[27] (let alone all other learning-related classifications). Reports about the relationship of the elusive concept of 'social intelligence' with verbal ability or other cognitive factors have conflicted. Frederiksen *et al* studied Year 4 medical students (n=91, randomly selected from an unreported denominator) from Philadelphia medical schools, finding the most notable relationship to be negative, i.e. those with the best scientific knowledge appeared to show least warmth when observed interviewing simulated patients and others[209].

In the US, in Brancati's satirical swipe at senior doctors' authoritarian posturing, he noted that when doctors mention the 'art of medicine' they usually mean healing, tolerating uncertainty, or sorting their finances, when really, as new consultants, they need to learn to continue foisting the 'art of pimping' on students and junior doctors (a term travelling poorly, and less celebrated, albeit familiar, elsewhere):

- *"Proper pimping inculcates the intern with a profound and abiding respect for his attending physician while ridding the intern of needless self-esteem. ...Pimp questions should come in rapid succession and should be essentially unanswerable"* **(Brancati, 1989)**[197p89]

Brancati summarized the key 'pimp questions' that medical students and junior doctors need to dodge or bluff:

- arcane points of history ('how was syphilis named?')
- teleology and metaphysics ('why are some organs paired?')
- very broad questions ('what is the differential diagnosis of a fever of unknown origin?')
- eponyms ('where does one find the semi-lunar space of Traube?'), and
- technical points of laboratory research ('what base sequence does the restriction endonuclease *Eco*RI recognize?')

As Benbassat and Cohen highlighted, under the 'punitive morality' of the authoritarian knowledge highground ('we good, they bad'/'we right, they wrong'), the doctor invariably attributes a bad clinical outcome to human omission and ignorance and condemns it[193]. Anecdotally, this apparently encourages students to acquiesce with 'I don't know...' and 'I have not done...' even if they *do* know or *have* done, as there appears only ever to be one right answer, i.e. the one known to authority.

The literature on medical students' intellectual development and conceptions of knowledge/learning is compelling and comprehensive, and more likely to reside in publications outwith the typical medical education literature. Moving on to the medical student's 'learning environment' brings the search back into such literature.

Learning environment/context and other factors

The learning environment[210] influences medical students' achievement, satisfaction, and success. Genn argued that the most important expression of the curriculum is the environment, *"educational and organizational, which embraces 'everything that is happening' in the medical school"*[211p338]. It comprises 'curriculum desiderata' that are physical, social, or organizational aspects for staff, or are educational stances (on learning, cognition, assessment, information technology, library)[211]. Researchers have focused relatively little on learning environment, maybe dismissing it for not being a specific educational experience. Such research emerged in the early seventies, but focused on core curricula and large-scale effects[212].

Even focusing on a specific element, Biddle *et al* found that the Medical School Environment Inventory (MSEI) was useful[212]. They found that it detected whether clinical elective sites (two community-orientated and the main teaching hospital) provided the right environment for Year 4 New York medical students' curriculum goals[212]. They found inter-site differences in perceived structure, interpersonal relationships, educational climate, and practicality. Gale and Wakeford used their own 11-dimension Medical Schools Environment Questionnaire (MSEQ) to explore UK medical students' perceptions of their educators' attitudes to behavioural sciences[213]. Research into medical students' learning environments has also included the operating theatre, where medical students:

- need to manage: the demands of the theatre; their learning objectives/tasks; and social relationships[214]
- perceive the environment conducive to learning mostly related to the surgical consultant's behaviour[65]

The 'curriculum desiderata' of Genn's learning environment are so diverse that full, robust, literature links with learning approaches have yet to develop. Clearly, a problem-based curriculum relates to most of the 'desiderata' and should, for example, prevent the negative competitive milieu that some learning environments foster[215].

Problem-based learning in medicine

The problem with the term problem-based learning

There is such 'conceptual fog' obscuring terms used in the PBL evidence-base[22] and such apparent kudos in claiming to use PBL, that caveats litter attempts at critical appraisal and summary. Barrows, who developed McMaster PBL, doubted people who claimed to use the very same approach as him[216]. For him, the main objectives were: structuring knowledge in clinical contexts; clinical reasoning; self-directed learning skills; intrinsic motivation[217]. (From years of empirical research, Norman doubted that generic clinical reasoning/problem-solving skills existed[218,219,220,221], there being much domain-specificity of such learning[222]). Norman and Schmidt noted:

- *"We can safely assume that any study that treats PBL as a single 'intervention' and examines the usual cognitive and clinical outcomes will arrive at a conclusion of minimal difference [versus conventional]"* **(Norman & Schmidt)**[223p727]

Engel highlighted that PBL should be both philosophy and method[224], like the well-established problem-based undergraduate medical curricula, rather than restricted to isolated 'subject-based' courses[225] (especially as it should promote students' horizontal and vertical knowledge integration between subjects and between basic/clinical science). This view prevails despite, for example, a nursing counter-argument against using PBL as a philosophy, and consigning it to just another method, because of its medical origins and an allegedly un-emancipatory nature[226]. Difficulty lies in straining the term and the credibility of its application, but attempts at using standard frameworks for comparison[227] have yet to gain useful ground.

The theories, the reviews

PBL has much face validity and should be a good way of learning to be a doctor, e.g. should allow students to learn using their own 'learning style'[108], and should promote self-directed learning and thus deep learning (despite *a* nursing view that it will do neither[226]). Theoretically, PBL should prevent low achievers from finalizing their cognitive structures until their knowledge level matches that of high achievers[228]. Stephenson *et al* considered such reforms to symbolize attempts to make the environment more conducive to learning professionalism[85]. For Petersen, PBL matches three criteria for optimal learning: immersion in ongoing practice with feedback; multidirectional learning; and a functional focus (the scenario)[229]. Dowie likened the Aristotelian concept of phronesis about ethics (practical wisdom) to the activity and reasoning of PBL[230,v]. Hunter considered that Aristotle's distinction between episteme (knowledge about science) and phronesis intentionally accommodates the uncertain, case-based, context-dependent 'way of knowing' required in medical practice[196]. The evidence-base on PBL in medicine has much about its development, implementation, and comparisons with traditional curricula.

[v] The ancient knowledge was classified as theoretical (*episteme*: related to science; *sophia*: related to philosophical wisdom) or practical (*techne*: related to craftsmanship; *phronesis*: related to wisdom) or practical and theoretical combined (*nous*: related to inductive knowledge that allows understanding of first principles and intuition).

Despite criticism of the evidence-base, and notwithstanding a relative dearth of evidence for traditional approaches, PBL does have strong theoretical foundations[27], and remains relatively well established, even permeating postgraduate short-courses[137]. It has reached all continents – a recent development saw the World Health Organization piloting PBL in Mymensingh Medical College as a first for Bangladesh[231], and various other professions. The challenges and barriers of effective implementation are intermittently restated[232].

The two main meta-analyses of PBL (Albanese and Mitchell[233]; Vernon and Blake[234]) and two other major reviews of PBL (Berkson[235]; Norman and Schmidt[236]) date from the early nineties. They showed students finding the learning environment more encouraging, and the learning more relevant and enjoyable.

Reviewing the post-1992 evidence, Colliver concluded that PBL suffered from poor theory and inadequate effect sizes[237]. Albanese[238] and Norman and Schmidt[223] challenged this and provided complementary, convincing critiques of Colliver's 'misunderstandings' about the theory and evidence, i.e. *"ignoring much of the data that he, himself, reviews"*[223p721] (to counterclaims from Colliver[239]). Albanese showed how Colliver's recommendation of effect-sizes ≥0.8 was unrealistic as it would dismiss *"over half the psychological, educational and behavioural treatment literature and a number of drug therapies in common use (chemotherapy for breast cancer)"*[238p731]. To Norman and Schmidt, the post-1992 evidence on PBL versus conventional approaches concurred with the pre-1992 findings, i.e. students a little better *or* a little worse on 'knowledge'; a small improvement on diagnostic ability or clinical reasoning, and a consistent benefit on satisfaction[223] that could be justification in itself[238]. Albanese outlined major theories (with evidence) that support PBL beyond the weaker contextual learning theory trounced by Colliver: information processing theory (prior knowledge activation, encoding specificity, elaboration of knowledge); cooperative learning; self-determination theory; and control theory[238].

Norman and Schmidt acknowledged that PBL was originally oversold[223]. Camp argued that poor implementation has undermined what is effectively a paradigm shift in danger of being dismissed as a fad[240]. Critics bemoan students achieving similar levels of competence at the expense of basic science knowledge, despite curricular reform debulking that component anyway and longitudinal evidence[241] that students' basic science knowledge decreases before graduation from conventional curricula. De Grave *et al* argued that critics questioning what PBL students learn are likely to have had a discipline-based education, and the deceptively simple question is very difficult to answer to their satisfaction[242]. This is partly due to disagreement about what 'knowledge' to compare, different PBL implementations[243], difficulties in study designs (e.g. inability to randomize participants in everyday curriculum settings), and using assessments favouring more traditional knowledge acquisition. Indeed, Schmidt *et al* summarized the problems comparing problem-based with traditional curricula back in 1987[244]. First, students are not randomly allocated to curricula, comparisons at best being quasi-experimental. Second, curricula extend over several years so addressing confounding variables is difficult. Such variables include:

- admission procedures[245]; attrition rates; things unforeseen or undocumented; comparison groups available; response rates (often low); and (particularly) in previous exposure to the measuring instrument (e.g. type of special examination administered)

By 2000, Norman and Schmidt were clear that education research on PBL needed rigorous theory-building and testing designs, structural equations modelling, and robust programme evaluations in realistic settings (rather than randomizing out the messy variables that may still be relevant)[223]. Indeed, problem-based undergraduate curricula are so heterogeneous, even when they share philosophy, that they need an eclectic approach to programme evaluation[246].

There have been other notable reviews. In 1999, Kalaian *et al* reported a meta-analysis using hierarchical linear modelling of the impact of problem-based versus traditional undergraduate medical curricula on US NBME I and II performance[247]. On conditional analysis, NBME I (but not NBME II) performance was statistically significantly better from curricula with greater PBL experience.

Empirically supported advantages are well-reported. Finucane *et al* reviewed the empirical evidence for PBL and noted that, despite tentative conclusions, its justification lies in key points of proven 'efficacy' and in following 'adult learning theory'[11], albeit a philosophy that Colliver disparaged[248]. Finucane *et al* summarized the advantage claims for which there is broad agreement on evidence as being:

- makes learning and tutoring more enjoyable

- makes learning environment more stimulating and humane
- enhances self-directed learning skills and their retention
- promotes deep rather than surface learning
- promotes student-faculty contact
- promotes interdepartmental working, e.g. basic-scientists and clinicians

There is, however, only weak or conflicting evidence about PBL promoting 'clinical reasoning' or 'problem-solving', promoting retention of clinically applicable knowledge, or improving motivation to learn. They summarized disadvantage claims (from conflicting evidence) as: start-up and maintenance costs (especially for cohorts of more than 50 and where enthusiasm is lacking); costly of staff time; stressful for students and staff; and students acquire less basic science knowledge. Overall, Finucane *et al* concluded that the Australian enthusiasm for PBL was well justified.

Examples of further evidence about PBL

Knowledge, cognition, and thinking in PBL

Following the big reviews, further insights have emerged about student achievement in problem-based curricula (particularly in the North American literature[249,250]), but Nendaz and Tekian's review of the assessment literature revealed little uniformity and consensus on practical application of principles[251]. Moore *et al* found students on the Harvard PBL track to outperform students on the conventional track on behavioural science (on NBME I, whereas all other subtests were similar), communication skills, and humanistic attitudes, and increasingly to prefer student-directed over teacher-directed learning (Preferred Learning Style Index)[252] Enarson and Cariaga-Lo found comparable performance on USMLE I and II for medical students on the Wake Forest (North Carolina) traditional and problem-based tracks over the seven years since USMLE replaced NBME[253]. Kaufman and Mann compared Dalhousie (Nova Scotia) medical students' achievement in volunteers from the last conventional cohort with the first two new PBL curriculum cohorts (1996-97)[254]. They compared outcomes on:

- a special core basic science Knowledge Test at the end of Year 2 (n=50, n=77, n=55, respectively; i.e. only modest numbers and volunteer bias possible, but among the few studies of this type)
- the national *qualifying* examinations:
  - Part 1 (on completing medical school; with almost 100% participation from each cohort of about 80)

- Part 2 (17 months postgraduation)

The first PBL cohort scored statistically significantly lower on the Knowledge Test than either the conventional cohort or the second PBL cohort. In contrast, all three cohorts performed *similarly* on Part 1 final score (six specialties), key features ('clinical reasoning and problem-solving'), and examination pass rate. The researchers attributed the second PBL cohort's performance to having strengthened scenarios, mentorship from the cohort ahead, and 'received wisdom' of what to learn. By design, the PBL students would have learned less basic science by that stage, but the Knowledge Test also had items encountered previously by the conventional cohort, thus complicating the results.

Kaufman and Mann also reported differences in specialty performance[254]. The PBL cohorts performed statistically significantly better than the conventional cohort on one Part 1 specialty, Psychiatry, probably through increased curriculum time. Moreover, the second PBL cohort performed significantly better on Part 1 Preventive Medicine and Community Health, probably through major revision of that element. The conventional cohort performed significantly better on Communication Skills, but the new curriculum lacked the explicit tuition of its predecessor. Overall, the PBL students attained a comparable knowledge-base. Verhoeven *et al* compared performance on Progress Test (a programme-independent True-False examination set at Final level for all) between two Dutch medical programmes, one problem-based, presumably Maastricht, and one conventional[255]. They found more similarities in knowledge (basic, clinical, and social science) than differences, which mostly involved the timing of when things were learned.

Eisenstaedt *et al*[256] studied Year 1 Temple University (Philadelphia) medical students volunteering for a 'PBL' version of their *3-4 week* haematology-transfusion medicine course. Of 112 randomly selected over three years, 59 participated (giving possible selection bias). This 'PBL' stretched the term as a *"preceptor made himself available to the students at defined times"*[256pS11] and there were self-study questions, but the literature quotes it as a rare study of long-term retention of knowledge with 'PBL'. On the end-of-course MCQ examination, the students performed statistically significantly worse than their traditional counterparts (whom the examination type and content favoured). Nevertheless, two years later, the control group's mean mark had fallen to that of the 'PBL' group, who had maintained their performance, i.e. the effect of lectured material was short-lived.

Criticism of PBL alleges that the big reviews from the early nineties fail to provide unequivocal support for success on the theoretical goals of PBL such as integrating basic and clinical science, clinical reasoning, and gaining lifelong learning skills. Hmelo *et al* therefore explored these cognitive effects, not just core knowledge outcomes, using a realistic learning task[257]. Forty medical students, who had completed or were undertaking a 32-week Year 1 elective, participated - 20 from a 'PBL elective' (intervention) and 20 from other non PBL-based electives (control). In each condition, half were Year 1 students (partway through elective) and half were Year 2 (completed elective the previous year). The setting, overall curriculum design, and the specific elective goals were not reported (but the researchers were at Vanderbilt University, Nashville). Although 'PBL' involved students questioning the facilitator for more information, and dividing learning tasks between them (contradicting a mainstream view of PBL), this study is one of the few 'non-laboratory' types and robustly designed. Hmelo *et al* measured disease-driven, data-driven, or basic science learning goals. The groups differed in their written reasoning in explaining causal pathways in a diabetes mellitus case[257].

The PBL group of students (particularly Year 2) were statistically significantly more likely to use hypothesis-driven reasoning (*backward* from hypothesis to data) than data-driven reasoning (*forward* from data to hypothesis)[257]. Such reasoning might suit novices with an insufficient knowledge-base better than data-driven reasoning, and experts use it when outwith their familiar practice[257]. The PBL group also showed statistically significantly more coherent explanations, by longer reasoning chains. The researchers considered that traditional assessment was likely to miss these cognitive effects associated with clinical reasoning and lifelong learning. Hmelo went on to consolidate evidence of cognitive benefits in further work[258,259].

The Maastricht curriculum provided rationale[260] and further evidence of cognitive benefits (and knowledge development generally[261]). De Grave *et al* randomly assigned 48 Year 1 medical students, 18 weeks into their problem-based programme to discuss a scenario about blood pressure regulation or a scenario about vision[242]. All participants then studied a text about blood pressure regulation individually. On an immediate free recall test, they were to *"Write down anything you can remember of the text on blood pressure regulation"*. This special extracurricular activity, in the normal setting, involved randomly assigned tutors who were Year 4 medical students with 3.5 years PBL experience of these scenarios, and instructed against giving clues[242]. (Despite the caveats of tutors acting as Chair, Scribe, and summarizer, and questionable transferability from student-tutors, the study design was relatively robust.) The unequal sample sizes between n=27 (randomly allocated to 5 intervention groups) and n=21 (randomly allocated to 4 control groups) was presumably due to chance, but was unexplained.

The intervention group, having discussed the topic in scenario-form, recalled 25% more (statistically significant) than the controls, as estimated by the number of accurate descriptive or explanatory (indicating integrated knowledge) propositions[242]. The intervention group used both types of proposition more, not just the latter. When students actively reconstruct material, as in problem-based discussion, they should also use more inferences during recall, perhaps forgetting the literal content (blurring prior and new knowledge)[242]. De Grave *et al*'s intervention group did not, however, show this effect, possibly as the intervention did not extend to post-session researching or further sessions to complete the PBL process.

De Grave *et al* described this as the first truly randomized trial in *"the ecologically valid context of a medical curriculum"*[242p33] rather than under 'laboratory conditions', another reason why the results were noteworthy. It gave evidence that students activating prior knowledge in group discussion, i.e. elaboration, were then able to integrate it better with new learning. De Grave *et al* noted two main shortcomings of their earlier 'laboratory experiments'. They had used contextually invalid trigger materials for medical students (effects on blood cell in saline solution rather than a clinical scenario) and they had involved students without prior PBL experience[242].

Self-directed learning, self-assessment, and reflection in PBL

Practising self-directed learning[262] can promote a more discovery orientated style of learning[182]. For effective self-directed learning, the learner must self-assess what they know, what needs learning, and how well it has been learnt. Norman criticized medical education's focus on self-directed learning, as good self-assessment cannot be assumed and what a doctor must learn should be non-negotiable, not an indulgence[36]. He warned of potential drawbacks for maintaining competence post-graduation, *"...like all good things, it succeeds in moderation only. When carried to excess, it creates its own tyrrany"*[36p888]. There is evidence though of PBL improving medical students' self-directed learning. Dolmans and Schmidt reported from cross-sectional questionnaire surveys of Years 1-4 Maastricht medical students more self-directed learning with increasing seniority[263]. Van den Hurk *et al* found that studying *only* the PBL group-generated learning issues, step-by-step ('learning issue restrictive'), decreased from Years 1-4 in Maastricht medical students and predicted poorer academic performance[264]. Using the PBL learning issues as global guidance, for broad flexible study ('learning issue broadening'), increased with seniority, predicted better performance, involved longer study hours, and probably meant better self-directed learning. Students defined a good learning issue as including 'keywords' (more so by Year 4), concise (more so by Year 1), and unambiguous[265], but students' ability to notice clear learning triggers in scenarios cannot be assumed[266].

While self-assessment is a valuable formative process and integral to PBL, it might need developing. Arnold *et al* provided longitudinal evidence of Missouri (Kansas) medical students' self-assessment skill (compared with faculty ratings of internal medicine placements) moving from overestimation to conservatism with progression, and of higher performing students underassessing themselves[267]. Moreover, Gruppen *et al* reported that, generally, for internal medicine diagnostic skills, Michigan medical students (conventional curriculum) did not allocate their study time according to self-assessed strengths and weaknesses[268], so study time might not be a good proxy.

Tousignant and DesMarchais found poor accuracy in Year 3 medical students' self-assessed performance (i.e. learners judging how much/how well they knew things), in the well-established 4-year curriculum at Sherbrooke (Canada)[269]. (PBL covered the first 2.5 (preclinical) years with Year 3 PBL focused on 'solving problems' and clinical management[269].) These researchers summarized the literature as showing quite poor agreement between students' self-assessment and external measures of the performance (by tutors or peers), and no evidence using the internal reference measure of the learner's own performance. They therefore studied Year 3 students taking their semester 1 summative structured oral examination. Students had to 'solve' three clinical problems randomly selected from a set, and marked by a single examiner against a checklist. All students received pre-examination information a week ahead, and at the start of the examination, and 70/91 (77%) consented. A narrowly focused questionnaire (for easy use from a book by Nöel[270]) explored pre- and post-examination self-assessment. Students scored (on a 1-5 scale) how well they envisaged solving the problem and, afterwards, their certainty about that answer. Overall, the responders' pre-examination self-assessment predicted very poorly their performance, and post-examination self-assessment was only weakly predictive, albeit statistically significant. A trend of higher performing students being more accurate in self-assessment was not statistically significant.

The metacognitive skill of reflection is integral to self-regulation in learning and Sobral provided empirical evidence of Brasilia medical students' reflection-in-learning being associated with a more positive and meaningful learning experience and being amenable to educational intervention[271], confirming similar findings by Mitchell in Harvard medical students[181].

Learning strategies and learning approaches in PBL

Of concern is that the advantages of PBL for students' learning might not last, despite evidence (usually quoted from two key articles) of learning approach changing favourably. Newble and Clarke administered the ASI-64 to medical students in Newcastle (New South Wales) versus Adelaide, i.e. a problem-based (6-year) versus traditional curriculum (5-year), towards the end of Years 1, 3, and Final. Compared with Adelaide students, Newcastle students scored statistically significantly[272]:

- *higher on:* meaning (for deep learning), Years 1 and 3
- *lower on:* reproducing (for surface learning), Years 1, 3, Final

Achieving (for strategic learning) did not differ between curricula. Coles found a similar effect in two other populations, i.e. Year 1 Southampton and Limburg (Maastricht) medical students[166]. In longitudinal evidence from Geneva medical students, Vu *et al* confirmed benefits of PBL versus traditional approaches on 'deep processing' (using Schmeck's Inventory of Learning Approaches (ILP))[273].

Delva *et al* suggested two explanations for the three big PBL reviews allegedly not showing substantial or consistent advantages for PBL over traditional curricula[274]:

- students might still fail to use appropriate learning strategies
- the measures are insensitive and more suited to traditional curricula.

They studied medical students' learning 'strategies' (Years 1 and 3) in the *"hybrid curriculum (i.e. combined lectures and PBL sessions)"* of Queen's University (Kingston, Ontario)[274]. Their new 52-item questionnaire (designed from focus groups and interviews) had a PBL and a lecture version and used 5-point Likert scales.

In Delva *et al*'s study, learning strategy changed with instructional context (lectures versus PBL) and affected the quality of assessment outcome as measured by MCQ examinations, short answer examinations, and OSCE. From principal component analysis, they reported a 14-component solution summarizing the strategies (but with barely 300 responders and 52 items, interpretation should probably be with caution). From paired responses to both versions, Delva *et al* reported that students used five strategies statistically significantly more in the PBL context than in lectures. These were: using library resources, using general texts, preparing for class sessions, participating in class, and learning selected topics[vi] to explain to the other students. Year 3 students reported statistically significantly reduced use of literature searches, journals, and participation in PBL sessions but, for PBL, more reviewing their notes compared with Year 1 students and less dividing topics between students. Transferability to other settings is problematic given insufficient detail about the 'hybrid' design and any curriculum overload or competing demands.

On multiple stepwise regression analysis, using lecture class-notes positively predicted performance on MCQ testing, but Delva *et al* acknowledged that testing focused on lecture material. Groupwork in either setting *negatively* predicted test performance, which rather questions the nature of the test. PBL participation, self-directed notetaking in either setting, and using lecture class-notes *positively* predicted OSCE performance, and using reference texts in either setting *negatively* predicted it. In either setting, 'highlighting text' negatively predicted short answer examination performance – why was unclear.

Delva *et al*'s results were important for confirming (albeit tentatively) a crucial link between learning *strategy* and *outcomes*. They considered that 'perceived importance' influences what students learn more than instructional context, doubting whether PBL develops higher level and self-directed learning, yet ignoring that its

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[vi] This division of learning effort would be deemed inappropriate in many problem-based curricula.

implementation might be crucial. Delva *et al*'s conclusion that, "*Content overload and assessment systems may be more important drivers of student learning strategies than the incorporation of PBL into the curriculum*"[274p176], would argue for PBL as curriculum philosophy and not the apparent add-on of that curriculum.

Wyller and Wyller considered 'learning approaches' to resonate with PBL's rationale, i.e. that "*PBL might be regarded as a way of getting a larger proportion of the students to use a deep learning approach*"[275p502]. They studied 'deep, strategic, and surface' learning approaches versus examination outcomes (pass/fail) in medical students learning via PBL. Despite an excellent 92% response from Year 1 Oslo students (giving n=113), statistical power was modest, and interpretation is difficult. First, their new 1996 curriculum was a hybrid of PBL plus other courses and lectures. Second, they measured learning approach with their own single item about students' perceived learning intention (to understand, to pass the examination, to remember; as proxies for deep, strategic, and surface learning). Third, it is unclear whether the examination was formative or summative. Nevertheless, notwithstanding a simple instrument, the statistically significant results generated an interesting recommendation, i.e. identifying and supporting 'strategic males' in problem-based curricula. 'Strategic learning' was commoner in males and predicted failing the end-of-semester 1 examination in applied knowledge and reasoning (as did older age, ≥24 years). Concurring with other research showing correlation between learning approach and with 'teaching'/course satisfaction (positively for deep and negatively for surface)[276], strategic learning also predicted overall curriculum *dis*satisfaction (as did more study experience). Unlike other PBL studies though[277], duration of independent study was not a predictor. Others have found the sex-specific difference, e.g. Gledhill *et al* found Year 5 male Pretoria medical students scoring statistically significantly higher than females on the extrinsic motivation (status and rewards) part of strategic orientation on ASI-64[278].

Iputo used the Lancaster ASI-30 to fill the literature gap on African medical students' learning approaches[279]. Of 150 entrants to the Transkei (Unitra) problem-based, community-orientated curriculum in 1992-95, 140 (93.3%) were 'interviewed', suggesting staff-administered questionnaires, and again in each of Years 2-4 (timing unspecified). By Year 4, an impressive 106 students had provided complete data.

Iputo reported statistically significant reductions in achieving orientation and improvidence (i.e. failing to see links between parts and with the whole) and increased versatility and operation learning over the four years, with meaning orientation starting high, dipping in Year 3, and recovering by Year 4. Iputo suggested that Unitra's PBL implementation might discourage the holistic approach that PBL should encourage, but at least discourage competition and improve learning quality. Of import, Iputo queried if versatile (strategic) learning were desirable, i.e. does it give good understanding by combining overall picture and detail (as in Pask's view[149]) or is it seeking success with least effort (as Schmidt *et al*'s review noted[244])?

There are many examples of the PBL label being strained or of limited or subject-specific implementations. McParland *et al* reported that Year 4 medical students' 'learning styles' did not change in a 'PBL curriculum'[280], but based this on a short (8-week) single-subject (Psychiatry) block in an otherwise traditional curriculum, with 'PBL' a shadow of its basic principles. PBL groups prepared oral presentations from a problem, with two facilitators 'available' between 3-4 groups, and the facilitators summarizing the 'take-home' messages. McParland *et al* accepted that this was not 'pure PBL', yet considered their approach akin to that described by Vernon and Blake[234], despite the only similarity being small-groupwork and a facilitator. McParland *et al* previously reported no difference between two Year 4 medical student cohorts, i.e. PBL (1999/2000) versus traditional (1998/99), in their attitudes on Attitudes to Psychiatry-30 and career intentions after this Psychiatry course[281], but without describing the details of PBL implementation of the subsequent article. PBL context and implementation are important details to report.

Blumberg and Daugherty gave evidence for PBL broadening learning strategies. They reported how medical students, in either the traditional or 'problem-based' curriculum, Likert-scored particular activities (e.g. reading textbooks, attending seminars) for perceived 'effectiveness' in passing examinations (short-term goal) and becoming good doctors (long-term goal)[282]. The traditional students, for example, scored 'community health experiences' and 'behavioural science discussions' highly for the long-term goal, but not for passing examinations. The problem-based students scored diverse key educational activities similarly for both goals.

Related to PBL's potential benefits for learning approaches is good small-groupwork. This has potentially positive effects, irrespective of the PBL label, e.g. Schwartz *et al* reported that small-group, case-based learning promoted deep learning in Otago (New Zealand) preclinical medical students in an otherwise traditional curriculum[283].

Groupwork, learning environment, and satisfaction in PBL

Since the big reviews, further evidence has confirmed how PBL can improve learning environment quality. Sobral's cohort study of Brasilia medical students compared exposure to a PBL or conventional 15-week course on digestive physiology[284]. Despite the limited implementation, the Course Valuing Inventory showed statistically significant advantages for PBL, i.e. more enjoyable and more appealing for preceptorship. Indeed, even students disliking PBL may still value its effects[285].

Various instruments have been used to research PBL learning environments, but overuse of the PBL label remains problematic. Bassaw *et al* studied Year 5 West Indies medical students with the Dundee Ready Education Environment Measure (DREEM), a 50-item instrument (from an international Delphi panel of almost 100) exploring perceptions of learning, teachers, academic issues, atmosphere, and social issues[286]. They described the curriculum as comprising 'problem-based sessions' for Years 1-3 and 'bedside clinical teaching' for Year 4-5. DREEM was used despite items starting, *"The teaching [is]..."* (e.g. 9/12 learning items) and *"The teachers are..."*, i.e. where PBL students might rightly question *"What 'teaching?'"*. The sample size was modest but all 70 students receiving DREEM responded (although mode of administration and reason for non-receipt by n=12 were unspecified). Bassaw *et al* found the overall learning environment score to be low compared with reports from Nigeria, Nepal, and the UK, with relatively low perceptions of learning, particularly by males (but without statistical testing for confirmation). Their conclusions that the students needed more self-directed learning through curiosity and teamworking suggested that the PBL implementation did not promote these, confirming some difficulties with the label.

Others have used the Medical School Learning Environment Survey (MSLES; by Marshall, Chicago) and found positive perceptions[287]. Lieberman *et al*, for example, found medical students on the Texas problem-based track scoring the MSLES statistically significantly more positively than students on the traditional track[288].

Feletti and Clarke (Newcastle, New South Wales) used a modified Australian MSLES (showing internal consistency and construct validity for these different settings) to compare two Australian medical schools in 1979[289]. This was completed in class by: preclinical students from a conventional curriculum (n=165) and Year 1 and 2 students from a 'contemporary' curriculum (n=112), confirmed in a later article as Newcastle (problem-based)[290]. No response rates or denominators were reported, but each school admitted about 220-260 and 60-70 students, annually, respectively, confirming high responses. The 'contemporary' school scored higher means for all seven subscales reported, especially for: flexibility, breadth of interest, emotional climate, and supportiveness. Clarke *et al*'s 1982 follow-up study at Newcastle found Year 1 still giving similarly positive scores[290]. Cross-sectional evidence across Years 1-5 showed overall environment score declining, however, with the cohorts from the previous study, now in their later clinical years, scoring the clinical learning environment as less satisfying.

In New Mexico's twin-track undergraduate medical curriculum, Moore-West *et al* used the Symptom Questionnaire and the Learning Environment Questionnaire (LEQ) (from MSLES) to measure several cohorts of medical students' distress levels and attitudes to the learning environment, respectively, in each of the first four semesters[291]. There were complete LEQ data for 62 students (1980-85 cohorts) and complete Symptom Questionnaire data for 147 (1983-85 cohorts). Although no response rates were reported, the overall cohort was about n=73. Over the four semesters, students on the innovative track were statistically significantly less distressed (depression, somatic complaints, hostility, anxiety) with more positive expectations and perceptions of their learning environment (emotions, student-student interaction, meaningfulness of learning, and open flexible versus closed rigid environment). Both tracks were similar though for perceived nurture by the environment. Student-student interactions declined progressively on both tracks, but significantly less so in the innovative track. This work verified that the small-group, problem-based approach supported and helped students to cope with the learning load.

Moving from general learning environments to the specific environment of small-groupwork, students in PBL need to tackle this with the skills of: consensual decision-making, dialogue and discussion; team maintenance; conflict management; and team leadership[229]. Small-groupwork cannot, however, be assumed to have universal benefits[292,293], and some students may need preparation[294]. Kaplowitz and Block claimed first confirmation in a medical school of sex-related differences in engagement with small-groupwork[295]. The setting was an 11-week block, at the end of Year 1, in Harvard's problem-based undergraduate medical 'New Pathway' parallel track. This was a small study, interesting for studying 23 medical students placed in one all-female group (requested by the 8 females) and three all-male PBL groups, with same-sex tutors, then surveying them as doctors a decade later. The questionnaire combined open-ended questions and Likert scoring, about participants' recollected reactions and performance, and long-term effects. Seven females and nine males responded. Although males *and* females had felt uncomfortable in mixed-sex groups, only the females felt better in the single-sex group, and only the females valued the experience. Whether the non-responding males would have felt differently was unknown. Kaplowitz and Block considered the females to have used the exercise to overcome their tentative contribution style (misinterpreted by males as an invitation to dominate), become more effective with 'male' tone and posture, and reap lasting effects. The females tended to comment on process, the males more so on content covered (and two males had almost forgotten the exercise). Study weaknesses included ignoring the tutor's effect and not exploring comments from ethnic minority doctors that their ethnicity *also* affected their groupwork contributions. Indeed, Mårtenson noted how cultural aspects of learning are generally under-researched[37].

Studying the relationship between groupwork dynamics in PBL and academic success is a developing field. As summarized previously, De Grave *et al*'s study showing that students' group discussion of a blood pressure regulation scenario increased their achievement on a subsequent test about blood pressure regulation[242]. De Grave *et al* also used critical incident analysis to explore how students perceive unproductive groups, by their ranking of 36 statements covering six success inhibitors: lack of elaboration, interaction, cohesion, motivation; unequal participation; and difficult personalities[94]. Although colleagues' lack of motivation was reported as being relatively infrequent, it was perceived to inhibit the learning process most, and students expected tutors to act[94]. Students and tutors both find quiet and dominant students problematic[296]. Wigen *et al* used their Group Process Evaluation Scale, a peer-evaluation tool, to study Year 1 Trondheim medical students undertaking

PBL[297]. Of the 199/208 (96.6%) agreeing to participate, 67.3% provided complete data. The groupwork variables 'improving learning' (contributes to effective learning and presents material well) and 'inhibiting group process' (wants things done his/her way and tends to dominate in unfortunate ways) were crucial to success[297]. On multiple regression, these variables replaced individual variables such as learning approach (Entwistle's ASI-30) and personality (locus of control and neuroticism) in positively predicting academic success, i.e. percentage achieved in examination. It is unclear why 'inhibiting group process' ('wants things done his/her way'; 'tends to dominate in unfortunate ways') should be a positive correlate and this was not discussed[297]. Carlo *et al* found that United Arab Emirates medical students' self-reported PBL group productivity was positively correlated with motivation, cohesion, interaction, and elaboration, and negatively with withdrawing (all statistically significant)[298]. Sponging (benefiting from others' contributions without contributing) had no effect – Carlo *et al* thought that students found this easier to ignore than to confront their peers[298].

Choosing PBL, choosing careers

Gresham argued that PBL should foster medical students' self-confidence in reasoning skills across various clinical scenarios, making a generalist career in internal medicine attractive, rather than narrowing down to a subspecialty[299]. Indeed, integration and community-orientation often accompany PBL to broaden horizons.

Research about who chooses problem-based curricula is unusual, but such students may be more self-sufficient[245]. Twin-track curricula are usually transitional, but give useful comparisons[245,273]. Evensen *et al* (Pennsylvania State University) studied entrants to 'problem-based' or 'conventional' tracks in *"a 4-year college of medicine in the Eastern United States affiliated with a large research university"*[300p104]. From 1992, the 'problem-based track' had a Year 2 option, chosen by about 20% of students annually, extended to Year 1 from 1994 (for n=30 annually). Students completed Evensen *et al's* postal Decision-Making Questionnaire (about decision-making methods, mode, depth, and breadth) before starting medical school.

Evensen *et al* likened the decision-making process between tracks to the PBL process itself. From the 1998 entry-cohort (n=82 conventional; n=23 PBL), the response rate was a worthy 63%. On cluster analysis, they found two decision-making styles.

Statistically significantly more PBL track students (72%) used the preferred style of seeking more sources of advice (through social methods), searching for information more comprehensively, and deliberating for longer, compared with the other students (54%). In both tracks, responders cited information from current medical students followed by beliefs about personal learning style as the commonest influences, but the PBL students differed significantly in using a greater number of resources and in perceiving the decision as more important. Moore found that the academic performance of medical students not choosing the Harvard New Pathway problem-based track, but enrolled in it anyway (because the tracks merged that year), did not suffer[301]. Indeed, more shifted preference to this from lecture-based approaches than vice versa[301].

The role of the problem-based learning tutor

Educators influence learners substantially, and it is crucial that doctors be good educators[302,303]. Some educators see this as a matter of human connection, e.g. Hallowell (a psychiatrist) describing influential teachers and tutors from his own education history, from infant school to Harvard Medical School:

- *"...a human connection. It was for Socrates and Plato, and it is still the same today. My teachers brought me into the wider world. I am here because they were there..."*[304p20]
- *...Being a good advisor, a wise presence, or an inspirational and stabilizing figure in the lives of students should be made at least as important, and worthy of reward, as publishing papers or making new discoveries. It is time to reaffirm the paramount importance of the human connection in education."* **(Hallowell, 1997)**[304p22]

This is supported by Paukert and Richards' exit surveys of 300 Baylor (Houston) medical students, which coded 1,153 descriptions of clinical faculty 'significantly and positively' influencing the 180 responders[305], using categories from Ullian *et al*'s study of residents. Of five roles: person, physician, supervisor, teacher, and unspecified (global), medical students valued teacher characteristics most[305], whereas Ullian *et al*'s residents valued the less controlling notion of 'supervisor' characteristics, reflecting their greater educational maturity[306]. Kendrick *et al* found that the Rogerian constructs of empathy, unconditional positive regard, and congruence in their clinical tutors influenced Bowman Gray/Wake Forest (North Carolina) internal medicine residents' overall evaluation of a rotation[307].

Despite their influential role, however, good educators may still feel undervalued and overstretched, and some may overestimate their skills. Indeed, Finucane *et al* wondered if complacency might surpass lack of enthusiasm as a threat to medial education when only 5% of Cardiff 'medical teachers' thought their 'teaching ability' to be 'below average'[308]. Subsequently, they reported that teaching staff at <u>both</u> Cardiff (traditional) and Newcastle (New South Wales) medical schools (problem-based) had inflated views of personal ability as educators, perceived lack of rewards as educators, and ambivalence to formal training[309]. Recruiting a sustainable supply of willing and capable PBL tutors may well therefore be a challenge.

The classic PBL tutoring role is as egalitarian facilitator, providing subtle collegial help from the wings, and far from the conventional 'lecturer'/'teacher' role as an authoritarian, information-dispensing content-expert, 'performing' centre-stage. Neville summarized the role as a flexible facilitator, who is sensitive to learning needs, and knowledgeable about the curriculum[310]. Listening skills, for example, are crucial:

- *"Listening usually requires more strength of mind than we had ever supposed it would. Most students assume that anyone who even remotely resembles a teacher feels duty-bound, and eager, to do most of the talking and to start doing it soon. [...] ...suffering with some moments of social awkwardness while a student scrutinizes the strange vision of a teacher who, though clearly interested, does not offer answers."* **(Perry, 1977)**[200p120]

The facilitator is essential to effective discussion to prevent lack of focus and purpose[229]. The PBL tutor role involves questioning, probing, promoting critical reflection, and challenging, all sparingly[311], but not dispensing information, judging, or arbitrating between right and wrong[25,312]. When and how to intervene are crucial. Woods outlined the two main McMaster interventions, i.e. ensuring students tackle the problem appropriately and challenging their assumptions (prompting reflection and justification of assertions)[313]. Promoting end-of-session process-evaluation is a third intervention[25]. The constraints on using content-expertise, the need to facilitate outwith comfort zones of subject-boundaries[314], the high level of process-expertise needed, and possible misinterpretation of 'student-centred' as 'tutor-inactive' might deter some staff[25]:

- *"The tutor's challenge is to forego the gratification of dispensing facts, and walk the tightrope of effectiveness by balancing intervention in group process between an informal, empathetic style and subtle and sparing use of personal content-expertise."* **(Maudsley, 1999)**[25p660]

Tipping *et al* showed, for example, how some Toronto PBL tutors role-modelled reflective practice badly and their observed practice contradicted their self-reports of facilitating good small groupwork[315]. (Students' conflicting expectations of PBL tutors[316] will compound the effect.) Tutors may well ignore the reflective/evaluative elements of PBL sessions, and students might undervalue the tutor's role in this[317]. Of Liverpool's original PBL tutors telephone-interviewed about PBL (100% response from n=34), most described its essence in terms of a positive philosophy, yet all except two descriptions omitted its reflective elements[318].

PBL tutor research has focused on the effect of content-expertise versus non-content-expertise[319] on either student outcomes or tutorial processes, and of various contextual variables on tutors' behaviour[320]. Inconsistent use of the term 'expert tutor' confuses the evidence-base. Usually, this refers to content-expertise as defined variously by[25]:

- self or the researcher
- different frames of reference, e.g.:-
  - for all or a subset of PBL scenarios (or associated learning block(s)) or for specific topics/learning objectives within PBL sessions
  - being in a particular discipline (despite contradicting PBL as a vehicle for integration of content)
  - being medically qualified or not
  - being an academic (versus being a non-academic or a student tutor)

There is evidence of students with expert tutors (defined as: authoring the scenarios or encountering such patients routinely), formulating double the learning objectives (with these three times more congruent with faculty indicative objectives), and double the study time (all statistically significant)[321]. Evidence from an isolated PBL course in a traditional curriculum showed students with content-expert PBL tutors (defined as: disciplinary and/or research expertise about the case scenario) doing better in assessments[322]. Silver and Wilkerson found that self-rated topic 'experts' (in videotaped PBL sessions) moved centre-stage when 'their' topics were under discussion. They were significantly more directive; more voluble (number and length of comments); gave more direct answers; suggested more items to discuss; and promoted more 'tutor-to-student' versus 'student-student' exchanges[323]. In another case study, Wilkerson *et al* also found that the tutors promoting self-directed learning in sessions were those facilitating active listening and appropriate silence, and who interrupted only as appropriate[324]. The foregoing evidence is all North American.

Maastricht research has given crucial insights about tutoring skills. Schmidt *et al* confirmed that effective PBL tutoring needed process-expertise (facilitation skills) *and* content-expertise (defined as: doctors whose medical specialty related to the scenario)[325]. Schmidt and Moust's structural-equations modelling found two requirements for the effective PBL tutor: 'social congruence' (informality *and* empathy with students) and subject-knowledge[326]. Content-expert tutors with subject-knowledge might force expositions of their topics on students, yet those who manage to retain a more facilitatory role are more satisfied[327]. Tutors without sufficient content-expertise might assess students' progress incorrectly[328]:

- Kaufman and Hansell studied ratings by non-expert PBL tutors (defined as such because none was expert in all the material) of Year 1 Dalhousie (Nova Scotia) medical students' knowledge acquisition and integration in PBL sessions[328]. The ratings explained less than 4% of the variance in examination scores. Likewise, tutors' predictions of students' examination scores explained only about 4% of variance in actual scores. Only 3/31 tutors were statistically significantly able to predict their students' actual scores.

Indeed, a tutor's content-expertise helps students most[329] when there is insufficient curriculum structure for the student level of learning[330] but the personal qualities of tutors remain crucial[331] for student motivation. (Tutoring plays a crucial role generally where students' prior knowledge is very low[332]).

PBL tutors' influence is likely to change emphasis, rather than become redundant, as students progress. In Dolmans and Schmidt's questionnaire survey of Years 1-4 Maastricht medical students the students perceived their tutors' influence to remain undiminished although self-directed learning was apparently improving[263].

Nevertheless, from programme evaluation data, Kalaian and Mullan reported a reduced (albeit still substantial) influence with progression, as group function and use of learning materials influenced students more[333].

More has been written about the faculty requirements of PBL tutors and their expertise than about determinants of tutor effectiveness[334]. The PBL tutor needs evaluating differently than with the criteria from conventional 'teaching', but the ideal clinical teacher has received more attention[335,336,337] than the ideal educator in other medical education settings[338]. Criteria by which students evaluate their PBL tutors should illuminate their needs, preferences, and conceptions of learning, while informing faculty development and programme evaluation. For Year 3 Dresden medical students, for example, Ravens *et al* found the highest scoring of 12 items about good PBL tutoring to be: allowing enough time for discussion, not interfering, having good tutor---students teamwork, and having content-expertise[339]. Despite this relating to a 6-week 'PBL' 'Basics of Drug Therapy' course, and no raw data or item design details being presented, this has some face validity. Fu-Gen medical students (Taiwan) preferred PBL tutors with both clinical and basic science knowledge, appropriate facilitator skills, and positive personality traits[340]. Cultural issues can divide tutors and students on what is good tutoring. United Arab Emirates medical students, for example, scored their largely expatriate PBL tutors lowest on the Alternative and Islamic Medicine theme compared with four other curriculum themes.

Overall, PBL tutor research has mostly explored the influence of their content- versus process-expertise on student learning; tutoring process variables on student learning; and various contextual factors on tutor behaviour[320]. The good tutor needs to use both content- and process-expertise judiciously. Dolmans *et al* noted the need for more qualitative insights into student learning and tutors' perceptions of their role[320].

Admission, satisfaction, academic performance, career intentions

Admission to medical school

The professions, generally, have difficulties ascertaining if they attract and select the right candidates for contemporary roles[341,342]. Levine *et al* noted that *"medical schools neither attract all desirable applicants into medicine nor accept all applicants desiring admission"*[343p131]. Undergraduate medical curricula that claim humanistic advances, however, must match this with selection systems relying on more than paper processes assessing only academic performance. World-wide, there have been various attempts to establish or improve the predictive powers of medical school interviews[344,345]. Admission requirements can encourage surface learning, with younger candidates more likely to score higher on surface learning at entry[346], but older age does not necessarily confer an advantage in subsequent performance[347]. Wear and Castellani urged pre-admission assessment of knowledge across *multiple* domains and work/voluntary experience over 'shadowing'[72]. Tutton argued that a good interview system should benefit applicants by improving their career awareness, preparation for the person specification, and motivation if admitted; plus gaining credibility as a people-orientated curriculum[344].

Various attempts to design undergraduate medical selection tests have tried to surpass mere academic achievement and avoid interviewer panels selecting in their own image (professional reproduction[75]). In Nottingham medical students, the candidate's Universities and Colleges Admission Service (UCAS) personal statement (plus prior academic performance and conscientiousness) predicted clinical performance whereas the reference did not[348]. Tutton reported on developing the Monash University (Melbourne) semistructured interviewing system, focusing on motivation, cognitive style, interpersonal style, and communication style and used accomplishment questions (evidence supporting an attribute) and situational questions (What would you do if...?)[344,349]. Trained panels of three (Faculty, local graduate non-Faculty, and lay) interviewed 114 and 140 Year 1 medical students (1990, 1991) as a pilot[344]:

- Interviewers reported most difficulty assessing appropriate cognitive style.
- Interrater reliability was good but lay interviewers were least congruent with the consensus scores.
- Lay interviewers' and outside graduates' scores did not correlate with the interviewees' socioeconomic status (unlike Faculty interviewers).

Of various demographic variables, the only statistically significant association was with school status – candidates from independent (versus government) schools received higher scores, again highlighting the need to guard against interviewer bias. Tutton found that the overall interview score[349]:

- was embedded in 'communication skill'
- overlapped little with, and therefore complemented, prior scholastic achievement

- overlapped modestly with the California Psychological Inventory scores suggesting that the interview did assess personal attributes yet psychometric testing could possibly complement this

The role of psychometric testing remains contentious. Concerning attraction to medicine, Olmsted reported on 'learning styles' and psychometrics amongst the 1968-70 cohorts of Michigan State medical students at entry (n=106 overall)[350]. Tests included the Allport Vernon-Lindzey (ALV) Study of Values to explore differential worth attributed between six values: theoretical, aesthetic, social, religious, economic, and political. Early in Year 1, interviews explored students':

- attraction to medicine ---classifying them as either science-orientated, people-orientated, or extrinsically orientated
- preferences for *facts* versus principles and concepts, *detailed instructions about what to learn* versus self-directed learning, and *all students doing the same learning at the same time* versus students doing different things ---classifying ≥2/3 as dependent learners *(≥2/3 of the opposing preferences as independent)*

Statistically significantly more science-orientated students preferred dependent learning, and more people-orientated students preferred independent learning. From complete data on 100 students, Olmsted found that the science-orientated students had their highest mean scores on valuing the theoretical perspective and people-orientated students on valuing the social perspective (statistically significant). She was unconvinced that medical school would change these preferences and values substantially, and that selection therefore determined the proportion of students feeling more comfortable with basic science than with clinical practice and with certain career choices over others.

A further challenge is obtaining appropriately representative intakes from the applicant pool available. The increasing female intake to medical schools focuses attention on male---female differences. From a counselling perspective, Wright considered females to suffer *"additional self-doubts resulting from perceived hostile attitudes in the educational environment and greater societal expectations"*[351p499]. Wright argued that making the medical school environment more conducive to females as well as males should not need extra funding, *"just initiative, commitment,* *responsiveness, and the vision of the medical community responding to the needs of all its medical students"*[351p500]. This would be relevant right from selection.

From a US national consensus conference about the medical education research agenda, Levine *et al* reported the need to study the applicant pool and their career decisions[343]. While a desire for wealth, autonomy, power, and prestige might underlie the motive and obligation to practise medicine, O'Brien considered these more as incentives with altruism remaining the main motivation. He reviewed the religious, humanistic, and biological explanations for altruism and found much overlap:

- *"We justify our right behavior by doing good that extends beyond self-interest. We transcend our individual being by doing God's will (religion), by working for the benefit of all mankind (humanism), and/or by assuring and assisting the continued existence of our species and its cultures (biology)."* **(O'Brien, 1995)**[352p42]

Issues affecting likelihood of admission to medical school may well then also impinge on satisfaction and achievement if admitted.

Satisfaction and assessment of medical students

Satisfaction with a medical curriculum is multifaceted. At one extreme, medical students who depart without graduating are lost to the medical workforce, a wasted investment, and an opportunity cost for others denied a place. Alexander and Haldane considered their particular dissatisfaction, e.g. frustration, resentment, humiliation, while acknowledging that some would be relieved[353]. Alexander and Haldane sent a 21-item postal questionnaire to all medical students leaving the Aberdeen programme in the six years from 1971/72, exploring their perceived interaction with the learning environment. From a fair response rate (62/115, 53.9%), most responders expected medical school to be hard and most accepted that professional development involved coping with stress. Nevertheless, most were dissatisfied with staff support, 75% did not consider that Faculty had facilitated the transition from school enough, yet only 8% had contacted staff when suffering emotional or psychological problems. Concerning intellectual self-image, 74% considered their performance to have fallen short of their expectations. Alexander and Haldane found attrition to be a complex interaction between organizational, personal, and academic factors.

Much more subtle issues can underpin dissatisfaction. Fox and West found that Year 1 and Year 2 California medical students whose self-directed learning strategies were inconsistent with the strategy predicted by their personality traits were more likely to be dissatisfied with the experience[354]. There was a statistically significant association between personality traits and their strategies for self-directed learning. MBTI extroversion, for example, predicted more innovative comprehensive strategies than merely using reading, lecture-notes, and consulting faculty.

In terms of learning approach and overall satisfaction, greater satisfaction has been found to accompany deep learning[355]. Prosser and Trigwell used Entwistle subscales with students from eleven programmes and seven faculties across two Sydney universities and found that those using deeper learning approaches evaluated their programmes more positively[276]. They considered this to be the first reported confirmation of the validity of students evaluating programme quality by questionnaire. They attributed Entwistle and Tait's failure to find this at that time[356] to having used the student rather than the programme as the unit of analysis.

Returning to *medical* students' learning approach (ASI or SPQ) affecting academic or clinical *performance*, there is evidence of at least a modest effect[139,163,165,170,178,357]. Other evidence is less striking[175] or unsupportive, e.g. Leiden *et al* studied Years 1-3 Nevada medical students and showed no link with GPA and NBME Part I scores using the '63-item' [sic] ASI (with n=79, giving a good response of 75%)[358]. For traditional curricula and assessments, correlation tends to be negative with surface learning rather than positive with deep learning[170].

Davies *et al* reported (first by letter[359], *then* by article[360]) the Kolb learning styles of two consecutive Year 1 East Virginia medical student cohorts at entry in 1991 and 1992 (both n=100), with an apparent 100% response rate. Accommodators scored higher in all categories of semester 2 interviewing skills, i.e. questioning, listening, developing rapport, nonverbal cues, and interviewing (and all statistically significant, bar questioning) and convergers scored worst in all bar listening. The converse held for Year 2 basic science performance, with convergers scoring best and accommodators worst for physiology (statistically significant), with neurology and anatomy showing a similar pattern. Biochemistry had no statistically significant pattern, but assimilators scored highest and divergers worst. Davies *et al* noted that assimilators' and divergers' reflective observation and appreciation of different viewpoints should make them amenable to both didactic and people-orientated approaches to learning, but that curriculum reform to promote both basic science *and* people-orientation should acknowledge all learning styles.

In Tooth *et al*'s study of St Mary's medical students, there were statistically significant changes in the learning approaches: increased surface learning and decreased strategic and deep learning between selection and mid-/Term 1 and again from then to early Term 3[81]. Learning approach correlated statistically significantly with end-of-year summative examination performance: a positive association for strategic learning, negative for surface learning, and none for deep learning. This was attributed to too much examination focus on factual recall and encouraging question-spotting. A-level performance was statistically significantly associated with this examination performance, albeit at r=0.3, but not the sessional (presumably formative) examination performance. Tooth *et al* queried the applicability of the Yerkes-Dodson law to anxiety and examination performance as 'state' anxiety was not associated with examination performance other than by predicting poor performance following poor sessional examination results.

'Study orchestrations' add another layer to understanding learning[361]. Lindblom-Ylänne and Lonka studied Year 5 Helsinki medical students before problem-based transformation of that curriculum. Of responders to a learning questionnaire (n=67, giving a 60% response), they interviewed 35 volunteers about their answers. They developed four 'study orchestrations' from cluster analysis, i.e. how individuals act according to learning orientation and learning environment[362]:

- meaning-orientated independent (found to be high achieving on assessment)
- meaning-orientated with a novice-like conception of knowledge
- reproduction-orientated and application-directed
- reproduction-orientated and externally regulated (found to be low-achieving)

They suggested that the traditional learning environment might have misled some students (individuals with dissonant orchestrations in the last group) about how to study, students who might have fared better in a problem-based environment[362]. Furthermore, some 'meaning-orientated' medical students were atypical in being apparently 'immune' to the effect of learning environment, and succeeded by not succumbing to a traditional learning environment that encouraged maladaptive study[362]. Lindblom-Ylänne and Lonka highlighted the problems of the 'hidden curriculum' not being in Biggs' 'constructive alignment' (i.e. instructional design does not match constructivist goals[159]) with traditional undergraduate medical assessment[363]. The interview study confirmed this with the two meaning-orientated groups persisting in searching for meaning despite the examinations requiring them to memorize[363]. Lindblom-Ylänne and Lonka found that study orchestrations did not influence students' perceptions of assessment procedures; all groups were similarly critical[363]. The students deemed it inappropriate for their future occupation that they felt pressurized to memorize and study superficially, but differed in whether or how to study or how to prepare for the assessment. They noted that, as for Entwistle *et al*'s work, meaning-orientation led to better academic performance.

The research literature shows various links between medical students' admission and other characteristics (e.g. learning approaches/styles) and their subsequent satisfaction and performance. The optimal selection procedure however remains elusive.

Career intentions of medical students

Knowing how medical students choose careers and what they choose is important for workforce planning, maintaining primary care-orientated health care, and evaluating attainment of curriculum goals. Low attraction to primary care and expanding medical student places (aimed at reducing inequitable distributions of doctors between specialties and places) draw attention to students' career perspectives and preferences[364,365], shifts in these, and their determinants. To increase attraction to family medicine, for example, Katz *et al* advised that: *"recruitment efforts would likely be most profitable if directed to the group of students initially expressing a preference for that field"*[366p289]. Careers advice is, however, often insufficient, notwithstanding reported examples of structured support, e.g. using MBTI and Gough's Medical Specialty Preference Scale to raise self-awareness (a northeastern US medical school)[367]. In the UK, only 1% of medical graduates in1966, and 20% in 1981, for example, received career advice in medical school[368].

Research about <u>what career</u> medical students choose is common. Most students' choices persist throughout medical school, but rejecting primary care for specialty practice is the predominant trend[364,369]. Among Illinois medical students (Rockford clinical site), Glasser *et al* reported a fairly highly stable choice of either 'primary care' *(family medicine, internal medicine, paediatrics)* or non-primary care *(surgery, psychiatry, obstetrics/gynaecology, etc.)*. This was, however, from a very small sample, i.e. from the first two graduating cohorts (n=19, 1975; n=25, 1976)[364]. Of the 44 responders in the first of their three clinical years (after one basic science year at Chicago or Urbana-Champaign), '59%' had wanted to do family medicine, falling to 41% at residency and 39% at practice stages. Nevertheless, 66% retained primary care choices from sophomore, through residency, to practice, whereas only 4.5% retained non-primary care choices. Rothman found postgraduates' most stable choice to be family practice, and for undergraduates it was an academic career, from surveying 205 Year 1 Toronto students at entry in 1971 (with 70% response), graduation in 1973, and 10 years postgraduation.

Jewett *et al* claimed the first report of learning *preferences* in doctors, using the Rezler LPI with Washington (US) residents from different specialties[370]. Statistically significantly more internal medicine residents preferred abstract learning and more psychiatric residents preferred teacher-structured learning. Jewett *et al* wondered whether doctors' career choices reflected such preferences[370]. Curry reported key differences on a battery of inventories of learning style, cognitive style, and personality, and related indicators, between doctors in three sentinel career categories[111]. They concluded, for example, that: paediatricians tend to focus on theory, surgeons tend to take as fact only what they can confirm personally (and are judgemental), and non-academic family doctors tend towards recall level only[111].

How students choose a specialty is less researched. Henry *et al* using Savickas's's[371] Medical Career Development Inventory found that late Year 1 medical students had developed their vocational identity but were unclear on specialty interests and goals, and there were no sex-specific differences[367]. Wright *et al* found that graduating McGill (Montreal) medical students' specialty choice corresponded to exposure to sufficient role models from that specialty (statistically significant odds ratios)[63]. Burack *et al* surveyed 157 Washington (US) medical students (with an excellent 85% response), classifying them to one of six career pathways, from choice at 'matriculation' to 'Match' at the end of medical school before entering specialty training[372]. From six subsequent focus groups of 47 participants, specialty choice emerged as a socially constructed process of " '*trying on' possible selves*"[372p540], possibly explaining why exceptional role models can overcome negative specialty stereotypes. Students preferring family medicine, paediatrics, or internal medicine ('primary care' group (PC)) were statistically significantly more influenced by role models than the non-primary care (NPC) group. PC students sought holistic care, and broad, diverse practice whereas NPC colleagues sought urgency, immediate impact, pace, performing procedures, excitement, and research. Both groups made their decisions using information about themselves, others in the specialty, and its content. Students not changing their choice tended to follow a *confirmation* decision-making process; whereas changing NPC→PC involved decision-making by *inclusion*; and PC→NPC involved decision-making by *elimination*.

Matorin *et al* found that Texas medical students perceived the main influences on choosing career to be their personality, faculty mentors and role models, group practice opportunities and subspecialty opportunities[365]. Of note, 40% reported having made their choice pre-admission, suggesting that career advice interventions must start early. Katz *et al* studied why Buffalo (New York State) medical students changed career choice[366]. Two weeks pre-graduation, 98 students (representing a 73% response) completed a retrospective questionnaire, generating nine career categories. Of the 53% reporting change of career choice during medical school, most changed during the clinical years (only 8% of changes occurring by end of Year 1), 84% of changes were for negative reasons, and 38% were away from family medicine. The most attractive specialties to changers were internal medicine and surgery and the least were family medicine and psychiatry, but the latter was most likely to keep the few students initially choosing it.

There have been various attempts to explain students' career intentions, and there is much literature from North America that may not translate so well to the UK setting. Difficulties attracting students to primary care are, however, a shared feature. While difficult working conditions in PRHO hospital posts[17] might increase primary care recruitment, this would be a rather negative solution. Positive promotion of this career is needed plus more flexible contractual arrangements to accommodate the increasing proportion of females among medical graduates[373].

Medical students learning a population perspective

In the 1960s, Simon wrote about difficulties getting medical students to synthesize basic science, clinical science, and population health science perspectives[374]. He considered preventive medicine and public health to come closest to medical students' initial expectations of medicine, but that disappointment soon supervened, requiring population health to improve its image with *"much more imagination, study, planning, and experimentation"*[374p780]. By 1988, The Edinburgh Declaration, an international consensus statement, was still needed to focus medical education on producing lifelong-learning, health promoting doctors[375,376,377]. Repeated mismatches between population health needs and type of doctor produced[378] have prompted various initiatives around the world. Tackling the medical school's 'social contract' (obligation to meet public health needs) with more undergraduate community-orientation[379,380,381] (and maybe more exposure to generalists[382]) might help.

Similar messages about medical students'[99,383], and doctors' antipathy to population health learning (including 'numerophobia'[384]) have recurred since the 1960s:

- *"As teachers of preventive medicine, all of us have observed the Medical Student Myopia Syndrome (MSMS), but we have not always diagnosed or successfully treated this plague... MSMS is usually manifested by medical school classes in epidemiology and preventive medicine full of empty chairs... The epidemiology of MSMS is classically described by its own unique person, place, and time. MSMS is... transmitted by word-of-mouth. Words such as "this is going to be boring" and "I'll never use this stuff" are vectors for transmission of this intellectually crippling condition... [It is] found at every medical school throughout the world... its one pathognomonic sign - a student reading the newspaper in the middle of class... In terms of treatment, only one [is effective]... RICE therapy (relevant, innovative, clinical with exacting expectations)."* **(Riegelman, 1991)**[385p252]

How to tackle students' disinterest is a recurrent dirge[385,386,387,388,389], mirroring angst about the plight of behavioural science elements (undermined by staff attitudes in the hidden curriculum[213]). The disinterest may be, for example, rooted in indifference to self-orientated preventive medicine[98,99]; determined at medical school selection[390]; or a backlash to outmoded courses dislocated from clinical practice. An example would be the 'new' 294-hour preventive/social medicine course resulting in Belgrade medical students' readiness to specialize in it declining precipitously and statistically significantly[387]. Various countries have revisited *what* medical students should learn about population health[380], mostly focused on clinical epidemiology[391,392], but *how* to do this requires extensive integration not tokenism and compartmentalization[388,393]. Public health professionals' apathy or antipathy to medical student-related issues[394] or education theory and evidence would be unhelpful, and historical tensions with clinical medicine run deep[395]. The UK response to the GMC *Tomorrow's Doctors* recommendation about promoting public health medicine as an integrated theme has been patchy[396,397,398], with exceptions[393], including community stakeholders' willingness to provide learning opportunities[399].

In the North American literature, medical students' public health education prioritizes individual preventive medicine (making elements like international health experience more important in public health awareness-raising[400]). In a survey of 'professional development' in the 125 US medical schools in 1998, only 41% of the 116 responders' curricula addressed the attribute *"respond to societal needs and reflect a social contract with the communities served"*[401p832]. Woolliscroft *et al* followed the 1984 entry-cohort of 73 Michigan medical students for three years, monitoring their attention to preventive medicine in clinical write-ups[402]. Statistically significant differences included Year 2 identifying more issues than Year 1, but this decreased and plateaued for Year 3. Year 1 students were also less able to translate risk factors into their problem/action-list. In Woolliscroft *et al*'s randomized trial of interventions to improve awareness in Year 3, the group receiving cueing (from subheadings on the history-taking form) and specific written feedback improved significantly, and the effect persisted for those receiving such feedback.

Attempts to measure awareness and attitudes to population health issues include the 63-item Likert-type Attitudes to Social Issues in Medicine (ATSIM) scale, but psychosocial and professional/personal development elements outweigh population perspective elements, and transferability to UK curricula cannot be assumed[403,404]. Items include: *"I believe that at least half of all patients in general hospitals have health problems related to social factors"*, and *"I believe that our present method of* *training medical students does not take into account the frequently social nature of illness in contemporary North American Society"*.

Parlow and Rothman used ATSIM to study Toronto health care profession students both years of *social work*; all four years of *nursing, and* two years *postgraduate*; *medical* Year 3; *dental* Year 4, and *pharmacy* Year 4. Overall, an impressive 750 students participated (83%), all the non-responders being absent rather than refusing. Parlow and Rothman found social work and nursing students to score statistically significantly higher on human relations and social issues, suggesting self-selection and admissions processes as the most likely explanation[405]. The medical and dental students shared similar attitudes, which Parlow and Rothman likened to Rosenberg's findings with medical and dental students[406]:

- He used the California Personality Inventory with 47 male dental students and 34 male medical students *pre*-entry to San Francisco Bay medical and dental schools (of unspecified selection procedure or denominator). Four years later, the medical students had changed on more scales, i.e. their profile was less stable than for dental students. *"One could cite the atmosphere of indifference that surrounds most dental schools"*[406p402], suggested Rosenberg. He was clearly expecting more shift in personality after four years of dental education.

Stephenson *et al* viewed population health learning, like ethics, to be integral to medical professionalism[85]. Price *et al* studied Queensland medical students' attitudes to moral dilemmas in 25 scenarios. Year 1's '1-from-4' responses showed that they valued *"Doctors have an obligation to society which can override their duty to the patient (and to each other)"* tenth highest of a list of 23 ethical statements[83]. It fell to 19th by Year 5 and 21st by Year 6 (only lagging behind not punishing patients and being obliged to use resources properly). Year 5 students' responses were statistically significantly less likely to invoke this statement compared with Year 1 students (6.6% versus 25.3% of possible score, respectively). A note of caution was that fewer than three of the '25x4' possible responses mapped to the statement.

For Schön most problems of greatest human concern were in the swamp (rather than on the 'technical rationality' high ground)[88], akin to the position of population health concerns in medical consciousness. He raised the 'rigour versus relevance' issue[88]:

- *"Public health doctors are probable inhabitants of Schön's 'swampy lowlands', because population-relevant problems potentially challenge conventional notions of science."* **(Maudsley and Strivens, 2000)[92p58]**

Interest in population health matters also varies by specialty. Most medical students do not consider Public Health Medicine for a career, with only 0.3-0.4% of UK graduates[19] citing it as first choice:

- *"The community medicine faculty members who are found in the medical school often focus on such topics as population dynamics or economics – not attractive role models for would-be healers."* **(Plovnick, 1975)[112p853]**

In 1993, Phillips *et al* reported that general surgeons scored preventive medicine as statistically significantly less relevant than did family practitioners (but omitted the figure)[407]. In their questionnaire survey, licensed doctors from Kentucky ranked 23 preventive medicine topics for relevance to their clinical practice (with a response of 54% from a random sample of 200)[407]. Some 'topics' were as broad as 'epidemiology' but, explicably, disease-specific topics and risk factor topics such as tobacco, cancer, diabetes, nutrition, 'coronary heart disease', and alcohol prevailed. Family planning, infant health, epidemiology, and oral health ranked lowest. The mean 'preventive' score across all topics did not correlate with age, sex, or practice location. Phillips *et al* concluded that:

- *"Epidemiology and disease reporting are not felt to be as relevant by the practicing [sic] physician and perhaps might best be presented as 'how to read the medical literature' by those trying to educate future or current practitioners."* **(Phillips *et al*, 1993)[407p111]**

Demonstrating relevance is key to public health education, and the critical appraisal function of clinical epidemiology is crucial. Indeed, as noted by Chessare:

- *"Rather than perpetuating the message to those in training that senior clinicians are the depository of all relevant information and that the goal is to learn as much as they 'know', educators of evidence-based medicine should attempt to show the learner how to find information efficiently and to judge its reliability and validity. It is a model of lifelong learning."* **(Chessare, 1996)[14p290]**

Stone described a 'clinical epidemiology ward round' to integrate clinical epidemiology and evidence-based principles into everyday child health practice for Year 5 Glasgow medical students[408]. Nevertheless, examples of research about how such learning develops are rare, but Hmelo-Silver *et al* explored learning about study design. They analysed how Year 4 medical students (novices) approached a simulated complex task to design a randomized controlled trial of a new oncology drug[409]. They found that, compared with a group of cancer experts (n=4), novices (six groups, n=24) achieved a similar endpoint but ran fewer experiments, changed more variables at once, used much less theory-driven planning (versus just using recent data), and evaluated their progress less (all statistically significant). As one aspect of critical appraisal skill, study design is clearly a complex task.

Returning to Phillips *et al* (above), their additional cross-sectional study of Kentucky medical students (1990/91) found a statistically significant increase in mean preventive medicine score for each successive year-group from 1-3 (but scores were not reported). This was on an anonymous 'in-class' 35-item questionnaire of preventive medicine statements related to pulmonary disease (with 5-point Likert scoring of agreement by n=212)[407]. For that academic year compared with the previous, the mean preventive score increased statistically significantly in a cohort followed longitudinally (n=157; but year-group and denominator were undisclosed). Of Year 2 students asked to provide an identifying number, 24 responded both before and after their preventive medicine course and showed a statistically significant increase in mean preventive score (but denominator, time between administrations, and absolute or differential scores were undisclosed). Their wider study surveyed 2,544 medical students across 12 institutions for career data (*"Planned specialty (one only): medicine, surgery, pediatrics, family medicine, ob/gyn, neurology, other (specify), uncertain"*), but again did not report the response rate. Overall, mean preventive score differed statistically significantly between career intentions. Those planning a career in surgery or obstetrics/gynaecology were more negative about preventive medicine than those in the other six groups.

Using a population health learning example, Imperato *et al* showed the vulnerability of learning to the effect of assessment[410]. From 1978-85, Year 2 New York State medical students evaluated a 'preventive medicine and community health' course five times (with good-excellent response rates of 60%-94%). In 1979, contrary to faculty intentions, the students perceived the mid-term examination as difficult. Students' anger spilt into rating many other course aspects negatively, despite their being consistently positively evaluated previously. Likewise, setting examination questions on required readings not covered in lectures stymied the 1983 survey. Surveying soon after the problematic examinations probably increased the projected negativity.

Marshall provided further evidence about the role of assessment from Year 3 Birmingham medical students in 1985 (n=152)[411]. Multiple regression of their epidemiology examination performance on several variables showed a statistically significantly better performance for females, and for students whose *clinical* examination was the previous week, not the same week (i.e. separated by a weekend) Although students whose *clinical* examination at *that* time was surgery rather than medicine apparently performed better on epidemiology (as students probably prioritized medicine over surgery, thus leaving less time for epidemiology), this was not statistically significant. Marshall estimated that a female whose clinical examination was the week before the epidemiology examination, and was in surgery, would score about 9% points higher on epidemiology than a male whose clinical examination was in the same week as the epidemiology examination, and was in medicine. Besides showing that the proximity of other examinations affected examination performance (therefore being irrelevant if all students took the same assessment synchronously), Marshall queried females' better performance. He wondered whether, at that time, despite the Equal Opportunities Act, females had to perform better to gain entry to medical school and that this might have translated into an educational advantage in epidemiological performance.

Novick *et al* claimed the first reported questionnaire to measure orientation to (willingness to use) population-based preventive options[412]. This involved responders allocating 100 points between five options (about treatment, clinical prevention, and population prevention) for each of nine scenarios. Piloted on public health directors (with 13/15 responding) plus family medicine doctors from Syracuse and Baltimore (n=18 and n=23, of undetermined sampling frames), only a heart disease scenario discriminated statistically significantly between them on the population prevention, treatment, *and* population-treatment differential measures. For 145 medical students studied simultaneously, however, the overall score *did* increase significantly on the population prevention scale and the population-treatment differential after a Year 2 epidemiology course. (Details of response, questionnaire distribution, the course, etc.

were undisclosed.) Only one scenario (about maternal and child health) showed significant differences on the population scale and population-treatment differential for public health directors versus one of the family medicine groups *and* versus medical students. Measuring population orientation therefore still had a way to go.

Considering that medical school might select students who are more negative about population perspective, Ewan explored if, as alleged, academic high-achievers lacked awareness and responsiveness to such issues. She used the ATSIM scale with Year 1 New South Wales medical students at entry (n=121, representing 72% response) compared with entrants to other faculties with similar and lower achievement (three random samples of 100: 55-63% response rates)[413]. Medical students were equally or more concerned than the other students only on attitudes that did not challenge the doctor's knowledge, role, or status, i.e. prevention and doctor-patient relationships. Ewan's follow-up showed that by Final year, medical students were statistically significantly less likely to acknowledge social determinants of disease than at entry[414].

On their Attitudes to Community Medicine (ATCM) questionnaire, Rolfe *et al* found that entrants to the Newcastle (New South Wales) problem-based curriculum had statistically significantly more positive attitudes than entrants to the conventional Adelaide curriculum[390]. Newcastle Final years also retained significantly more positive attitudes[390]. The results were unsurprising as Newcastle emphasized these issues (with Population Medicine as one of five curriculum domains[415]). Newcastle found, however, that preregistration house officer performance might not retain the benefit of undergraduate 'population perspective' performance, as busy 'internships' and assessments might ignore it[415]. Such references to population perspective issues in problem-based curricula are unusual, and many problem-based North American curricula tend to use PBL as a vehicle for integrating basic science in a clinical context, rather than widening the scope beyond an individual patient. Examples tend to be from undergraduate courses[416,417,418] or postgraduate programmes[419] that are solely for public health and/or epidemiology.

Overall, research about medical students learning a population health perspective is flimsy, and examples related to integrated problem-based curricula are scarce, despite recurring recommendations to match medical education with public health needs.

Summary

The literature review found much relevant research for **'What is known about medical students' conceptions, in problem-based curricula, of their learning, knowledge, and career (and how these relate to examination outcomes and learning about population health)?'**. There were relatively few connections made, however, between factors affecting medical students' learning, knowledge conceptions, academic achievement, and career intentions, or with the growing literature on their professional development, the small literature on their ideal educators, and the quite scarce literature on their population health learning. In the learning styles literature, Kolb LSI generated intriguing yet inconsistent associations. Entwistle learning approaches originated in qualitative evidence, and development principles for psychometric scales and incremental models. Some non-UK evidence found 'PBL' promoting more desirable (deep) learning approaches. The evidence-base involved various Entwistle instruments, often without specifying which version. The 18-item short RASI has yet to be reported in undergraduate medical research.

Research about *problem-based* undergraduate medical education is an academic battlefield, mostly about perceived gaps in PBL graduates' basic science knowledge and undermined by unrealistic expectations of 'effect sizes'. There is growing evidence, however, of positive effects on enjoyment/satisfaction, small benefits in clinical diagnostic reasoning, and likely cognitive benefits beyond clinically competent performance. As for PBL generally, evidence about the PBL tutor's effect (and group dynamics) is often undermined by different definitions of 'PBL' and 'expert tutor', and variable implementation of key principles. Learning a population dimension via PBL features little. Much medical education research literature is North American and it struggles for attention beyond the aficionados. Where problem-based innovation (either at programme or 'subject course' level) is involved, all five continents are represented, but much key literature is North American, Dutch, Scandinavian, or Australian. Several issues frustrate synthesis of key messages from the evidence-base:

- Educational environments and interventions are very context-specific, yet articles often use terms loosely or inappropriately and do not specify context.
- Where such details are clear, bias (all three main types: selection, information, and confounding) is problematic – randomization, controlled conditions, and adjustment are not necessarily ethical, feasible, desirable, or relevant.

- Disentangling effects of selection, socialization, and 'schooling' therefore needs sympathetic designs and robust effort, equivalent to research endeavours in other more established fields.
- Notwithstanding challenges to using conventional clinicoepidemiological quantitative research designs, basic details are not universally reported, e.g. about: numerators, denominators, sampling, questionnaire development and mode/context of administration.
- Recognition of *both* quantitative and qualitative evidence has not kept pace with general educational literature; proper theory-building work is uncommon; and much is inferred from one-off cross-sectional studies and/or relatively small sample sizes.
- Many key curricula generating PBL-based evidence have no clear tradition of population health learning, Newcastle (New South Wales) being an exception.
- The North American literature refers to rather different medical career structures and health services (particularly about equity of access, funding, priorities, and what constitutes primary care), and a view of public health mostly focused on individual preventive medicine.

In 1974, Levine *et al* reported from a US National Center for Health Services Research and Development conference of medical educators and social scientists exploring some medical education *assumptions needing research*[343]. These were that medical education would be better with more: early patient contact; integration of basic and clinical sciences; community-orientation; multiple tracks; shorter curricula; 'humanizing' experience and incorporating social and ethical dimensions; and responsibility for communities, social, and ethical issues in the doctor's role[343].

This literature review showed that world-wide, three decades later, these 'assumptions' probably remain on contemporary research agendas, as would Levine *et al*'s key research topics: selection; socialization; effect of medical school environment; and impacts on house officer and subsequent practice. Levine *et al*'s call to focus medical education research on issues affecting whole programmes not individual disciplines, compare with other programmes rather than be isolated, and be longitudinal not fragmented also have contemporary worth[343], even if all educational researchers cannot necessarily meet such ideals.

Chapter 3: Mixed methods research in medical education

Quantitative and qualitative, not quantitative versus qualitative

Whether medicine is science, art, or both is contentious, obscured by tensions between realism and nominalism, determinism and voluntarism, and nomothetic versus idiographic methods[420]. Including the spectrum of notions of knowledge (epistemology) gives four sets of assumptions describing social reality[421,422], from objectivity to subjectivity (**Box 5**).

Box 5: Dimensions distinguishing assumptions underlying 'objective' and 'subjective' approaches to social science (Burrell & Morgan, 1979)[421]

	'subjective'		*'objective'*	
▪ *Social reality is individually constructed from consciousness*	**nominalism**	ontology ←------→	**realism**	▪ *Social reality is external, imposed on consciousness*
▪ *Knowledge is personal, subjective, unique*	**anti-positivism**	epistemology ←------→	**positivism**	▪ *Knowledge is hard, objective, tangible*
▪ *Humans initiate their own actions; as masters of free will*	**voluntarism**	human nature ←------→	**determinism**	▪ *Humans respond mechanically to environments, as marionettes*
▪ *The emphasis is on the particular and individual*	**idiographic**	methods ←------→	**nomothetic**	▪ *The emphasis is on discovery of general laws*

Marginal summaries at each end of box added from Cohen & Manion[422]

Wilson commented that many doctors might think it redundant to ask - If medicine is a science, what type is involved? - as they might acknowledge only one form (biomedical science), whereas science philosophers debate various standpoints. He identified objectivist assumptions that biomedical science usually embodies and are integral to enculturation in medical school: patient-disease separation; simplistic cause-and-effect models; and the doctor's distance from the patient (akin to a natural scientist)[420]. He noted conflict between the 'detached observer' gaining knowledge and the 'detached observer' applying it to patients, i.e. mixing universal with existential approaches. Cribb and Bignold accepted that *"it would be dangerously cavalier"*[48p207] to dismiss the doctor's survival mechanism of detachment, but that medical schools needed more reflexivity in both education and research generally.

Wilson highlighted similar debates in anthropology, physics, and politics that refocused from positivist and realist positions to more subjectivist stances, allowing cultural relativity. He argued for a new medical paradigm *building* on biomedicine, namely a social constructivist medical model affording qualitative and quantitative research approaches equivalent status. While the former struggles for funding and medical acceptance[48], its popularity *is* increasing[423,424], e.g. particularly in general practice research[425,426]. Boulton *et al* found though that only 2% of original articles in seven medical journals, 1991-95, reported qualitative research (and only 17% of these mixed qualitative and quantitative research substantially)[426]. Guidance on qualitative research standards is emerging albeit conflicting[425,426,427,428,429,430,431,432]. Stacy and Spencer argued that assessing qualitative research evidence is not just about standards and, with much medical education research having an evaluative component, standards cannot be 'neutral'[430]. They advised that 'best evidence' guidance should focus on being theoretically explicit (i.e. the British Medical Journal Education Group for Guidelines approach[433]) rather than claiming elusive researcher 'independence' (i.e. the Harden *et al* approach in Best Evidence Medical Education (BEME) Guide 1: *"Are the researchers independent?"*[434p557]). Moreover, Popay *et al* reminded that qualitative research aims for logical, rather than probabilistic, generalization[431].

The 'quantitative versus qualitative' research debate appears inescapable, somewhat zealous, and arguably futile (*"a phony war"*[424p561]). From an educational perspective, Onwuegbuzie traced this debate to the late 1800s, when logical positivism underpinned 'science', i.e. systematic 'hard' data collection, objective evidence, with probabilistic and inferential analysis, to explain, predict, and control phenomena[435]. Researchers into human and social phenomena soon challenged this approach and advocated interpretist/hermeneutical approaches (seeking understanding from the participant's perspective)[435]. Post-positivism **(p107)** emerged during the 1950s/1960s, followed by constructivism **(p107)**, interpretivism (searching for meaning rather than truth, i.e. opposite to empiricism), and naturalism (studying people in situ with minimal researcher interference[427]), but the schism remained[435]:

- *"...realism versus idealism, foundational versus antifoundational, objective versus subjective, hard versus soft, scientists versus critics, personal versus impersonal, deductive reasoning versus inductive reasoning, rigor versus intuition, generalization versus uniqueness, logistic versus dialectic, rationalism versus naturalism, reductionism versus holistic, causal versus acausal, macro versus micro, correspondence versus coherence, quantifiers versus describers, and numbers versus words."* **(Onwuegbuzie, 2000)**[435p13]

Onwuegbuzie outlined misconceptions by purists, with each side claiming paradigm superiority – as if morals were at stake rather than a research approach. The debate:

- *"...has tended to obfuscate rather than to clarify, to stereotype rather than to enlighten, and to divide rather than to unite educational researchers. Out of these disputes, misleading clichés have emerged that have taken a life of their own. The intricacies and subtleties of research have been reduced to simplistic but obdurate reifications."* **(Onwuegbuzie, 2000)[435p10-11]**

Likewise from an educational perspective, Punch preferred emphasizing similarities rather than being mired in differences in data, their collection, and analysis (i.e. qualitative: case-orientated versus quantitative: variable-orientated)[436]. For Punch, paradigm issues were barriers, as either approach could be theory-generating or -testing, both had strengths and weakness, and social research needed both. From nursing research, Goodwin and Goodwin dismissed myths about mutual exclusivity of certain methods for certain paradigms (despite others defining qualitative research in this way[426]); about qualitative research being invariably or exclusively unobtrusive, naturalistic, and subjective; and about its validity and reliability being irrelevant[437].

In reviewing *"the paradigm wars"* of the social and behavioural sciences, between different belief systems and worldviews (usually positivism versus constructivism), Tashakkori and Teddlie cast the pragmatism paradigm as pacifist[438]. They highlighted pragmatism's close association with its American origins (e.g. Dewey, Rorty, etc.) and Europe's tendency to disparage pragmatism for conceiving 'truth' as 'what works' and debunking the search for metaphysical truth. 'Pragmatism', by *"rejection of the either-or"* quantitative–qualitative debate, avoids forcing choice between methods, logic, or epistemology[438], and underpinned Onwuegbuzie's plea for 'bi-researchers' to mix methods (*"epistemological ecumenism..."*[435p11]) and *"Why can't we all just get along?"*[435p11].

What is mixed methods research?

Mixed methods research uses the pragmatism paradigm. From educational psychology, Creswell (adapting a model by Crotty) summarized three core elements differentiating between qualitative, quantitative, and mixed methods research approaches[439]:

- *What knowledge claims and theory (the paradigm)?*
- *What enquiry strategy (associated traditions of enquiry)?*
- *What data collection and analysis methods?*

Creswell described claims about knowledge (i.e. what it is, how we know, by what values, how we write about it, and the discovery process) for four paradigms:

- ***"postpositivism:*** *determination, reductionism, empirical observation and measurement, theory verification...*
- ***constructivism:*** *understanding, multiple participant meanings, social and historical construction, theory generation...*
- ***advocacy/participatory:*** *political, empowerment issue-orientated, collaborative, change-orientated...*
- ***pragmatism:*** *consequences of actions, problem-centred, pluralistic, real-world practice orientated"* **(Creswell, 2003)**[439p6]

Cherryholmes wrote of pragmatists that, *"Even if we came upon a True account of what is 'real', we would be at a loss to recognize it as True"*, because pragmatists *are* realists whereas 'scientific realists' are romantics in seeking reality[440]. According to Creswell, pragmatism's knowledge claims involve[439]:

- distance from particular systems of philosophy and reality; freedom to choose appropriate methods, techniques, procedures; indifference to 'qualitative *or* quantitative'; and belief in 'qualitative *and* quantitative', i.e. truth is what works at the time
- focus on purpose when deciding what and how to research; recognition of the social, historical, and political context; and a move beyond debating reality and the laws of nature

The enquiry strategies for qualitative, quantitative, and mixed methods research are classified variously. Like many educational and social science researchers, Creswell viewed quantitative research enquiry strategies as 'experiments' or 'surveys' (using the latter whether cross-sectional or longitudinal, questionnaire or semistructured interview). The clinicoepidemiological hierarchy of study design provides a more comprehensive view: case report, case series (clinical or population), cross-sectional study, case-control study, cohort study, randomized controlled trial[441]. The social and educational literature tends, however, to ignore the clinicoepidemiological literature/terminology even when describing quantitative approaches.

Qualitative research strategies and their classifications abound. Creswell noted that some researchers identify about 20, but his book reported five main traditions:

biography/narrative, phenomenology, grounded theory, ethnography, case studies[442]. Reviewing grounded theory's contribution to medical education, Harris considered that such approaches worked best for research questions of complex human intentions and motivations[3]. Grbich classified qualitative approaches in health research into field-based, action-based, or library-based, differentiating them mostly on purpose[443]. Qualitative research questions are probably appropriate with: 'immature' concepts; a need for exploration, description, and theory generation; uncertainty about the current theory; and phenomena not amenable to quantitative approaches[444] (e.g. sensitive and socially dependent issues[423]). Generally, qualitative research tends towards open-ended questions, unstructured approaches, and highlighting differences rather than averaging responses for generalization[423]. Health services research is increasingly using it[445], but Chapple and Rogers noted that much conflicting advice about how to 'do' qualitative research might discourage such researchers, e.g. with recipe-like checklists (attracting much criticism[446]) and claiming its superiority, but only if used by formally trained social scientists who understand the theory[429]. *"Feigning 'immaculate perception'* "[447p43] is a barrier.

For mixed methods research, Tashakkori and Teddlie wanted to prevent mixed methods becoming 'mixed up methods', hence their three-part taxonomy of enquiry strategies (although, arguably, this might over-complicate things)[438]:

- *concurrent mixed analysis:* •parallel mixed analysis (i.e. triangulation of data sources); •'quantitizing' (converting qualitative data into quantitative data for statistical analysis); •'qualitizing' (converting quantitative data into narrative for qualitative analysis)
- *sequential QUAL-QUAN analysis:* •qualitative analysis followed by confirmatory quantitative data collection and analysis
- *sequential QUAN-QUAL analysis:* •quantitative analysis followed by confirmatory qualitative data collection and analysis

Specific data collection and analysis methods are not necessarily exclusive to certain research paradigms[437], despite often being portrayed as such. Educational researchers have, however, pioneered 'mixing' qualitative and quantitative approaches[436,438,439], emphasizing a qualitative-quantitative research continuum[448], that *"...we should be shamelessly eclectic in our use of methods [in education]"*[449p17]. Tashakkori and

Teddlie cast each of six key facets of the 'pragmatism' research paradigm as a continuum not 'either-or' issues[438]:

- *methods:* use both qualitative and quantitative
- *logic:* use both inductive and deductive
- *epistemology (knower↔known relationship):* accept both subjective and objective perspectives ('epistemological relativism')
- *axiology (the role of values):* accept that values are very influential in interpreting results
- *ontology (nature of reality):* accept external reality → choose the explanations that best produce the outcomes
- *causation:* accept the possibility of causal relationships, while acknowledging their potential elusoriness

The mix in mixed methods research

Rossman and Wilson described three distinct stances that researchers take about combining qualitative and quantitative orientations[450]:

- *purism:* they cannot be combined and only one orientation is favoured
- *situationalism:* both orientations are valuable and may appear in the same study, but only if kept in their place, and
- *pragmatism:* both orientations are valuable, particularly when combined in the same study, whether in design, data collection, or analysis

Their three reasons for combining the orientations were[450]:

- corroboration: of convergent findings, i.e. true triangulation - concurrent validation from Morse's description[444]
- elaboration: enriching findings of one with the other; Greene *et al*'s complementarity[451]
- initiation: turning ideas around, suggesting further interpretations/work, searching for the provocative

They later included a fourth, namely development (using one orientation to inform the other)[449], but not Greene *et al's* fifth category of 'expansion' (adding breadth and scope to an evaluation project, e.g. exploring both process and outcome[451].

Misuse of the word 'triangulation', often in attempting to claim rigour[452], can be confusing. It should mean concurrent validation of the same issue from different sources. Tashakkori and Teddlie highlighted Denzin's four basic types of triangulation: data, investigator, theory, and methodological triangulation and that 'true triangulation' was the *"intellectual wedge that eventually broke the methodological hegemony of the monomethod purists"*[438p41]. Morse described simultaneous versus sequential triangulation, contrasting the former (measuring slightly different aspects of a problem using complementary methods) with true triangulation, i.e. measuring the *same* concept with different methods (concurrent validation)[444]. Reviewing a purposive sample of 57 education evaluation studies, Greene *et al* revealed that, indeed, the term 'triangulation' was misused, four-fifths of primary aims and one-half of total aims were complementarity or expansion, and combined data analysis was rare[451].

Qualitative and quantitative approaches can be combined at various levels. For Punch, 'combination' could mean: adding, interweaving, integrating, or linking them in increasing order of complexity - 'them' being methods, data, and/or findings[436]. Creswell described variations on such an 'enquiry strategy' in terms of: *implementing* 'mixing' concurrently, sequentially, and/or transformatively; showing *priority* to qualitative or quantitative or both equally, *integrating* them at data collection, analysis, and/or interpretation, and being explicit or implicit about the *theoretical perspective*[439]. While mixing might involve several separate data collection methods, it might involve a single instrument mixing data collection meaningfully (rather than adding perfunctorily):

- *"For example, in data collection, this 'mixing' might involve combining open-ended questions on a survey with closed-ended questions on the survey. Mixing at the stage of data analysis and interpretation might involve transforming qualitative themes or codes into quantitative numbers and comparing that information with quantitative results in an 'interpretation' study."* **(Creswell, 2003)**[439p212]
- *"Combining approaches can mean simply incorporating open-ended questions in a fixed-choice self-completion questionnaire, or systematically collecting quantitative information (such as age or length of an experience) during interviews or focus groups."* **(Barbour, 1999)**[453p40]

'Horses for courses': Mixing study approaches depending on the question

Education research has generally embraced the 'horses for courses' approach (i.e. research design follows the question asked), health services research has increasingly followed suit[453], and the early 1990s saw calls for nursing research to mix qualitative and quantitative approaches when appropriate[444,454]. The essential eclecticism of medical education research is increasingly acknowledged[433,455], as is the inadequacy of studies *"saying little more than that the students liked the innovation"*[433p1,265].

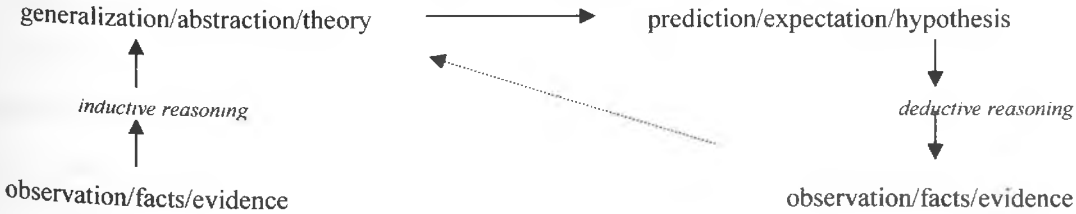
For Tashakkori and Teddlie, the *"dictatorship of the research question (not the paradigm or method)"* governed mixed methods research:

- *"pragmatists consider the research question to be more important than either the method they use or the worldview that is supposed to underlie the method. ...For most researchers committed to the thorough study of a research problem, method is secondary to the research question itself, and the underlying worldview hardly enters the picture, except in the most abstract sense."* **(Tashakkori & Teddlie)**[438p21]

Rigid 'quantitative versus qualitative' positions appear pointless if choice of research approach is questions-driven not methods-driven. Punch considered that the choice should depend mainly on the research question, but also reflect context, current literature, feasibility, potential cost-benefit, and personal expertise/experience[436]. Likewise, Creswell summarized the main considerations to be the research question, researcher's experience, and potential audience[439]. Further debates stymying the research question involve choice of study designs and methods, e.g.:

- *"Experimentalists are critical of surveys because of their reduced ability to control or manipulate important variables, for following events rather than making them happen and for their inability to prove causal relationships. ...It would be more helpful to suggest that choosing the best design or the best method* ***is a matter of appropriateness****. No single approach is always or necessarily superior; it all depends on what we need to find out and on the type of question to which we seek an answer."* **(Oppenheim, 1992)**[456p12]

Tashakkori and Teddlie related pragmatism to the 'scientific method' research cycle of inferences, within which any research, at any stage, falls somewhere and usually completes at least one full cycle, regardless of starting at 'facts' or theories[438]. For pragmatism, the inductive and deductive phases are more apparent and possibly simultaneous, but the main focus remains the research question[438]:



Challenges and objections abound. Buchanan argued that quantitative research dominates social science because of: 'scientific method's' success in understanding the natural world; comforting 'certainties' in 'hard' science; government and funding support; wanting the 'perfect' experiment; concerns about subjectivity; and unfamiliarity with the goals, standards, and assumptions of qualitative research[457]. Buchanan remained unconvinced about mixing qualitative and quantitative approaches, yet wanted qualitative research to predominate any such combination[457].

For Buchanan, the alliance was uneasy because each approach differed in how to make sense of: singular responses; logical inferences; the construction and use of ideal type; and universal themes[457]. For example, quantitative research tends to disregard the outlier automatically, whereas qualitative research highlights the singular response (the exception), because that responder might be more perceptive or articulate, raising an 'important' albeit uncommon issue. Logical inference is problematic when translating qualitative data for quantitative analysis by forcing rather complex answers into inappropriate dichotomous categories, and because responders' opinions do not necessarily relate one-to-one, linearly, with their behaviour. 'Ideal types' are themes emerging in a fragmentary but convincing way across a whole interview, yet defy 'scoring'[457]. Lastly, quantitative research does not help with all-pervasive themes.

A Journal of Medical Education editorial in 1969 highlighted the challenge *"to look critically in our researches at the uniquely human elements in medical education"*[70p280]. Buchanan remarked how quantitative research struggled with human behaviour as humans behaved differently from test-tube chemicals or planets, and yet the physical sciences provided the goals and standards[457].

By 2004, mixed methods research was by no means 'home and dry'. Howe reported his concerns about two allegedly retrograde emerging approaches to educational research, the second of which mixed in some qualitative research[458]:

- *'neoclassical experimentalism'*: focused on even more restrictive designs than the 'classical' approach, on causal relationships to establish 'what works', and on venerating randomization
- *'mixed methods experimentalism'*: still focused on 'cause'/'what works' and randomization but using some qualitative research

He considered the former to denounce qualitative approach and the latter to relegate it to an auxiliary role. Howe promoted 'mixed methods interpretism' as a more progressive, more democratic, alternative, where the 'what works' questions are less technocratic and are value-neutral (not value-free or value-laden)[458].

Medical education research has struggled to develop and meet its challenges since its organized origins in the late 1950s/early 1960s[7] (let alone since the less systematic early 20th century research into medical students' personality and intelligence[343]). Medical education theory and research have detractors who cannot take it seriously[459].

Medical education research: The challenges of being 'evidence-based', of aligning with health services research, of the 'RCT'

A major challenge for medical education research is maintaining credibility[460] within the evidence-based movement when: research questions, designs, and samples are too often inadequate[7,461]; it is neither basic nor clinical science[462]; and underfunding is rife[459,460]. Dauphinee considered medical education research to have lagged well behind medical fields of similar vintage such as clinical epidemiology[461]. Reviewing its progress, McGuire recommended that medical education research: redefines medical education goals against a defensible construct of the competent doctor; highlights theory and evidence for designing relevant curricula; and evaluates cost-effectiveness of alternative reforms[7].

Colliver considered educational theory to be little more than a metaphor (*"not rigorous, tested, confirmed scientific theory"*[248p1,217]). He criticized cognitive science particularly, despite its coherent contribution[27], and PBL, which embodies cognitive science[463] (denouncing Norman and Schmidt's apologies for educational theory being in its infancy[464]). He urged medical educators to admit that *"educational innovations and practice claims are at best conjecture, not evidence-based science"*[248p1,220]. Citing the major reviews of PBL[233,234,235] as little persuasive evidence of educational effectiveness, he neither suggested a constructive alternative nor recognized the dearth of evidence about 'conventional' education. Many detractors see no need to change conventional medial education. As Petersen noted:

- *"...for many... the same professional standards are not so commonly applied. All doctors have been successful medical students, and it seems easy to assume that this alone qualifies them to educate others. Few surgeons would claim that surviving a surgical procedure qualifies a patient to perform it on another."* **(Petersen, 1999)**[465p1,223]

Caveats on the evidence-base fuel the detractors. As Finucane noted, the PBL evidence-base, for example, is plagued by confounding variables; small, very context-specific, single-centre studies; different definitions of PBL in very different contexts (preventing meaningful pooling); and conditions preventing randomized controlled trials[11]. Furthermore, medical education should learn from education research generally[26] and recognize broader types of evidence[466].

Education, especially medical education, appears to have followed the Cochrane Collaboration's lead in 'evidence-based medicine'[1]. The BEME collaboration[434], an international venture coordinated from the University of Dundee and supported by National Health Service (NHS) Scotland and the Association for Medical Education in Europe (AMEE), leads the systematic evaluation of evidence for undergraduate medical education. The dimensions used are 'QUESTS': quality, utility, extent, strength, target, and the setting, viewing education on a continuum between evidence-based and opinion-based (depending on best available evidence)[434].

The relatively poor standard of much medical education research is, however, not just due to the methodological sophistication required. Murray summarized the problems improving medical education research as: complexity of educational interventions, difficulties randomly allocating them, underfunding, difficulties defining suitable outcomes and corresponding measurement tools and, particularly, clinicians' lack of educational research culture[467]. Petersen echoed this, urging medical educationalists to avoid jargon and improve their study designs while waiting for the graduates of innovative curricula to emerge and help change attitudes[465]. Van Der Vleuten *et al* deliberated on marked differences between university staff mindsets about research or professional practice versus education, where, *"...any challenge to one's convictions is an actual challenge to one's professional integrity"*[468p246]. Van Der Vleuten *et al* argued for using evidence over tradition and intuition, illustrating how the latter had led to such non-viable assumptions as: 'teaching is learning', 'the more we teach the more students learn', 'competence consists of distinct competences', and 'the curriculum dictates learning'[468].

Other big challenges are how medical education research should develop[469,470], learn from other fields, and on what it should focus. Links with health care outcomes are particularly contentious. Prystowsky and Bordage's content analysis of medical education research used an *outcomes* research framework borrowed from health care, and concluded that the product cost and quality in medical education were under-researched[2]. Shea disagreed with their aspirations towards health services research examples, however, for four reasons[470]:

- Medical education research has the learner not the patient as the 'primary customer'.
- Showing learners' outcomes affecting patients' outcomes will be almost impossible due to dilution.
- Changes in medical education often occur before any strong study design can be implemented.
- Cost may already be covered more than Prystowsky and Bordage reported, as they studied *one* main focus only per article, and cost analysis may often be a supplementary element instead.

Nevertheless, McGuire bemoaned the *"inexcusable shortage of outcomes research"*[7pS125], wanting educational impact shown in health care currency. Likewise, Albanese *et al* noted how health care and research had relatively clear measures of productivity compared with education, and how the US managed care system undermined innovation, funding, and research for medical education[460]. Institutional backing for medical education research programmes does not come easily[460,471]. Murray considered health services research to provide suitable lessons, as evaluation of complex interventions required mixing qualitative and quantitative approaches[467].

Murray's list of challenges omitted the thorny methodological issue of mixing per se, yet the potential identity crisis from straddling disciplines (and being disowned somewhere between qualitative and quantitative leanings) remains *another* problem.

Opinions differ about directions of influence and transferability of concepts and techniques between medical education and other fields. Harris considered medical education research to follow trends in social science and education research generally, because of the relevant scholars' close ties with educational psychology and the omnipresent 'biomedical' research philosophy of the medical school environment[3]. Wolf *et al* noted how the Cochrane Collaboration's influence brought some concepts full-circle, e.g. the term 'meta-analysis' first emerged in the presidential address at the American *Educational Research* Association in the mid-seventies[1]. Ultimately, 'who influenced whom' is less relevant than making progress with clear guiding frameworks and rationale.

The above challenges highlight potential lessons and pitfalls for 'evidence-based education'[472]. Wolf derived ten possible lessons from evidence-based medicine[473]:

•Synthesizing evidence is usually more *complex and complicated* than anticipated. •It *can* be done in a systematic, organized way, especially internationally. •Resources are necessary at various levels, including updating reviews. •Special registers of primary studies are invaluable. •There are multiple audiences with varying needs. •Generating evidence is easier than translating it into practice. •Secondary or even tertiary databases may be more efficient than primary databases. •Evidence alone will be insufficient and needs combining with educational experience/expertise and learner preference. •Systematic reviews can improve future primary research. •The way in which evidence is communicated influences decision-making.

Referring to the first of these, synthesizing evidence from *outwith* randomized controlled trials (RCTs) remains even more problematic. All other research approaches, whether quantitative and/or qualitative, struggle for acknowledgement, further undermined by the 'qualitative or quantitative' debate. Wolf applied the five steps of evidence-based medicine (ask a relevant answerable question; find the best evidence efficiently, critically appraise it; integrate it with expertise and apply to practice; evaluate performance/outcome) to judge progress in evidence-based medicine[473]. To him, most progress was with critical appraisal (closely followed by finding best evidence), least progress with both integration and evaluation, and little to indicate that evidence-based medical education would develop any differently from evidence-based medicine[473]. Ultimately, whatever research approaches are being synthesized, systematic reviews of medical education research will be a big challenge.

RCTs are a challenge in social research[474]. Critiquing BEME assumptions, Norman agreed that education research cannot be subjected to a universal set of standards, but not because it is a 'soft sister' of clinical research (for which many counterexamples exist). The 'universal approach' is inappropriate for many *clinical* research questions, let alone education research questions[475], based as it is on RCTs (and therefore *"[their] current fundamentalism"*[476p730] and the *"positivist conceptions of argument and investigation... of evidence-based medicine"*[476p732], according to Gillett). Indeed, the 'perfect study' might tell us little of use anyway[26]. From 136 research articles, using at least one observational study design in selected clinical treatment areas, Benson and Hartz found the evidence to be sufficiently robust compared with RCTs[477]. Cohort studies have considerable credibility[478]. While such observational studies allegedly overestimate 'treatment effects', Concato *et al* disproved this for those with contemporary controls[479]. Nevertheless, calls for major development of medical educational epidemiology[480] and replacement of RCTs with single-case experimental designs to counter practical and ethical constraints of RCTs[481] have ignored that this would only address (and only partly) the quantitative-type questions.

Norman argued that BEME's embrace of epistemological differences is appropriate, but incorporating them into a measure of rigour is problematic and presupposes unidimensionality. Norman raised other issues[475]:

- Educational interventions are rarely standard in a way that allows transferability like with drug doses from RCTs.
- Approaches to strength and extent of evidence presuppose one 'world-view', i.e. one convincing study *can* sometimes be sufficient, small p values *do not* necessarily equate to large effect sizes, and many valuable research questions *do not* reduce to effect sizes anyway (which is not simply a quantitative↔qualitative issue).

- BEME might be overpessimistic about the scope for generalizability, as well-established examples exist.

Prideaux also summarized RCT limitations in educational research, namely that everyday education is not conducive to randomization and blinding, controlled interventions, and few appropriate outcome measures[482].

Medical education research: The challenges of mixed methods research

Against the challenges for medical education research generally, further challenges for *mixed methods* research specifically include the time, effort, and expertise needed for extensive data collection of different types and different analytical approaches[439,444], while retaining clear justification and purpose for the 'mixing'. Prideaux highlighted the *"sophistication in thinking and understanding"*[469p502] required to undertake medical education research across various research traditions, especially as its recent tendency to diversify more makes tidy enquiry strategies quite elusive. He reinforced the *"... 'virtue' in embracing 'eclecticism'..."*[469p502], whether each researcher is able to research across the traditions or medical education or various researchers from different backgrounds collaborate on large-scale projects. It is ironic that some researchers might be uncomfortable with mixing assumptions across the main approaches, yet happy to mix methods within qualitative research despite this mixing assumptions between very different traditions[452].

Specific, *labelled*, examples of mixed methods research in undergraduate medical education are uncommon, but include explorations of learning in the operating theatre[214] (complemented by mixed methods evaluation of academic surgeons as educators by residents in the operating room and clinic[483]). Frye *et al* commended a mixed approach to evaluate the complex learning environment of 22 Year 3 medical students rotating through the nine clerkships of Bowman Gray/Wake Forest School of Medicine (North Carolina)[484]. The students had followed a problem-based parallel track. Of note, using direct observations, interviews, short written questionnaires, activity log-card, and examination of clerkship documents, Frye *et al* considered themselves to be mixing *"five qualitative data collection methods"*[484p46]. While the questionnaire comprised open-ended questions (albeit requiring only 5 minutes to complete), many qualitatively-orientated researchers would consign any questionnaire to 'quantitative' oblivion. In Frye *et al*'s study, the questionnaire gave an efficient, easy to use, non-intrusive way of complementing other insights. It would, however, probably have been inadequate in this small sample without the other data: *"No single method captures the 'big picture', either of individual clerkships or of clerkships working together to create a comprehensive curriculum"*[484p59].

The role of the questionnaire for data collection

The questionnaire

The questionnaire is a much misused and much undermined tool (e.g. for understanding how students learn in PBL[466]), but has considerable potential in mixed methods research and medical education research. Bergsjø acknowledged the questionnaire's role in qualitative research, albeit as, *"the most programmatic approach"*[424p560]. Nevertheless, it is often excluded from lists of allegedly bona fide qualitative research data collection methods[426]. Oppenheim warned about responders possibly providing certain sets of responses merely as an expression of social desirability, acquiescence, rigidity, dogmatism, or authoritarianism[456]. Expressing items both positively and negatively only partly addresses such 'response-sets' because these tendencies are mostly independent of content[456]. Nevertheless, Oppenheim gave robust advice on questionnaire design, mindful of such caveats[456]:

- Attitude scales are more about providing broad population groupings rather than insights about an individual:

  "They are techniques for placing people on a continuum in relation to each other, in relative and not in absolute terms." **(Oppenheim, 1992)**[456p187]
- A Likert scale elicits the responder's opinion on statements using a continuum of disagreement-agreement (an adjectival scale), and should avoid excess neutral and extreme items (and 100 responders is generally sufficient).
- Likert scales are quite good at ordering people consistently by their attitudes, are fairly easy to design, express a degree of agreement/disagreement beyond mere dichotomy, and can use subtler content for more sophisticated insights.
- *"...it is dangerous to infer people's attitudes from their behaviour or from their group membership. ...the best available measure of the attitude concerned is the total item pool... By purifying this, the items will at least be consistent and homogenous - they will all be measuring the same thing - and the scale may possibly also be valid."* **(Oppenheim, 1992)**[456p198]

Questionnaire development therefore uses scaling theory.

Scaling theory

Oppenheim noted that: *"...such non-factual topics as awareness, percepts, social representations, brand images, opinions, beliefs, attitudes, values and stereotypes"*[456p150] may well require the multiple question or *scaling* approach. A scale should satisfy certain conditions of the linear-scaling model by being linear, unidimensional, and reliable; having units of measurement (potentially exchangeable but not necessarily equal) with standard fixed points; and, above all, being valid. To be useful, an attitude scale requires good attitude statements that interest and mean something to participants:

- *"An attitude statement is a single sentence that expresses a point of view, a belief, a preference, a judgement, an emotional feeling, a position for or against something."* **(Oppenheim, 1992)**[456p174]

where Oppenheim defines an attitude as a *"state of readiness, a tendency to respond in a certain manner when confronted with certain stimuli"*[456p174].

Summary

The literature review of '**What is mixed methods research, and how does it relate to medical education research?**' reinforced how medical education research taking an 'either quantitative or qualitative' stance is unhelpful. 'Pragmatism' provides a conciliatory paradigm for using the research approach appropriate to the research question and is central to much research in education generally. Medical education research struggles for credibility alongside RCT-driven evidence-based medicine and has an uneasy relationship with health services research.

Personal note on author

I have been a PBL tutor since the first cohort of medical students in the Liverpool problem-based curriculum in 1996. My subsequent empirical research focused mostly on the tutor's role[314,318]*, and I also published literature reviews of PBL, tutoring, and problem-based programme evaluation (all based on my MEd)*[22,25,92,246,485]*. As a product of the traditional Liverpool curriculum, experience of this new approach and the evidence that I explored meant that I became a proponent of PBL as a properly implemented philosophy and process. As a public health doctor using quantitative research, the MEd introduced mixed methods research (rather than 'qualitative only' alternatives), resonating with health services research developments and a personal preference for a 'horses for courses' research approach. Despite my best efforts, such factors will have impinged on my decisions about various aspects of study design and interpretation.*

Rationale for the Methods

In the literature review, inadequately implemented and/or reported studies were worryingly common yet, paradoxically, still gave usable insights about under-researched phenomena (provided that caveats were acknowledged). The evidence-base was cautiously optimistic about medical students' learning in problem-based curricula. While the PBL tutor's expertise and role remain valuable research areas, evidence gaps about students' perspectives on what tutors and students ought to do in PBL sessions are equally compelling. Given related evidence gaps about learning approaches, more longitudinal studies are needed in problem-based settings plus more robust studies to link these with achievement, curriculum satisfaction, career intentions, expectations, and wider views of medicine like population health. Addressing such gaps, the rationale for research methods in this thesis was as follows:

- The Liverpool problem-based transformation from a longstanding traditional undergraduate medical programme involved considerable innovation (and student numbers were to increase by 50% within the decade). Local evidence about how students were learning was a natural corollary.
- Year 1 medical students were mostly on campus, accessible, and could provide a baseline. The students were unlikely to devote much time to the research, and it would be preferable to gain views from whole cohorts. Including applicants interviewed might provide further pre-admission insights.
- At first, the research questions were not fully formed and exploring issues hitherto unexplored in this curriculum, hence the need for qualitative elements. Notions of causality and inference were core to the research questions, inviting quantitative elements. Iterative and longitudinal elements would allow progressive development of questions, and pragmatism gave a valuable steer.
- Questionnaires were preferable to interviews or focus groups, for example, in allowing whole year-cohorts to be studied, relatively efficiently, and without direct contact (to avoid deterring student response). Short well-designed questionnaires would allow combined, meaningful, complementary, longitudinal qualitative-quantitative data collection.
- How students fared in assessments and their curriculum satisfaction appeared to be key outcome measures worth pursuing.

Overall, this rationale followed the Aim, Research Questions, and Objectives **(p18)**.

Chapter 4: Methods

This chapter describes Study-elements 1-6 **(Figure 1)**, which used interlinked self-completion questionnaires **(Appendix 1-6)** to generate qualitative and quantitative data on two cohorts of medical students and one cohort of interview candidates. **Study-elements 1-6 were numbered in chronological order** **(Figure 1)**, giving the:

- Red cohort: S1, S2, and S5
- Blue cohort: S3 and S6
- Green cohort: S4

Levels of analysis

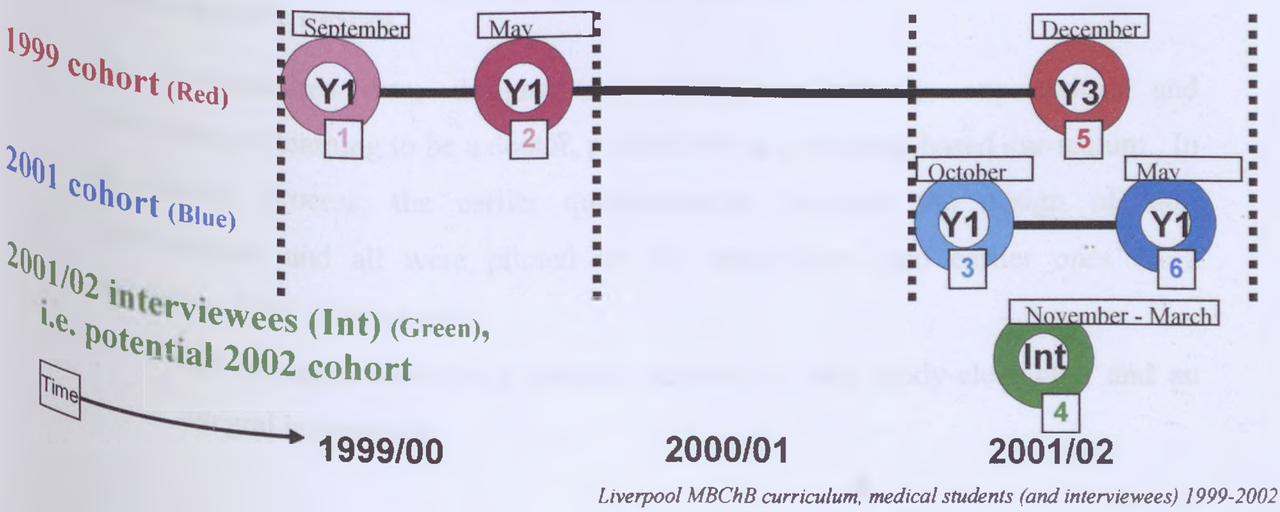
Generally, three levels (L) of analysis guided the layout of the Methods, as appropriate (unless, for example, it made more sense to place certain parts elsewhere): •L1: *individual study-elements*; •L2: *intra-cohort:* links between same items (paired, unpaired, as appropriate); links between different items across study-elements; •L3: *inter-cohort and/or intra-cohort:* multifaceted links between different items.

Therefore, **firstly**, an overview-section previews the six study-elements and highlights shared features. **Subsequent sections** outline each study-element of:

- Red cohort (followed by a section linking them), then
- Blue cohort (followed by a section linking them), and then
- Green cohort

The **final section** outlines methods applied to various study-elements, linking within and between cohorts using multivariate techniques.

Figure 1: Six study-elements (questionnaire surveys), in chronological order, involving three cohorts of medical students/interview candidates



Overview of study design

Study design

The research paradigm was 'pragmatic'[439]. The study used 'mixed methods' research[439] (for data collection instruments and analyses) with a quantitative predominance. From an epidemiological perspective, the design was observational, with descriptive and analytical elements; and, mainly, it combined cross-sectional and longitudinal/cohort design. The main data collection tool was the questionnaire supplemented by record abstraction to check demographic data and collect assessment outcomes. Data were quantitative and qualitative. Measures were between-participants (i.e. independent, separate, unpaired) and within-participants (i.e. related, repeated, paired), and units of analysis were both individual (e.g. mean individual differences in paired data), group (e.g. difference in group means in unpaired data), and even ecological (e.g. using an aggregate 'place' variable, e.g. postcode - here as a proxy for individual socioeconomic class). The main qualitative data analysis was inductive and iterative, confirming themes by re-using them in other study-elements. Individuals were not generally characterized by linking their qualitative responses, partly to avoid possible identification, but a minor example included reporting:

- Year 1 comments on baseline expectations of learning to be a doctor with the same individuals' expectations of learning via PBL (qualitative data)

Examples of integrating qualitative and quantitative data included reporting:

- mid-Year 3 comments on learning for a medical career via PBL versus Likert-scoring of curriculum satisfaction (qualitative illuminating quantitative data)
- difference in mean learning approach subscale scores between responders who were negative about *Population Perspective* when commenting on its utility

Questionnaire design

Six questionnaires were designed to explore, collectively, expectations and experiences of learning to be a doctor, particularly in a problem-based curriculum. In an iterative process, the earlier questionnaires informed the design of later questionnaires and all were piloted on the supervisors (and earlier ones on a secretary). Each questionnaire:

- had a unique identifying number (re-used in later study-elements), and an integral letter about:

- the research, researcher's role, unique identifying number to allow linking with other responses/data, and that participation was voluntary and separate from official curriculum (or admission) administration channels, i.e. whether/how they responded would not affect progress (or admission)

– sought similar demographic characteristics
– used mixed data collection (except for S4, which had no open-ended questions)
– contained the same closed question about career intentions **(Box 6)**

In the later study-elements, recurring closed questions had responders scoring their learning approach, scoring their perceptions of a good PBL tutor, and ranking 'good doctor' characteristics. The latter started as an S1 open-ended question, then became an S2 closed question to confirm the emerging themes, followed by ranking these themes in S4, S5, and S6. Entwistle gave permission to use the 18-item 'short RASI' from within the ASSIST inventory (S3, S4, S5, S6) and supplied the coding key **(Appendix 1)**.

Entwistle's short RASI, the good tutor items, and three items designed as a pragmatic proxy for programme satisfaction (S5 and S6) all used a 5-point Likert-scale (*5=Agree, 4=Agree somewhat, 3=Unsure, 2=Disagree somewhat, 1=Disagree*).

Preliminary scale development for 'good tutor'

The nineteen themes emerging from an open-ended question about perceived characteristics of a good tutor (S2) were used to design a 38 item-set for S3, S5, and S6. Of these nineteen pairs of statements, 18 had one statement phrased negatively, the other positively; the 19th pair, in error, had both negative) **(Appendix 7)**:

– Thirteen pairs each featured a single theme.
– Two pairs each amalgamated two themes, i.e. tutor provides inappropriate input amalgamated with tutor has good insight; and tutor provides feedback amalgamated with tutor has a non-judgemental approach.
– One theme (tutor providing feedback) appeared in two pairs of statements.
– Two extra pairs, not specifically linked to any single theme, covered explicit requirements of the tutoring role, i.e. the tutor encourages active discussion and the tutor ensures that discussion integrates across subjects and themes.
– The 38 items were presented in the same random order.

Box 6: Six study-elements (questionnaire surveys), in chronological order, involving three cohorts of medical students/interviewees: overview of questionnaire content

1999 cohort

2001 cohort

Study-element (S)	S1 career & learning experience	S2 PBL & learning experience	S3 learning approach & PBL (tutors)	S4 learning approach	S5 learning approach & PBL (tutors)	S6 learning approach & PBL (tutors)
A4 page-length:	two	one	two	one	two	two
Basic demography	✓	✓	✓	✓	✓	✓
▪ sex, date of birth, age, student no. ▪ 'home' or non-European Community ▪ ethnic group if 'home'* and entry postcode if United Kingdom ▪ entry status ▪ mother/father occupation	*...not whether home or overseas in S1*		*...plus problem-based learning (PBL) group no. in S3*	*UCAS no. rather than student no.*	*not mother/ father occupation in S5*	*...plus PBL group no. in S6* *not mother/ father occupation in S6*
Closed questions:						
Career intentions	✓	✓	✓	✓	✓	✓
Scored 5-point Likert scale on items about:						
- Would do Medicine... problem-based... here... again? (3 items designed)					✓	✓
- Learning approaches (Entwistle short RASI): 18 items about deep, strategic, surface			✓	✓	✓	✓
- Characteristics of ideal PBL tutor (38 items designed)			✓	38 items → scored in S3&S6, S5	✓	✓
Good doctor characteristics						
Nine S1 themes: - Scored separately on importance - Ranked themes	9 themes emerged → revisited in S2	✓	9 themes → ranked in S4, S5, S6	✓	✓	✓
Open questions:	▪characteristics of good doctor ▪successful Year 1 ▪preregistration house year ▪previous and expected learning experiences	▪factors affecting learning ▪characteristics of PBL and good tutoring ▪(dis)advantage of PBL	▪a critical incident in PBL ▪why Medicine?	**Nil**	▪experience of learning for a medical career via PBL ▪(dis)advantage of PBL ▪how *Population Perspective* fits into future work as doctor	▪PBL does not work so well for me [if I…] [if others…] [if tutor...] ▪ how *Population Perspective* fits into future work as doctor

Two pairs of duplicated questions underlined in lilac and orange *Liverpool MBChB curriculum, medical students and interviewees 1999-2002*

* According to the Office for National Statistics/Office of Population Censuses & Surveys 1991 classification → indicates development of items

UCAS= Universities and Colleges Admission Services

Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Questionnaire administration

The Director of Medical Studies permitted the use of the appropriate class-list (interview-lists for S4) and approved each questionnaire, with its integral covering letter and accompanying rubric assuring confidentiality **(Appendix 8)**. The Director of PBL and the appropriate year directors (admissions subdean for the admissions survey) were also consulted and informed. The University Data Protection Officer was consulted about using address data, etc., from the central electronic records, e.g. from the SPIDER (Student Programmes, Information, Degrees, Examinations and Registration) database.

Administrative-lists provided core information. For all study-elements except S4 (of interviewees), the class-lists provided each student's:

- name
- sex
- whether:
  - a graduate (where a degree counted towards admission criteria)
  - a non-'home' student (i.e. outwith the European Union)
  - a mature non-graduate (≥21 years)
  - retaking year
  - restarting year

For S4, the interview-lists provided each candidate's:

- name
- UCAS number
- date of interview and whether in the morning or afternoon

Questionnaire distribution **(Box 7)** involved internal and external post, and two rounds of reminders (plus an e-mail year-group briefing/reminder to complete the questionnaire), except for S4 (in which interviewees received, completed, and deposited the questionnaire in a special box on interview day).

Box 7: Six study-elements (questionnaire surveys), in chronological order, involving three cohorts of medical students/ interviewees: overview of questionnaire distribution and data-handling

Study-element (S)	S1 career & learning experience	S2 PBL & learning experience	S3 learning approach & PBL (tutors)	S4 learning approach	S5 learning approach & PBL (tutors)	S6 learning approach & (PBL tutors)
	1999 cohort	1999 cohort	2001 cohort		1999 cohort	2001 cohort
Distribution:						
Participants	1999 cohort: students at start-of-Year 1	1999 cohort: students at end-of-Year 1	2001 cohort: students at start -of-Year 1	2001/02 interviewees for 2002 cohort	1999 cohort: students at mid-Year 3	2001 cohort: students at end-of-Year 1
Taken from: class-list	✓	✓	✓	interview-lists	✓	✓
Unique no. linking:		…as from S1			…as from S1	…as from S3
- questionnaire &	✓	✓	✓	✓	✓	✓
- class-list	✓	✓	✓	interview-lists	✓	✓
Integrated letter to: - describe aim - assure confidential & separate from formal channels	✓	✓	✓	✓	✓	✓
Original questionnaires/letters distributed… with addressed-envelope:	23.9.99, via a secretary [in person, at induction, 2 days pre-start]	5.5.00 via pigeonholes	22.10.01 via pigeonholes [W5, S1]	5.11.01-5.4.02 on interview day	11.12.01 to term-time addresses [permanent if unavailable]	14.5.02 via pigeonholes [& posted to home if not collected; last week of S2 contact, 10 days pre-assessment (summ.)]
- internal - stamped*	✓ to deposit in special box on Office desk	✓ to post from halls of residence or via Office in-tray	✓ to post from halls of residence or via Office in-tray	to deposit completed or not in special box	✓ for normal post	✓ post from halls, via Office in-tray, or normal post
Reminder questionnaire/ letters at x weeks (w)… with addressed-envelopes:	✧1.5w via pigeonholes ✧4.5w via pigeonholes	✧3.5w via pigeonholes ✧7.5w to home	✧3.5w via pigeonholes ✧6w via pigeonholes, penultimate week of S1	Nil	✧4.5w via pigeonholes ✧7w to home	✧3.5w: last day S2/ results day; via pigeonholes (posted to home if not collected) ✧12w: mid-summer-break, to home
- internal	✓✓	✓				
- stamped*		✓	✓✓		✓✓	✓✓
Data-handling:						
Open-ended questions - transcription into Word & checked - inductive, iterative analysis (1-3 stages)→coding**	✓	✓	✓	Nil	✓	✓
Double data-entry (Access) for quantitative data & qualitative data-codes then → Excel	✓	✓	✓	✓	✓	✓
Error-check by subtracting spreadsheets & inspecting textual & alphanumeric data	✓	✓	✓	✓	✓	✓
Quantitative data analysed in SPSS	✓	✓	✓	✓	✓	✓
Dates→days since 15th October 1582: - then date minus date & ÷365.25→years	✓	✓	✓	✓	✓	✓

Liverpool MBChB curriculum, medical students and interviewees 1999-2002

Microsoft Access 2000: database and simple statistical analysis; Microsoft Word 2000: wordprocessing; Microsoft Excel 2000: spreadsheet and data 'laundering'; Statistical Package for Social Science for Windows 11.0: statistical analysis and data restructuring PBL=problem-based learning

*Commemorative 'picture' stamps used if possible **Manual coding using coloured pens (S1, S2) or using electronic copy-paste in Word (S3, S5, S6)

Office = MBChB Office W=Week S=Semester summ.=summative home=permanent home address

Questionnaire data entry/handling & analytical methods (Box 7, Box 8, Box 9)

For analysis of each study-element **(Box 7)**, the most identifiable data were held in separate databases that linked to the main data by a unique identifier. The responders' self-reported status (sex, whether entering as school-leaver/graduate…, etc.) was compared with the original class-list information as a broad check that the intended recipient had completed the right questionnaire, according to its unique identifying (study) number. Wherever possible, the Researcher used the responders' study-numbers (unique identifier) and avoided linking these with their names (e.g. using appropriate administrative staff as intermediaries). Subsequent analysis of qualitative data involved deriving and sometimes counting key themes from textual answers (using a coloured pen/paper approach). Subsequent analysis of quantitative data involved generating simple frequencies and crosstabulations, and multivariate study, using Statistical Package for Social Science [for Windows] (SPSS) 11.0.

Open-ended questions

The Researcher transcribed the students' written descriptions into wordprocessed format for:

- S1: Q1-5
- S2: Q1-5
- S5: Q22, Q23a/b, Q62 (but subsequently analysed slightly differently, **p141**)
- S3: Q57, Q59
- S6: Q22-24 (but subsequently analysed slightly differently, **p145**), Q63 **(p145)**

The Researcher checked the transcripts twice against the original (with a secretary checking them once). This meant reading the transcripts several times during their formation, and then re-reading them several times subsequently to analyse inductively and iteratively to synthesize themes (with due consideration of 'exceptions')[436,438,442,443,446,452,453,486].

Analysis of each of the main open questions for S1 and S2, and S3 and S6, involved 1-3 levels of identifying and aggregating concepts. These comprised:

- colour-coding manually all initial concepts in each answer, assigning any one code once only to any one responder **[i]**
- aggregating and recoding the concepts into interim themes **[ii]**

- aggregating these into *overall themes* **[iii]**

There were separate databases for each level of aggregation of codes.

- S1: Q1: written descriptions of 'a good doctor'; Q2: a successful first undergraduate year; and Q5: pre-registration house year **→ 3 levels each [i→ii→iii]** (e.g. **Appendix 12a-12c**). Q4a: baseline perceptions and/or expectations about learning experience at university **→ 2 levels [i→iii]**
- S2: Q1 and Q2: factors helping/hindering learning; Q4: advantage/disadvantage of PBL; and Q5: characteristics of a good PBL tutor **→ 2 levels each [i→iii]**. Q5, the essential characteristics of PBL, **→ 3 levels [i→ii→iii]**
- S3: Q57: a critical incident disrupting their PBL; Q59: why they chose Medicine: **→ 1 level each [→iii]** [Colour-coding used the copy-paste and colour-font functions of Microsoft Word to allocate each answer in the electronic transcript-file to an emerging theme, rather than coding manually with coloured pens.]
- S6: Q63: utility of population perspective learning: **→ 2 levels [i→iii]** [Colour-coding was electronic as for S3.]

S5 open questions used the final coding-frames from other study-elements for related questions (and electronic colour-coding) **(p141)**.

All qualitative data-codes were entered into Microsoft Access databases (in an 'episode-based' structure, for ease of data-entry, i.e. each code creating a new record for the responder) and checked twice against source. The S1 and S2 codes at the initial level were aggregated into the codes of the next two (interim and overall) levels, as appropriate, by setting up 'relationships' with Access recoding databases. Counts were then derived using the Query function of Access, and expressed as appropriate proportions. S5, S3, and S6 qualitative data-codes in Access were exported, after checking against source, to an Excel spreadsheet to detect keyboard errors (by subtraction). They were analysed in SPSS 11.0 (which also allowed S3 and S6 restructured/recoding with the 'Compute' function, as appropriate).

Some data entered into Access database format also needed transforming from an 'episode-based' to a 'student-based' structure to allow further analysis in SPSS 11.0. Examples included: S1 Q4a (university learning); S2 Q3 (PBL essence); S3 Q59 (why medicine); and S5 Q62 and its counterpart S6 Q63 (population perspective). Exporting from Access to SPSS 11.0, then using the 'restructure' function, moved data from a structure where each initial concept produced one record to a structure where each student produced one record with each initial concept as a separate variable. The 'selected cases [records] into variables' option was used, with record-number as the 'identifier variable', to get to this 'one case [record] only per student' structure. This allowed a yes/no variable to be created for each initial concept or interim theme, which was then recoded into the next aggregation level using the 'compute' function. (Access dealt with the more basic analysis of other open-ended responses for simply 'counting' individuals mentioning something under a theme).

The qualitative data-codes were expressed at each level as the number (percentage) of responders mentioning ≥1 concept(s) in that theme. For answers constrained to:

- "Outline **three** things…" (Q2, S1)
- "Outline **three** things…" or "Outline **three** characteristics…" (Q1, Q2, Q5, S2)
- "…provide your **two** main comments…" (Q63, S6)

…the proportion of comments made under the *overall* themes (after recoding/aggregation) was expressed in two ways, i.e. per responder and per mentions:

- $\dfrac{\text{number of responders who mentioned something under this } overall \text{ theme}}{\text{total number of responders to that question}} \times 100\ \%$

For this, each responder contributes only one such mention. The further check was:

- $\dfrac{\text{total number of initial mentions under this } overall \text{ theme}}{\text{total number of initial mentions under all } overall \text{ themes}} \times 100\ \%$

For this, each responder could contribute all the first mentions of *initial* concepts, at the first level of coding, allowing mentions of a concept still to be acknowledged even if it was subsequently recoded into the same overall theme as another such concept.

Demographic & career data and learning/tutoring data

For all study-elements, demographic and career data underwent double data-entry into Microsoft Access databases. Each pair of datasets was imported into an Excel 2000 spreadsheet for similar checks: subtraction of one from the other to check for discrepancies in quantitative data (showing as non-zero values); visual inspection of other data (textual and alphanumeric); some internal crosstabulation; and checking/supplementation with central sources **(Box 8)**. The databases were also checked, as appropriate, against the class-list data[vii] and against similar data from the same responders to other study-elements. Responders' postcodes that were difficult to decipher from the handwriting (often highlighted on double data-entry check) or suspected of being invalid were checked. This used Multimap World-Wide Web (WWW)[487] or the QASPro version 3.01 (QuickAddress Pro for Windows; © QAS Systems Ltd. and The Post Office, 1997) software package to derive the most likely valid postcode. Omissions or remaining discrepancies in the demographic data were listed and supplemented with data retrieved by the Curriculum Administrator from the undergraduate office paper-records or ultimately with SPIDER data.

For the various Likert scale responses (S3, S4, S5, S6), the very small proportion with two options shaded were recorded as expressing the most opinionated of these. If both options cancelled each other out, '3' was recorded. For the very small proportion of responders leaving one or a few blanks in either the 'learning approach' response-set or the 'good PBL tutoring' response-set, blanks were coded as '3' ("*=unsure... or [it] cannot apply to you or your course*").

In S4, S5, and S6, for the closed question ranking the nine 'good doctor' themes from 1 (highest) to 9 (lowest), if the nine ranks did not add to 45 but could be adjusted to do so, *while retaining their relative positions*, this was done **(Box 9)**. In all study-elements, for the very few responders ticking more than one career intention this was coded as 'do not know'.

[vii] In S1, for example, for two responders reporting a different 'sex', the student number given by each was used to obtain the definitive answer: one apparently ticked the wrong box; the original class-list attributed the other student wrongly!

Box 8: Data-entry checks of demographic/career data in the questionnaire surveys of medical students & interviewees (Study-elements (S) 1-6) and of the learning approaches +/- tutoring data (S3, S4, S5, S6)

- Double-data entry → pair of Microsoft Access databases → pair of Excel 2000 spreadsheets → checked for discrepancies:
  - in quantitative data: by subtracting one from the other
  - in other (textual and alphanumeric) data: by visual inspection
  - as appropriate, against the class-list data (and against similar data from the same responders in the other study-elements (S1, S2, & S5, or S3 & S6) or against interviewee-list (S4) and 2002 entry class-list
  - in postcodes, for S1, S2, & S5, by rechecking against the electronic file of addresses/postcodes provided (from the university's SPIDER *(Student Programmes, Information, Degrees, Examinations and Registration)* database) to post the S5 questionnaires
  - in postcodes, date of birth, entry status for all study-elements by checking occasional individual details against SPIDER, e.g. if age wrong for being a graduate/mature/retaking A-levels/school-leaver, etc.
- Listed omissions or remaining discrepancies in demographic data → supplemented with data retrieved by Curriculum Administrator (S1, S2, S3, S5, S6) or Admissions Office (S4), from undergraduate/admissions office paper-records, and occasionally from the SPIDER electronic records

Liverpool MBChB curriculum, medical students and interviewees 1999-2002

Box 9: Data-handling of ranking the nine 'good doctor' themes in the questionnaire surveys of medical students & interviewees (Study-elements (S) 4, 5, 6) and of the learning approaches +/- tutoring data (S3, S4, S5, S6)*

"In Q... please rank the [good doctor] descriptions (derived from 1st Year's answers in 1999/00) using each number 1 to 9, as 1 most important to 9 least important, so the ranks add to 45"

- If ranks did not add to 45 → adjusted to do so if possible while retaining relative positions, e.g.:

– all nine boxes ='1' or '9',	all → '5'	=45
– used only eight of the nine ranks	blank box → missing number inserted	
– used same ranks more than once	e.g. 111111334 → 444444669	=45
	or 112224555 → 223335999	=45

- Final recheck → search for responders where these nine variables did not add to 45

Both sets of items (learning approaches and tutoring) with 5-point Likert responses*:
(5=Agree, 4=Agree somewhat, 3=Unsure, 2=Disagree somewhat, 1=Disagree)

- For the few responders not completing those items straightforwardly:

– chose 2 of 5 options*	→ recorded the most opinionated of these
– chose 2 of 5 options; these cancelled each other out*	→ recorded '3'
– one or a few blank items in either set	→ 'recorded 3'

*...and for the three satisfaction items (S5, S6) *Liverpool MBChB curriculum, medical students and interviewees 1999-2002*

For all study-elements, when data-checking and amendment were complete, the Access databases were exported to SPSS 11.0 to allow tabulation and crosstabulation of frequencies for each categorical variable, and calculate summary measures such as the mean and median for continuous data. Dates were converted into days, from 15th October 1582, deriving age in years by dividing time periods by 365.25.

For S5; S3, S6; S4: after viewing the item frequency distributions, the Likert scale responses were generally treated as continuous data. 'Agree/agree somewhat' were sometimes combined, however, and analysed as categorical data, e.g. satisfaction with the Liverpool curriculum. For learning approaches (Q1-18), each responder's subscale scores out of 30 and the percentage of the total points allocated out of 90 (to deep, strategic, and surface subscales) were calculated. Each responder's most and least evident subscales were identified. If two or all three subscale scores tied for the highest/lowest position, predominance was attributed to deep over strategic over surface (surface>strategic>deep for the least evident). Identifying the least evident subscale attempted to adjust for responders minimizing surface learning scoring as undesirable, yet still not relegating it to last place.

Pearson correlation coefficient with significance testing (and Spearman rank coefficient to check, when Likert data were treated as continuous) was calculated for:

- satisfaction scores versus each of the learning approach subscale scores, and versus the percentage of the total points allocated out of 90 (to these deep, strategic, and surface subscales), treated as a continuous variable (S5; S6)
- individual good PBL tutor item scores (for the 10/38 items with most face validity for the Liverpool PBL tutor role – two with which responders *should* agree and eight with which they *should* disagree) versus the learning approach subscale scores (S5; S3, S6)

For the repeated 'good doctor characteristics' ranking question (S5, Q64; S6, Q65; S4, Q20), responders' mean scores on each of the nine themes (therein assuming continuous data and Normality for that action) were used to assign an overall rank to each theme (checked by summing the individual ranks for each theme). The proportion of responders ranking each of the themes highest (excluding those using tied ranks, i.e. *not* allocating each number 1-9) was calculated. Spearman rank correlation coefficient (with significance testing) and Analysis of Variance (ANOVA) were calculated for:

- ranking of good doctor characteristics versus each of the learning approach subscale scores (S5, S6, S4)

  (e.g. ANOVA of mean deep score across the nine groups ranking *"well-balanced..."* 1st, 2nd, 3rd, etc. for a good doctor)

- ranking of good doctor characteristics versus satisfaction score for Liverpool problem-based curriculum (S5, S6)

  (e.g. ANOVA of mean on *"...I would still do Medicine in this Liverpool problem-based curriculum"* score across nine groups ranking *"well-balanced..."* 1st, 2nd, 3rd, etc. for a good doctor)

For S5; S3, S6; S4: The predominant category (and the least evident category) of the three learning approaches was crosstabulated against responders' career intentions, collapsing categories to increase cell numbers reported. Furthermore, a t-test was undertaken between the mean scores on any of the three learning approaches subscales versus dichotomous career intention subgroups.

For categorical data, hypothesis testing of the following crosstabulations used:

- *'2 x k':* Pearson Chi-square
- *'2 x 2' containing a cell with an expected frequency of <5:* Fisher's exact test
- *all other '2 x 2':* Yates-corrected Chi-square

Methods 1: 1999 cohort S1, start-of-Year 1

Questionnaire design & administration (Figure 1 p123; Box 6, p126; Box 7, p128)

The S1 participants were on the class-list as Year 1 entrants to the MBChB curriculum in September 1999. A 2-page questionnaire was designed **(Appendix 1; Overview, p124** refers to the covering-letter) to collect basic demographic details and career intentions and to explore students' conceptual baseline about 'learning to be a doctor' **(Box 6, p126)**:

- Demographic details comprised: student number; sex; date of birth; age; ethnic group of 'home' students only (according to the Office for National Statistics (ONS)/Office of Population Censuses & Surveys (OPCS) 1991 classification); whether entering as school-leaver/graduate, etc.; socioeconomic proxy measures: parental occupation and permanent residential postcode (UK students only); date received.
- Open-ended questions (Q1-5) explored their perceptions and/or expectations about: 'a good doctor'; a successful first undergraduate year; their learning experience at school (and likely differences expected now); and pre-registration house year.
- A closed question (Q6) sought their career intentions.

Questionnaire distribution was as described previously **(Box 7, p128)**.

Questionnaire data entry & analysis

Open-ended questions: Learning and medicine

Data from Q1, Q2, Q5, and Q4a were analysed inductively as in **Overview, p129**.

Q4b and Q4c (baseline perceptions and/or expectations about learning to be a doctor and learning using PBL) were explored only for illustrative quotations.

To accommodate students' diverse approaches to answering Q3 about experience of learning at school, the main categories were sought. Within any of the seven categories identified, comments were then coded as disclosing a potentially negative (1), positive (3), or neutral/indeterminate (2) impact on learning in this curriculum.

Data handling for Q1, Q2, Q5 and Q4a was outlined in **Overview, p129**.

The preliminary results were presented to and discussed with supervisor-colleagues (JGB/EMIW), adjusted accordingly, and presented formally elsewhere[viii,ix].

Demographic & career data

Data handling for demographic and career data was outlined in **Overview, p132**.

[viii] Q1, Q2, and Q5 were presented as a peer-reviewed abstract at a conference:
Maudsley G, Williams EMI, Bligh JG. *Towards what image of doctoring might new medical students be focusing their learning? Reflections and revelations about 'a good doctor', 'success', and 'house year' from the entrants to a problem-based curriculum.* **Parallel session presentation** at: *"Association for the Study of Medical Education (ASME) Annual Scientific Meeting (Tomorrow's Teachers)"* - 2½ days, 13.9.00-15.9.00, City Hall, Cardiff.

[ix] Q4 was presented as a peer-reviewed abstract at a conference (with Q3 and others, as appropriate, for background):
Maudsley G. *What learning experiences do medical students bring and develop early in a problem-based curriculum?* **Parallel session presentation** at: *"Implementing problem-based learning in higher education"* – 2-day conference, 16.1.01-17.1.01, UMIST/University of Manchester (North West Universities Association).

Methods 2: 1999 cohort S2, end-of-Year 1

Questionnaire design & administration (Figure 1, p123; Box 6, p126; Box 7, p128)

A 1-page self-completion questionnaire was designed **(Appendix 2; Overview, p124** refers to the covering-letter**)** to study the 1999 cohort, for the second time, at the end of Year 1. This (re)collected the same demographic details plus:

- home (European Community (EC)) versus 'overseas' status explicitly
- 'A-level/Highers' resit year(s)

Besides reseeking career intentions, the questionnaire also explored students' ideas about their learning during the year, specifically about PBL **(Box 6, p126)**:

- Open-ended questions explored students' perceptions about factors helping and hindering their learning during the year (Q1-2) and re-used questions (Q3-5) from the Researcher's 1997 interview-study of PBL tutors[318] to explore the essential features of PBL, its main advantage and disadvantage, and characteristics of a good PBL tutor.
- Closed question (Q6) asked responders to score (1 disagree to 4 agree) the importance of each of the nine aspects of a good doctor derived from S1, and the extent to which their curriculum promoted each; and sought their career intentions (Q7) as previously.

Questionnaire distribution was as described previously **(Box 7, p128)**. The first reminders coincided with the end of the summative assessments and the Final reminders were posted during the summer break (using pre-printed address labels provided by the MBChB Office). The Post Office returned some questionnaires and some students had their permanent address showing as a hall of residence (but were not known to be a hall tutor, and were very likely to have left that address now). The MBChB Office checked the SPIDER and paper-records for alternative addresses for these questionnaires to be resent.

Questionnaire data entry & analysis

Open-ended questions: Learning and tutoring in a problem-based curriculum

Data from Q1-5 were analysed inductively and handled as in **Overview, p129**.

For closed Q6, to 'validate' the nine 'good doctor' themes generated from S1, responders' mean scores, on the importance of each theme and the extent to which the curriculum promoted it, were calculated and used to rank those themes. For each theme, the mean of the individual differences between the scores ('important' minus 'promoted') was also calculated, with a 95% confidence interval (a negative value indicating that the theme's prominence in the curriculum outweighed its perceived importance).

The preliminary results were presented to and discussed with supervisor-colleagues ([JGB]/EMIW/DCMT), adjusted accordingly, and presented formally elsewhere[x].

Demographic & career data, and scored 'good doctor' data

Data handling for demographic and career data was outlined in **Overview, p132**.

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[x] Q3 (with Q1 and Q2, as appropriate, for background) and Q5 (with Q4 for background) were presented as a peer-reviewed abstracts at two conferences, respectively:

Maudsley G, Williams EMI. *What do medical students see as the main characteristics of problem-based learning after a year's experience?* **Parallel session presentation** at: *"Association for the Study of Medical Education (ASME) Annual Scientific Meeting (Medical education in a multicultural world)"* - 2½ days, 11.7.01-13.7.01, Dublin.

Maudsley G. *How do medical students characterize good problem-based learning (PBL) tutoring after a year's experience.* **Parallel session presentation** at: *"Association Medical Education in Europe (AMEE) Annual Scientific Meeting (Medical Education and Standards at a Time of Change)"* - 2½ days, 3.9.01-5.9.01, Berlin.

Methods 5: 1999 cohort S5, mid-Year 3

Questionnaire design & administration (Figure 1 p123; Box 6, p126; Box 7, p128)

The 1999/00 Year 1 class-list was used to ascertain from the MBChB Office which students remained with the main cohort by the time of the Year 3 survey. A 2-page self-completion questionnaire was designed **(Appendix 5; Overview, p124** refers to the covering-letter). This (re)collected the same demographic details as S2, but omitted parental occupation.

Besides reseeking career intentions, the questionnaire also explored students' learning approaches, including related perceptions of the PBL tutor's role, the good doctor's characteristics, and of wider population health issues:

- Open-ended questions (Q22, Q23, Q62) explored students' perceptions about the PBL experience so far, its main advantage and disadvantage (repeated from S2), and the vocational utility of learning about population health issues.
- Closed questions incorporated Entwistle's 18-item short RASI for learning approaches (Q1-18), and 38 new items about the ideal PBL tutor (Q24-61), derived from S2.
- Other closed questions focused on responders' satisfaction with learning medicine, in this way, here (Q19-21); their ranking of the nine good doctor themes (Q64) (*"using each number 1 to 9, as 1 most important to 9 least important, so the ranks add to 45"*), and their career intentions again (Q63).

Questionnaire distribution was as described previously **(Box 7, p128)**. The questionnaires were posted in December 2001, 2½ weeks after students completed Level 2 summative assessment (about a week after they received their results). The Researcher checked all the term-time addresses provided electronically by the MBChB Office from the SPIDER database with local contact-details on cover-sheets submitted recently by the students with their 'Critical Thinking Module' abstracts, supplementing or amending the original list. The first and second reminder questionnaires were posted after the Christmas break. If the Post Office returned questionnaires or if the permanent address still showed as a hall of residence (when the student was not known to be a hall tutor) or was overseas, the MBChB Office checked the SPIDER and paper-records for alternative addresses for use to resend questionnaires. The Researcher e-mailed the student e-mail year-list to inform and remind them about the study, including a plea that if students had never received the questionnaire their central address records were probably out-of-date. Eight students e-mailed a valid address and requested that the questionnaire be sent there.

Questionnaire data entry & analysis

Open-ended questions: The experience of PBL and learning about Population Perspective

Qualitative data from Q23a/b (PBL advantage/disadvantage) and Q62 (utility of learning about a population perspective) were coded directly to the overall themes generated in S2 (same 1999 cohort, end-of-Year 1, **p139**) and S6 (2001 cohort, end-of-Year 1, **p146**), respectively, only generating a new theme if appropriate.

The qualitative data from Q22 (experience of learning via PBL) were analysed to provide illustrative comments for each of the five response-groups to Q21 about satisfaction with the Liverpool problem-based curriculum (Likert scale 1-5, disagree to agree: "*would still do Medicine in this problem-based curriculum*"). Quotations were identified from responders sharing similar perceptions of their experiences where these referred to common issues such as: the PBL tutor, basic science learning, motivation, and criticism from hospital consultants, etc. A count was made of responders whose comments were uniformly negative to Q22.

The preliminary results were presented to and discussed with supervisor-colleagues (EMIW/DCMT) and adjusted accordingly, and the learning/tutoring data were presented formally elsewhere[xi].

Demographic & career, learning/tutoring data

Overview (p132) described the data-handling relevant to this study-element and shared with other study-elements. These comprised data-handling for:

- Access databases after checking/amendment

[xi] The relationship between learning approaches, perceptions of a good tutor, ranking of the characteristics of a good doctor, and satisfaction with the curriculum were presented as a peer-reviewed conference abstract from S5:
Maudsley G, Williams EMI, Taylor DCM. *A question of style: How does medical students' satisfaction with a problem-based curriculum relate to their learning styles and notions of ideal tutors and good doctors?* **Parallel session presentation** at the "*The 10th Ottawa Conference on Medical Education, Ottawa Conference on Medical Education*" - 4 days, 13.7.02-16.7.02, Ottawa Congress Centre, Ottawa, Canada.

- demographic and career data
- learning approaches/tutoring data
- closed Q64, ranking the nine 'good doctor' themes from 1 (highest) to 9 (lowest) **(p129, p135)**

Principal components analysis of tutoring data and learning data (described elsewhere)

Described elsewhere **(p152, p153)**.

Methods 1, 2 & 5 linked: 1999 cohort S1, S2, S5; start-of-Year 1, end-of-Year 1, mid-Year 3

Data preparation & basic analysis

Using a multistaged approach, the main S1, S2, S5 SPSS databases were merged on the unique identifier (study/record number), resulting in one combined record for each participant who had *ever* responded in any of the three studies and blank records for never-responders. Three new variables were created to record whether or not the participants had responded at each of the three time-points, allowing the proportions of those responding to various combinations of the time-points to be derived. For each of the fixed demographic variables a new merged variable was created for use at any of the time-points. For each study-element, the sex of responders (and whether graduate or not) versus non-responders was compared.

The career intentions data were crosstabulated to show what proportions of those intending to be a GP were in each of the six categories (GP, hospital doctor (consultant), community doctor (consultant), public health doctor, other, do not know) by the subsequent time-point(s). This was repeated for those reporting their intention to be a hospital consultant and those reporting that they did not know. The proportion reporting unchanged intentions was noted, checking for any inclination towards or away from particular categories.

Multiple regression analysis of assessment outcomes

Described elsewhere **(p154)**.

Methods 3: 2001 Cohort S3, start-of-Year 1

Questionnaire design & administration (Figure 1 p123; Box 6, p126; Box 7, p128)

S3 surveyed Year 1 entrants to the MBChB curriculum, in September 2001, according to the Year 1 class-list (which contained the same details as for S1). The 2-page self-completion questionnaire that was designed **(Appendix 3; Overview p124** refers to the covering-letter) formed the precursor for the questionnaire in S5 (of the Red cohort), therefore containing the same two sets of items exploring students' learning approaches (Q1-18) and related perceptions of the PBL tutor's role (Q19-56). The questionnaire also collected similar demographic details and career intentions, as for the 1999 cohort of Year 1 students (plus PBL group number):

- Open-ended questions (Q57 and Q59) explored their experience of critical incidents in unproductive PBL sessions and why they chose Medicine, respectively.

Questionnaire distribution was as described previously **(Box 7, p128)**.

Questionnaire data entry & analysis

Open-ended question: Critical incidents in problem-based learning, and choosing Medicine

Data from Q57 and Q59 were analysed inductively and handled as in **Overview, p129**.

The preliminary results were presented to and discussed with supervisor-colleagues (EMIW/DCMT) and adjusted accordingly.

Demographic, career & learning/tutoring data

Overview (p132) described the data-handling relevant to this study-element and shared by other study-elements. These comprise data-handling for:

- demographic and career data
- learning approaches/tutoring data

Principal components analysis of tutoring data and learning data (described elsewhere)

Described elsewhere **(p152, p153)**.

Methods 6: 2001 Cohort S6, end-of-Year 1

Questionnaire design & administration (Figure 1 p123; Box 6, p126; Box 7, p128)

S6 focused on the 2001 cohort at the end of Year 1, in May 2002. This used a 2-page self-completion questionnaire designed **(Appendix 6; Overview, p124** refers to the covering-letter) to repeat the two core sets of items from the questionnaire received by the same cohort in S3 (and by the Red cohort, in S5, mid-Year 3). The questionnaire therefore explored students' learning approaches (Q1-18) and their associated perceptions of the PBL tutor's role (Q25-62). The remaining closed questions collected similar demographic details (plus PBL group number), career intentions as for the 1999 cohort of Year 1 students, satisfaction with learning medicine (in a problem-based curriculum; in Liverpool) (Q19-21), and the ranking of the nine good doctor themes (repeated from S5):

- Open-ended questions (Q22, Q23, Q24) explored students' perceptions about how their own, other students', and tutors' contributions made PBL sessions effective, and the vocational utility of learning about population health issues (i.e. repeated from S5, Q63).

Questionnaire distribution was as described previously **(Box 7, p128)**. The second reminder questionnaires and/or the original questionnaire, and first reminder remaining in students' pigeonholes a week after the end of the semester, were retrieved and posted to students' permanent (or alternative) addresses (provided by MBChB Office from the SPIDER system or paper-records). For that last round, for several non-responders whose recorded addresses were overseas or invalid, mailings were retained and issued to them as they arrived back at Faculty Office for Year 2. The few non-responders whose studies were terminated at September Progress Committee received no further mailing.

Questionnaire data entry & analysis

Open-ended question: Effective contributions in problem-based learning, and learning about Population Perspective

Data from Q22-Q23 (ineffective contributions in PBL: own and other students) were coded directly to the overall themes generated in S3 (same 2001 cohort, start-of-Year 1, **p144**) for critical incidents. Data from Q24 (ineffective contributions in PBL: tutor) were coded directly to the overall themes generated in S2 (from the 1999 cohort, end-of-Year 1, **p139**) for characteristics of a good tutor. New themes were only added to these coding-frames, if appropriate. Data from Q63 (utility of learning about a population perspective) were analysed inductively and handled as in **Overview, p129**, and provided the coding-frame for the same question (Q62) in S5 **(p141)**. The preliminary results were presented to and discussed with supervisor-colleagues (DCMT/EMIW), adjusted accordingly, and presented formally elsewhere[xii,xiii].

Demographic, career & learning/tutoring data

Overview (p132) described the data-handling relevant to this study-element and shared by other study-elements. These comprised data-handling for:

- demographic and career data
- learning approaches/tutoring data
- closed Q65, ranking the nine 'good doctor' themes from 1 (highest) to 9 lowest **(p129, p135)**

Spearman rank correlation coefficient (with significance testing) and ANOVA were calculated for:

- ranking of good doctor characteristics versus each of the learning approach subscale scores

  (e.g. ANOVA of mean deep score across the nine groups ranking *"well-balanced..."* 1st, 2nd, 3rd, etc. for a good doctor)

[xii] Perceptions of population perspective learning from both the 1999 (Q62) and 2001 (Q63) cohorts, and their relationship with learning approaches, were presented as a peer-reviewed conference abstract from S5 and S6:

Maudsley G, Williams EMI, Taylor DCM. *Public health literacy and social responsibility of tomorrow's doctors: How does a population perspective on health (in a problem-based curriculum) fit into medical students' career view?* **Parallel session presentation** at *"The 11th Ottawa Conference on Medical Education, Ottawa Conference on Medical Education"* - 2 days, 6.7.04-7.7.04, Catalonia Palace of Congresses, Barcelona, Spain.

[xiii] Perceived factors (from self, other students, PBL tutor; Q22-24) influencing the effectiveness of PBL were presented as a peer-reviewed conference abstract from S5 (referring to perceived: critical incidents, S3; characteristics of good tutors: S2):

Maudsley G. *"PBL sessions do not work for me so well if..." How do medical students' perceptions of difficulties in problem-based learning relate to notions of ideal tutoring and critical incidents?* **Parallel session presentation** at the *"Association for Medical Education in Europe (AMEE) Annual Conference"* - 3 days, 6.9.04-8.9.04, Edinburgh International Conference Centre, Edinburgh, Scotland.

- ranking of good doctor characteristics versus satisfaction score for Liverpool problem-based curriculum

  (e.g. ANOVA of mean on *"...I would still do Medicine in this Liverpool problem-based curriculum"* score across nine groups ranking *"well-balanced..."* 1st, 2nd, 3rd, etc. for a good doctor)

Pearson (and Spearman rank as a check) correlation coefficient, with significance testing, was calculated for:

- individual good PBL tutor item scores (for ten of the 38 items with most face validity in describing the Liverpool PBL tutor role – two with which to agree and eight with which to disagree) versus the learning approach subscale scores
- satisfaction scores versus each of the learning approach subscale scores, and versus the percentage of the total points allocated out of 90 (to these deep, strategic, and surface subscales), which was treated as a continuous variable

Principal components analysis of tutoring data and learning data (described elsewhere)

Described elsewhere **(p152, p153)**.

Methods 3 & 6 linked 2001 Cohort S3, S6; start-of-Year 1, end-of-Year 1

Data preparation & basic analysis

Using a multistaged approach similar to that for the 1999 Red cohort, the main SPSS databases for each of the two time-points were merged on the unique identifier (record number). This produced one combined record for each participant who had responded to *either* of the two studies and blank records for *never*-responders. Two new variables recorded whether or not the participants had responded at either of the time-points, allowing the proportions of those responding to *either* or *both* to be derived. For each of the fixed demographic variables a new merged variable was created for use at either time-point.

As for the 1999 Red cohort, the career intentions data were crosstabulated to show what proportions of those intending to be a GP initially (start-of-Year 1) were in each of the six categories (GP, hospital doctor (consultant), community doctor (consultant), public health doctor, other, do not know) by the subsequent time-point (end-of-Year 1). This was repeated for those reporting their intention to be a hospital consultant and those reporting that they did not know. The proportion reporting unchanged intentions was noted, checking for any tendency towards or away from specific categories.

Principal component analysis of learning data (described elsewhere)

Described elsewhere **(p153)**.

Multiple regression analysis of assessment outcomes (described elsewhere)

Described elsewhere **(p154)**.

Methods 4 (interviewees for 2002 Cohort S4)

Questionnaire design & administration (Figure 1 p123; Box 6, p126; Box 7, p128)

The Director of Medical Studies and the Admissions Subdean approved a cross-sectional survey of candidates interviewed on campus between November 2001 and March 2002 for an MBChB place. The 1-page self-completion questionnaire **(Appendix 4; Overview, p124** refers to the covering-letter) was adapted from the questionnaire for the 2002 cohort of Year 1 entrants (S3). The questionnaire collected similar demographic details and career intentions, and mostly comprised Entwistle's 18-item short RASI for learning approaches (Q1-18). The last item involved ranking the nine good doctor themes (as for S5 and S6).

The Admissions Officer or Admissions Assistant inserted the UCAS number and date of interview (and whether morning or afternoon) before handing the questionnaires to the candidates for completion with other pre-interview documentation. These admissions staff emphasized to candidates key-points from the covering-letter. These were that the questionnaire was for research purposes only, that its completion was voluntary and irrelevant to decisions about admissions, and that, whether or not candidates completed the questionnaire, they should place it in the special research-box in the waiting-room. When interviewing for MBChB admissions (as part of normal everyday-work), the Researcher reminded candidates, before they entered the interview-room, that the questionnaire that he/she may or may not have just completed had no bearing on his/her interview or the subsequent decision-making.

At least weekly, the Researcher collected batches of the questionnaires from the research-box, assigned each questionnaire a unique study-number, transcribed its UCAS number to a paper list of study numbers, and then added the candidate-name, from the official interview-lists (morning or afternoon) using the UCAS number. Where the UCAS number differed between the questionnaires and the operational lists, the Admissions Officer or Admissions Assistant checked this on the SPIDER system and provided the correct UCAS number/name combination. The Admissions Office kept the Researcher's paper list securely. The sampling-frame excluded those applicants not invited, declining, or not arriving for interview (and about 30 candidates interviewed by the Admissions Subdean in Malaysia in January 2002 and in otherwise exceptional circumstances on campus (at least 6 candidates between about April and August of 2002).

Questionnaire data entry & analysis

Demographic, career & learning/tutoring data

Overview (p132) described the data-handling relevant to this study-element and shared by other study-elements. These comprised data-handling for:

- demographic and career data
- learning approaches data
- closed Q20, ranking the nine 'good doctor' themes from 1 (highest) to 9 (lowest) **(p129, p135)**

Principal components analysis of learning data (described elsewhere)

Described elsewhere **(p153)**.

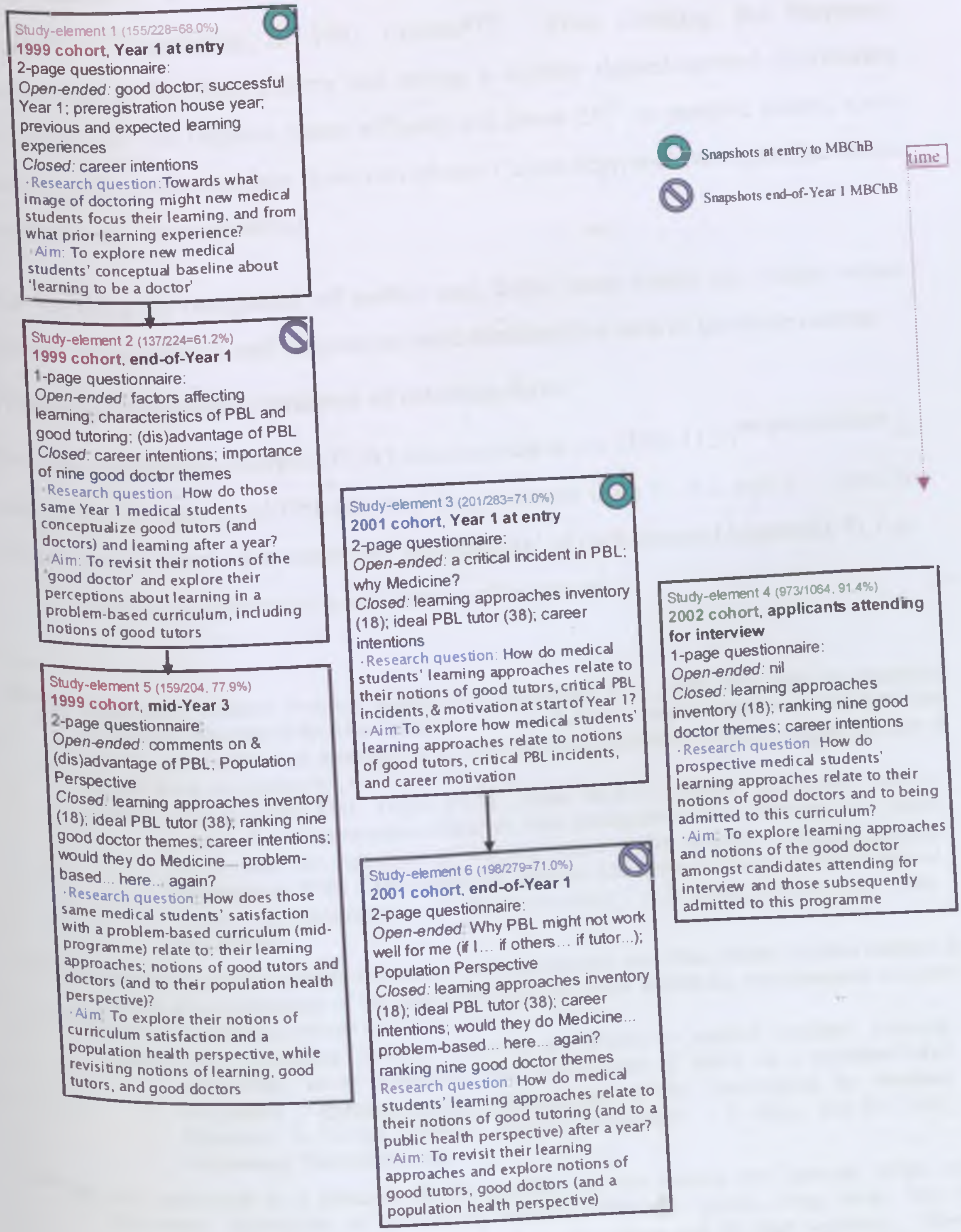
Multiple regression analysis of admission outcomes (described elsewhere)

Described elsewhere **(p154)**.

Methods 1-6 linked: 1999 Cohort S1, S2, S5; 2001 Cohort S3, S6; interviewees for 2002 Cohort S4 (including multivariate techniques)

Links were made between data within and between the three cohorts (Study-elements 1-6). To recap, some items appeared in more than one questionnaire (**Figure 2**):

Figure 2: Six questionnaire surveys (Study-elements 1-6) of three cohorts of medical students (and potential medical students) about learning to be a doctor



Some of the links between learning, tutoring, career, and satisfaction data were explored in formal presentations elsewhere[xiv,xv].

Postcode and occupation analysis

After postcode checking **(p132)**, responding 'home' residents of England and Wales were allocated a measure of ward-level material deprivation (Townsend score)[488,489,490] according to 1991 Census[xvi]. After checking the frequency distributions in the three cohorts and noting a slightly righted-skewed distribution with about 3/5th on negative (more affluent) and about 2/5th on positive scores, some analyses split responders into these two groups ('most deprived' two quintiles versus 'most affluent' three quintiles).

The variables on occupation of mother and father were coded for 'either versus neither' being medical, and frequencies were tabulated for each of the three cohorts.

Principal components analysis of tutoring data

Principal components analysis (PCA) was undertaken (in SPSS 11.0)[491,492,493,494,495] to analyse the 38-item 'good PBL tutoring' response-sets from S3, S6, and S5. Specific indicators were checked to assess the 'factorability' of each dataset **(Appendix 9)**, e.g:

- *correlation matrix:* for correlation coefficients ≥0.3

[xiv] The relationship between learning approaches, perceptions of a good tutor and of population perspective, ranking of the characteristics of a good doctor, career intentions, and satisfaction with the curriculum was presented as a peer-reviewed conference abstract relating S5 data to similar items, as appropriate, in S3 and S6:

Maudsley G, Williams EMI, Taylor DCM. *How medical students' satisfaction with a problem-based curriculum relates to their perceptions about learning and future career (and the relevance of learning about wider issues)?* **Parallel session presentation** at the *"Association for Medical Education in Europe (AMEE) Annual Conference (Relevance in medical education)"* - 3 days, 1.9.03-3.9.03, Bern, Switzerland.

[xv] The relationship between learning approaches and expectations *over time*, related to other changes in outlook, e.g. expectations of the good PBL tutor and career intentions, was presented as a peer-reviewed conference abstract (S5; S3 & S6):

Maudsley G. *Changing outlooks: Patterns and trends in medical students' learning approaches, career intentions, and expectations of tutors in a problem-based curriculum.* **Parallel session presentation** at the "Association for Medical Education in Europe (AMEE) Annual Conference" - 3 days, 30.8.05-2.9.05, Amsterdam, The Netherlands.

[xvi] This was undertaken by a colleague (CRW) familiar with the process, the 'look-up' tables, and Manchester Information & Associated Services (MIMAS) system, using three files of responders' postcodes only (i.e. stripped of record-numbers and all other variables). Where ward was unobtainable, enumeration district (then postal district) was used to allocate a score.

- *anti-image matrix:* for Kaiser-Meyer-Olkin (KMO) values of >0.5 for each variable on the diagonal of the upper section, and small negative partial correlations (off-diagonal) in the lower section
- *KMO Measure of Sampling Adequacy (mean of KMOs for variables)*, allowing ≥0.6 as acceptable, and
- *Bartlett's Test of Sphericity (if <5 participants per variable)* for $0.00001<p<0.05$.

Varimax orthogonal rotation (maximizing high correlations, minimizing low correlations) was chosen to extract components, after checking that there was no substantial overlap between components (i.e. no correlations ≥0.32 on oblique rotation). For each dataset, the scree-plot was studied to estimate the number of components to retain (generally the component preceding the point of inflection of the line). Analyses were performed that retained one fewer to several more (mostly about 4-8) components, allowing exploration of changes in the parameters of the resulting solutions. The number retained was determined by theory, statistical judgement, pragmatism, and ultimately what 'made sense' (interpretability) to explain the highest % of variance for the smallest number of components **(Appendix 9)**. Naming components took account of the highest post-rotation loadings (the correlations between each variable and each component), using a general cut-off loading of 0.40 and cross-checking between the model for each study-element **(Appendix 10)**. Composite scores of 'performance' on each component (for each responder in the relevant model) were calculated by the regression method (i.e. adjusted for the initial correlation matrix), in SPSS 11.0, for use in multiple regression.

Principal components analysis of learning data

PCA was undertaken (in SPSS 11.0), to analyse the 18-item response-sets from Entwistle's short RASI for learning approaches, in S3, S6, S5, and S4. The same specific indicators were checked to assess the 'factorability' of these three datasets as above. Varimax orthogonal rotation was chosen to extract components, after again checking that there was no substantial overlap between components. For each dataset, the scree-plot was studied to check for evidence against retaining other than the expected three components. Analyses were performed that retained one or two more components, allowing exploration of changes in the parameters of the resulting solutions. The ultimate number of components retained was determined largely by prior knowledge (i.e. three expected) complemented by the scree-plots. The components were checked to see if the highest post-rotation loadings (using a general cut-off loading of 0.40) were as expected **(Appendix 11)**.

Multiple logistic regression analysis on assessment outcomes and multiple regression analysis on satisfaction

Assessment outcomes were linked to the study datasets of 1999 and 2001 cohort responders and non-responders to calculate simple frequencies. The outcomes were ---passed; passed after retake; failed twice and left cohort--- for the main summative assessment components, and cumulatively for Levels 1-3 of the 1999 Cohort.

Multiple linear *logistic* regression analyses were undertaken, using the SPSS binary logistic regression function on the 1999 cohort and the 2001 cohort data. The criterion variable comprised assessment outcomes and the predictor variables comprised: the three Entwistle learning approach subscales, the two strongest of perceived good tutor components (from PCA), age, sex, and whether from outwith the EC **(Box 10)**.

Participants were selected if they responded to the relevant study-element, and ultimately passed the relevant assessments (first time or at retake) with the main cohort. Two methods were used: 'forced entry', then the least likelihood version of the backward stepwise method (setting entry p=0.05 and exit p=0.10). Other options used comprised the Hosmer-Lemeshow test of 'goodness-of-fit', classification plots, casewise listing of residuals, and Cox & Snell R^2 and Nagelkerke R^2 (for explanatory potential of model). Residuals were checked for fit and for undue influence from particular responders. To check for substantial relationships between the predictors (multicollinearity), the multiple linear regression function was used on the dataset, with all options turned off except for collinearity diagnostics. Tolerance and the correlation matrix were assessed for multicollinearity.

The 1999 cohort model was re-run for end-of-Year 1 assessment outcome, assuming that mid-Year 3 predictor variables would have been broadly similar in Year 1.

Box 10: Details of multiple linear logistic regression of medical students' assessment outcomes (written and clinical/communication components under examination conditions only) related to learning approaches, tutoring perceptions, and demography (1999 cohort and 2001 cohort)

	criterion variable (categorical)	predictor variables (continuous Co or categorical Ca)
One model: Study-element (S)5	**Fail and pass retake of anything versus pass everything by the end-of-Year 4** (whether students progressing with main cohort to Year 4 had failed then passed the retake of any element of any of the three sets of summative assessments versus passed everything first time)	– subscale learning approach scores (Co) (for S3, S6, S5, respectively): ▪ deep ▪ strategic ▪ surface – the strongest two components from principal components analysis (PCA) of the good tutor variable (Co) (for S3, S6, S5, respectively): ▪ tells me what to learn… ▪ helps me with how to learn – age in years at entry (Co) – sex (Ca) – whether an overseas student (versus home/European Community (EC)) (Ca)
Two models: S3 S6	**Fail and pass retake of anything versus pass everything by the end-of-Year 1** (whether students progressing with main cohort to the end of Year 1 had failed then passed the retake of any element of the summative assessment versus passed everything first time)	– subscale learning approach scores (Co) (for S3, S6, respectively): ▪ deep ▪ strategic ▪ surface – the strongest three components from PCA of the good tutor variable (Co) (for S3, S6, respectively): ▪ tells me what to learn… ▪ helps me with how to learn – age in years at entry (Co) – sex (Ca) – whether an overseas student (versus home/EC) (Ca)
	Selection methods used: – Entry (all predictors at once) – Backward Stepwise with Likelihood-Ratios (all predictors in, then testing the removal of each based on maximum partial likelihood estimates)	

Liverpool MBChB curriculum, 1999 entry-cohort of medical students, cumulative outcomes to end-of-Year 4, with Year 3, S5 data AND 2001 entry-cohort of medical students, cumulative outcomes to end-of-Year 1, with Year 1, S3 and/or S6 data

Multiple linear regression analyses were undertaken, in SPSS 11.0, on Liverpool problem-based curriculum 'satisfaction', with predictor variables comprising:

- the three Entwistle learning approach subscales
- the two strongest good tutor components (from PCA)
- whether intending to be a GP (versus all other answers)
- age, sex, whether from outwith the EC
- the ranking of whichever of the nine good doctor themes showed a statistically significant association with 'satisfaction' in a stepwise forward multiple regression model containing only the nine themes

For the 1999 cohort, the criterion variable and the predictor variables were all taken from S5. For the 2001 cohort, two models of predictor variables were used for the same criterion variable (S6 'satisfaction'):

- a model using all S6 predictors
- a further model using mostly S3 predictors but still using the relevant ranking(s) of the good doctor theme(s) from S6.

The two methods used were: the forced entry method and then the forward stepwise method. Adjusted R^2 was used to assess the explanatory potential of the models and ANOVA assessed the models for statistical significance. The Durbin-Watson test was used to assess the assumption of independent residuals (i.e. no autocorrelation). The residuals were checked for Normal distribution on histogram and Normal probability plot. The correlation matrix and tolerance were used to check for multicollinearity.

Multiple logistic regression analysis on whether admitted

Multiple linear *logistic* regression analysis was undertaken of S4 (interviewees) data using the SPSS binary logistic regression function. The criterion variable comprised whether admitted and the predictor variables comprised: the three Entwistle learning approach subscales, age, and sex. To check for substantial relationships between the predictors (multicollinearity), SPSS multiple linear regression was used with all options turned off except for collinearity diagnostics. Tolerance and the correlation matrix were assessed for multicollinearity.

Some regression results were presented formally elsewhere[xvii].

[xvii] The relationship between learning approaches and assessment outcomes (and curriculum satisfaction and selection outcome) was presented as a peer-reviewed conference abstract (S5; S3 & S6):
Maudsley G. *Great expectations and style: Predictors of medical student satisfaction and assessment progress in a problem-based curriculum.* **Parallel session presentation** at "*Association for the Study of Medical Education (ASME) Annual Scientific Meeting (The continuum of healthcare education)*" - 2 days, 11.7.05-13.7.05, The University of Newcastle, Newcastle-upon-Tyne.

Chapter 5: Results

Study-numbers have been adapted for presentation and prefixed by S1-6 for the relevant study.

◗ denotes full answers to questions; ◗ denotes extracts from answers, within which [...] denotes edited text

This chapter describes the findings of Study-elements 1-6:

Red cohort: S1, S2, S5; Blue cohort: S3, S6; Green cohort: S4.

Levels of analysis

Generally, the same three levels (L) from Methods also guide the Results layout, as appropriate: •L1: *individual study-elements*; •L2: *intra-cohort:* links between same items (paired, unpaired, as appropriate); links between different items across study-elements; •L3: *inter-cohort and/or intra-cohort:* multifaceted links between different items. Hence, **sections** outline study-elements of: Red cohort (then a section linking them), Blue cohort (then a section linking them), Green cohort; then a section linking within and between cohorts. Each section (except if short) has a **Summary**.

Results 1: 1999 cohort S1, start-of-Year 1
Questionnaire response (Table 1)

The response rate was 155/228 (68.0%). Most responders were female (63.9%) and 'home' (EC) students (139/155, 89.7%). The largest ethnic groups were home/White (72.5% overall and 111/137, 81.0% of all home student answering) and home/Indian (5.9%), and 12.9% were graduates **(Tables 1a, 1b, 1c)**. The proportions did not differ statistically significantly from those of non-responders for being:

- female: 40/73 (54.8%) (Yates-corrected χ^2=1.36$_1$ and p=0.244; 95% confidence interval on 9.08 difference: -4.62, 22.77)
- graduate [versus remainder]: 15/73 (20.5%) (Yates-corrected χ^2=1.68$_1$ and p=0.195; 95% confidence interval on -7.64 difference: -18.31, 3.02)

Nevertheless, responders comprised statistically significantly more overseas students (16/155, 10.3%) than non-responders (1/73, 1.4%) (Yates-corrected χ^2=4.54$_1$ and p=0.033; 95% confidence interval on 8.95 difference: 3.47, 14.43). The median age of the responders at receipt of their questionnaires was 19.2 years, and most responders (129/155, 83.2%) were school-leavers (+/- A-level/Highers retakes, +/- deferred entry).

Table 1a: Questionnaire survey of Year 1 medical students at the start and end of 1999/00, and followed to Year 3 (Study-element (S)1, S2 & S5): Demographic profile and response rates

S1+S5: complete sets: n=119

S1+S2: complete sets: n=105 | S2+S5: complete sets: n=115

S1+S2+S5: complete sets: n=91

Characteristic	S1: start-of-Year 1 (155/228)		S2: end-of-Year 1 (137/224)		S5: mid-Year 3 (159/204)		S1–S2–S5
	Response rate: *68.0%*		Response rate: *61.2%*		Response rate: *77.9%*		response vs not χ^2=14.09$_2$, p=0.0009
	no.	**years**	**no.**	**years**	**no.**	**years**	
Age (exact): at receipt of completed questionnaire	155		137		159		
▪ mean *(& at start 27.9.99)*		20.1 *(20.1)*		20.9 *(20.2)*		22.5 *(20.2)*	
▪ median *(& at start 27.9.99)*		19.2 *(19.1)*		19.8 *(19.2)*		21.4 *(19.2)*	
▪ range		18.0-36.5		18.7-36.0		20.3-38.6	
Sex	**no.**	**%**	**no.**	**%**	**no.**	**%**	male vs females χ^2=1.12$_2$, p=0.572
▪ male	56	*36.1*	57	*41.6*	65	*40.9*	
▪ female	99	*63.9*	80	*58.4*	94	*59.1*	
	155	*100.0*	137	*100.0*	159	*100.0*	
Self-reported ethnic origin: 'home students' only	**no.**	**%**	**no.**	**%**	**no.**	**%**	
▪ White	111	*72.5*	104	*76.5*	117	*74.5*	
▪ Black-Caribbean	1	*0.7*	0	*0*	0	*0*	
▪ Black-African	1	*0.7*	1	*0.7*	1	*0.6*	
▪ Black-other	0	*0*	0	*0*	0	*0*	
▪ Indian	9	*5.9*	6	*4.4*	9	*5.7*	
▪ Pakistani	3	*2.0*	3	*2.2*	6	*3.8*	
▪ Bangladeshi	0	*0*	0	*0*	0	*0*	
▪ Asian-other	5	*3.3*	7	*5.1*	7	*4.5*	
▪ Chinese	2	*1.3*	2	*1.5*	2	*1.3*	
▪ Other	5	*3.3*	5	*3.7*	3	*1.9*	home/EC vs rest χ^2=2.05$_2$, p=0.358
▪ Non-European Community (EC)	16	*10.5*	8	*5.9*	12	*7.6*	
	153*	*100.2*	136**	*100.0*	157*	*99.9*	
Entered as:	**no.**	**%**	**no.**	**%**	**no.**	**%**	
▪ school-leaver	104	*67.1*	68	*49.6*	80	*50.3*	school-leaver/ resit/ gap year vs rest χ^2=3.45$_2$, p=0.179
	including resit A-levels/ Highers						
▪ school-leaver: after resit A-levels/Highers	Not classified separately		21	*15.3*	26	*16.4*	
▪ school-leaver: after gap year	25	*16.1*	14	*10.2*	15	*9.4*	
▪ graduate	20	*12.9*	22	*16.1*	26	*16.4*	
▪ other (mature)	5	*3.2*	10	*7.3*	10	*6.3*	
▪ mature with non-relevant degree: admitted on A-levels	1	*0.6*	2	*1.5*	2	*1.3*	
	155	*99.9*	137	*100.0*	159	*100.1*	

All totals do not add to 100.0% due to rounding

Liverpool MBChB curriculum, Year 1→3 medical students, Study (S)1, S2, S5

Yates-corrected χ^2=2.01$_1$, p=0.156 (95% confidence interval (CI) on 6.82 difference: –1.98, 15.62)

Yates-corrected χ^2=4.89$_1$, p=0.027 (95% CI on 9.96% difference: 1.65, 18.27)

Yates-corrected χ^2=13.32$_1$, p=0.0007 (95% CI on 16.78% difference: 8.23, 25.33)

**2 and ** 1 UK students did not self-report*

n=204 eligible for all 3 studies

McNemar (binomial distribution) on single responders in:
- *paired S1—S2 data: n=48 versus n=32 → exact p=0.093*
- *paired S2—S5 data: n=12 versus n=44 → exact p=0.000002*
- *paired S1—S5 data: n=20 versus n=40 → exact p=0.013*

Of non-responders to:
S1 (n=73)→32 responded to S2, 40 to S5; S2 (n=87)→48 responded to S1, 44 to S5; S5 (n=45) →20 responded to S1, 12 to S5

Of responders to:
S1 (n=155)→105 responded to S2, 119 to S5; S2 (n=137)→105 responded to S1, 115 to S5; S5 (n=159) →119 responded to S1, 115 to S2

Table 1b: Questionnaire survey of Year 1 medical students at start and end of 1999/00, followed to Year 3 (Study-element (S)1, S2 & S5): Differential response of demographic subgroups of those eligible for all three studies (n=204)

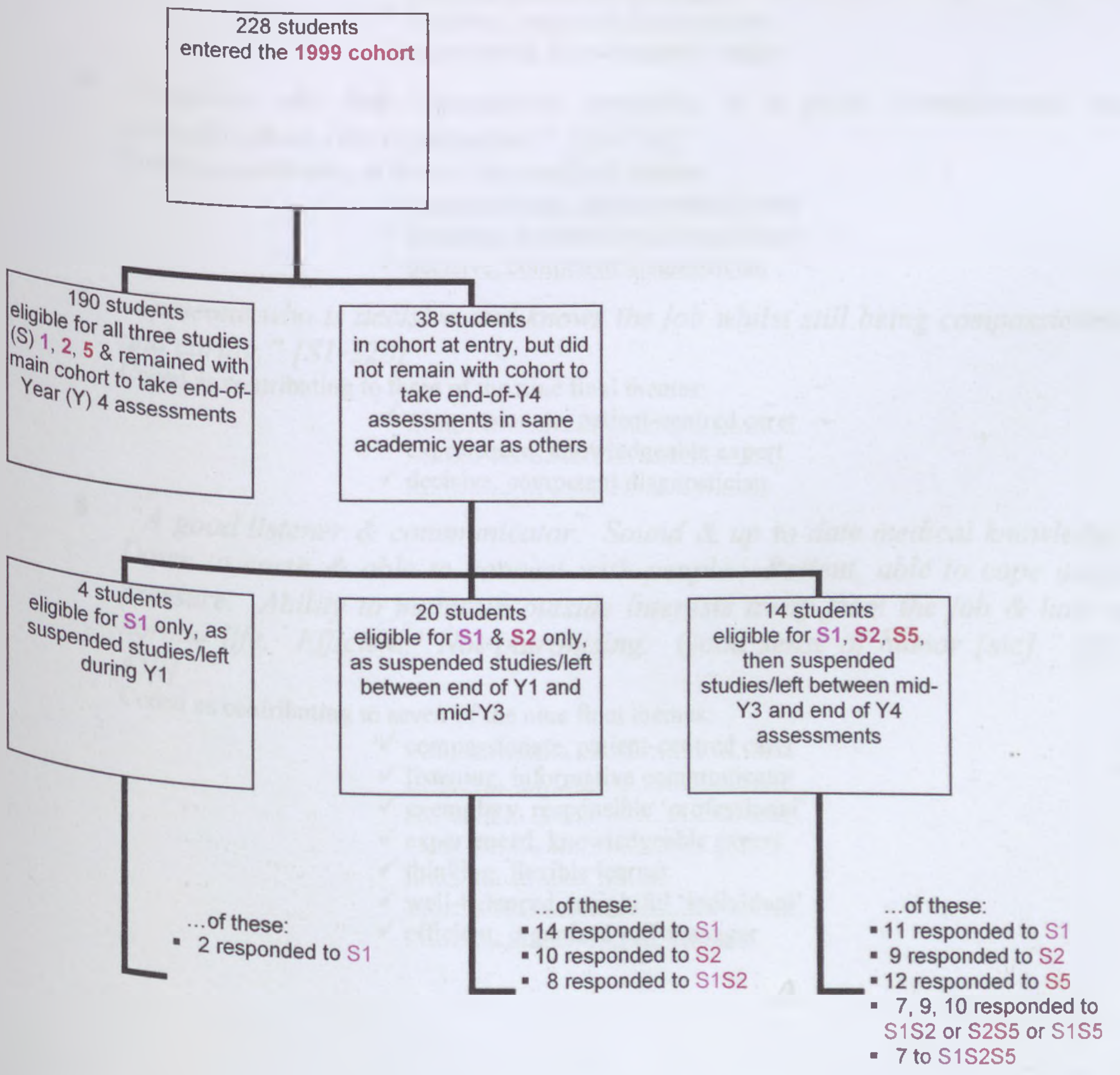
no. (%)	All: S1+S2+S5	None	S1 only	S2 only	S5 only	S1+S5 only	S2+S5 only	S1+S2 only	
All	91 *(44.6)*	19 *(9.3)*	14 *(6.9)*	6 *(2.9)*	16 *(7.8)*	28 *(13.7)*	24 *(11.8)*	6 *(2.9)*	204* *(99.9)*
Sex: male	34 *(42.0)*	7 *(8.6)*	5 *(6.2)*	2 *(2.5)*	8 *(9.9)*	9 *(11.1)*	14 *(17.3)*	2 *(2.5)*	81 *(100.1)*
female	57 *(46.3)*	12 *(9.8)*	9 *(7.3)*	4 *(3.3)*	8 *(6.5)*	19 *(15.4)*	10 *(8.1)*	4 *(3.3)*	123 *(100.0)*
									204
			Combined single or double responders (n=94): S1 only, S2 only, S5 only, S1+S5 only, S2+S5 only, S1+S2 only:						
Home/ European Community (EC)	84 *(44.0)*	19 *(9.9)*	88 *(46.1)*						191 *(100.0)*
non-EC	7 *(53.8)*	0 *(0)*	6 *(46.2)*						13 *(100.0)*
All	91	19	94						204
Entry as: graduate	16 *(51.6)*	2 *(6.5)*	13 *(41.9)*						31 *(100.0)*
...school-leaver +/resit A-levels or gap year; mature/ other	75 *(43.4)*	17 *(9.8)*	81 *(46.8)*						173 *(100.0)*
									204

All totals do not add to 100.0% due to rounding *Liverpool MBChB curriculum. 1999 cohort: Year 1→3 medical students. Study (S)1, S2, S5*

**Since the original 228 entered, 24 had suspended studies out of the main cohort or had left → n=204 eligible for all 3 studies*

Responded to: either S1 or S2 = 187; S1 or S5=195; S2 or S5=181

Table 1c: Questionnaire survey of Year 1 medical students at start and end of 1999/00, followed to Year 3 (Study-element (S)1, S2 & S5), with assessment analysis at end-of-Year 4: Students leaving the original 1999 cohort of n=228



Liverpool MBChB curriculum. 1999 cohort: Year 1→3 medical students. S1, S2, S5

Open-ended questions: Learning and medicine

Characteristics of a good doctor (Table 2)

Q1 "Describe what, for you, makes a good doctor"

The responders' descriptions of a good doctor generally contributed to nine overall themes, focusing mostly on two: compassionate patient-centredness (77.4%) and good communication skills for listening, explaining, etc. (74.2%) **(Table 2; Appendix 12** for interim steps). The following nine responders illustrated these two themes (coding denoted by underlining):

- *"A knowledgeable and experienced professional who is intelligent, educated and well trained. Someone who is sensitive to others [sic] needs, compassionate and is able to empathise. A good listener and communicater [sic] who is competent, non-judgemental and has a reassuring nature. Has the ability to make good & accurate diagnosis of illness." [S1-300]*

  Coded as contributing to six of the nine final themes:
  - ✓ compassionate, patient-centred carer
  - ✓ listening, informative communicator
  - ✓ exemplary, responsible 'professional'
  - ✓ friendly, inclusive team player
  - ✓ decisive, competent diagnostician
  - ✓ experienced, knowledgeable expert

- *"Someone who has compassion, empathy, is a good communicator but probably above all is competent." [S1-710]*

  Coded as contributing to three of the nine final themes:
  - ✓ compassionate, patient-centred carer
  - ✓ listening, informative communicator
  - ✓ decisive, competent diagnostician

- *"Someone who is decisive and knows the job whilst still being compassionate and caring." [S1-220]*

  Coded as contributing to three of the nine final themes:
  - ✓ compassionate, patient-centred carer
  - ✓ experienced, knowledgeable expert
  - ✓ decisive, competent diagnostician

- *"A good listener & communicator. Sound & up to date medical knowledge. Down to earth & able to connect with people. Patient, able to cope under pressure. Ability to maintain outside interests away from the job & have a normal life. Efficient. Not patronising. Good sense of humor [sic]." [S1-450]*

  Coded as contributing to seven of the nine final themes:
  - ✓ compassionate, patient-centred carer
  - ✓ listening, informative communicator
  - ✓ exemplary, responsible 'professional'
  - ✓ experienced, knowledgeable expert
  - ✓ thinking, flexible learner
  - ✓ well-balanced, insightful 'individual'
  - ✓ efficient, organized self-manager

Table 2: Questionnaire survey of Year 1 medical students at start of 1999/00 (Study-element 1): Nine themes* emerging from answers to Q1 (n=155): "Describe what, for *you*, makes a good doctor"

Theme **A good doctor is a(n)…**	**Students mentioning at least one concept in this overall theme:** no.	%
▪ compassionate, patient-centred carer	120	*77.4*
▪ listening, informative communicator	115	*74.2*
▪ exemplary, responsible 'professional'	88	*56.8*
▪ experienced, knowledgeable expert	51	*32.9*
▪ friendly, inclusive teamplayer	48	*31.0*
▪ thinking, flexible learner	47	*30.3*
▪ decisive, competent diagnostician	43	*27.7*
▪ well-balanced, insightful 'individual'	13	*8.4*
▪ efficient, organized self-manager	11	*7.1*

Liverpool MBChB curriculum. Year 1 medical students. Study (S)1

*via 70 initial concepts (760 mentions) → 23 interim themes (590 first-mentions) → 9 themes (536 first-mentions)

- *"•An individual who CARES – about others, about themselves – this will show in their approach and attitude to the job.*
  •A good listener is also important, responding to both emotional and physical needs.
  •A hard worker, being dedicated to the improvement of the medical profession.
  •Trust, openness and sense of humour also aid patient care" [S1-860]
  Coded as contributing to four of the nine final themes:
  - ✓ compassionate, patient-centred carer
  - ✓ listening, informative communicator
  - ✓ exemplary, responsible 'professional'
  - ✓ well-balanced, insightful 'individual'

- *"•Caring*
  •Compassionate
  •sympathetic
  •Curiousity [sic]
  •Good personal organisation & stamina.
  •Communications skills – good listener
  •Accurate diagnosis – assess quickly what is wrong → correct treatment
  •Up to date knowledge in the diagnosis & treatment of disease." [S1-341]
  Coded as contributing to seven of the nine final themes:
  - ✓ compassionate, patient-centred carer
  - ✓ listening, informative communicator
  - ✓ exemplary, responsible 'professional'
  - ✓ decisive, competent diagnostician
  - ✓ experienced, knowledgeable expert
  - ✓ thinking, flexible learner
  - ✓ efficient, organized self-manager

- *"Knowledgeable but approachable, not so intellectual that it is intimidating, humane. Reassuring but realistic. Straight forward ie honest and trustworthy (with tact!).*
  Ability to continue learning and to never assume a situation. Affection for his profession.
  Confidence in taking charge and making decisions; at the same time having appreciation of the vital rôles [sic] of his co-workers." [S1-761]
  Coded as contributing to six of the nine final themes:
  - ✓ compassionate, patient-centred carer
  - ✓ exemplary, responsible 'professional'
  - ✓ friendly, inclusive team player
  - ✓ decisive, competent diagnostician
  - ✓ experienced, knowledgeable expert
  - ✓ thinking, flexible learner

- *"Ability to communicate well with people. Be able to work in a team. Be capable of continued learning." [S1-412]*
  Coded as contributing to three of the nine final themes:
  - ✓ listening, informative communicator
  - ✓ friendly, inclusive team player
  - ✓ thinking, flexible learner

- *"Somebody who not only has academic ability but has the compassion to listen and talk to patients as people, and work as a team with collegues [sic]." [S1-222]*

  Coded as contributing to four of the nine final themes:
  - ✓ compassionate, patient-centred carer
  - ✓ listening, informative communicator
  - ✓ experienced, knowledgeable expert
  - ✓ friendly, inclusive team player

The maximum number of themes to which responders referred was seven of the nine overall themes, achieved by two responders, *[S1-450]* and *[S1-341]* above. The least frequently mentioned themes were well-balanced, insightful 'individual' (8.4%) and efficient, organized self-manager (7.1%). The former involved such comments as *"humourous [sic]", "has a sense of humour", "good sense of humour", "have a good life away from work", "sense of humour... Ability to differentiate between work + play – balance", "is able to focus on the good he/she can do, not on what he/she can't do to help", "optimism".* The latter involved such comments as *"sensible", "efficient", "good personal organisation", "works well on their own", "Organisation especially of time management".*

Factors for a successful Year 1 (Table 3)
Q2 "Outline three things that would make this first undergraduate year a success for you"

Of nine overall themes encompassing their three choices, the responders' top four for a successful first medical school year were coping with/doing well with/enjoying their studies/learning (66.9%), passing assessments (well) (55.2%), making friends/being accepted socially (45.5%), and generally enjoying: themselves, their social life/leisure, and meeting people (40.3%) **(Table 3)**. Such answers were illustrated by:

- *"➢Make good friends. ➢Enjoy the academic work + the social life ➢Pass well." [S1-320]*
- *"➢Make lots of friends ➢Cope well with the demands of the course ➢"Pass all exams/assessments" [S1-970]*
- *➢LMSS [Liverpool Medical Student Society] Parties every week (they already are) very social very Fun! ➢To find the work enjoyable, interesting and relevant (I DO) ➢To get on with other medics, PBL groups + staff (so far achieved very well)" [S1-490]*
- *"➢Getting on well with other medics and other first years. ➢Passing exams well and understanding new things. ➢Feeling confident in myself and what I have learnt." [S1-381]*
- *"➢Pass my exams and assessments. ➢Settle in well in halls and on the course. ➢Work well and efficently [sic] with my PBL group." [S1-422]*

The least common themes indicating a successful first year were those of:

- having good learning resources (8.4%), illustrated by these four responders:

  e.g. *"Warm, caring and understanding Acedemic [sic] Staff"*; *"helpful tutors"*; *"Getting easy access to computers"*; *"Having a large source of info readily available – H.C. [Harold Cohen] library"*;

- managing self/being independent (7.1%)

  e.g. *"If I became more disciplined in everything I did"*; *"Good time management"*; *"Personal Growth eg, Gaining independence"*; *"Having the freedom to make my own decisions."*; and

- focusing on future career (5.8%)

  e.g. *"Begin to feel on the way to a career in Medicine"*; *"Appreciate how to satisfy + understand patient's problems."*; *"Feeling that I am on my way to become an excellent doctor"*; *"That I'd still have the enthusiasm and passion I have for a career in Medicine, that I have now."*.

Each final theme's priority was unchanged when allowing for multiple mentions of initial comments under the same final theme (e.g. if a responder felt strongly enough to have three related, albeit different, 'things' for the three suggestions). One male student was quite specific that *"To find the girl of my dreams!"* would make a successful first year.

Descriptions of pre-registration house year (Table 4)

Q5 At the outset of your medical career, describe what you know about 'preregistration house year'

The responders' descriptions of 'preregistration house year' generally contributed to ten overall themes, focusing mostly on three: working hard overlong hours (including on-call) (58.0%), performing basic clinical duties on clinical rotations in medicine and surgery (51.3%), and having an intense opportunity to learn and gain experience, under supervision (45.3%) **(Table 4)**. The following three responders illustrated these three themes (coding denoted by underlining):

- *"Final year medical students apply for PRHO jobs, and do rotations in different parts of the health service. Doctors are attached to firms within the department that they are working in. PRHO are expected to be competent at basic medical techniques, and history taking, but also able to seek more advice when necessary. PRHOs work many hours a week, including being on call." [S1-120]*

  Coded as contributing to four of the ten final themes:

  ✓ working hard overlong hours, including on-call

  ✓ performing basic clinical duties on clinical rotations in medicine and surgery

  ✓ having an intense opportunity to learn and gain experience, under supervision

  ✓ starting (poorly paid) employment as a junior doctor

Table 3: Questionnaire survey of Year 1 medical students at start of 1999/00 (Study-element 1): Nine themes* emerging from answers to Q2 (n=154): "Outline three things that would make this first undergraduate year a success for *you*"

Theme A successful year involves...	Students mentioning at least one concept in this overall theme: no.	%	(initial comments for this overall theme as a % of the n=456 comments for all overall themes)** no.	(%)
▪ coping/doing well with/enjoying my learning approach/study	103	*66.9*	140	*(30.7)*
▪ passing assessment	85	*55.2*	89	*(19.5)*
▪ gaining friendships/social acceptance	70	*45.5*	72	*(15.8)*
▪ having good social life/leisure/enjoyment; meeting people	62	*40.3*	68	*(14.9)*
▪ learning interesting knowledge/skills	34	*22.1*	37	*(8.1)*
▪ receiving social/financial support	16	*10.4*	16	*(3.5)*
▪ having good learning resources (staff, library, computer)	13	*8.4*	14	*(3.1)*
▪ showing self-management/independence	11	*7.1*	11	*(2.4)*
▪ remaining focused on this choice of career	9	*5.8*	9	*(2.0)*
			456	*(100.0)*

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Five responders outlined 1 or 2 'things', and others outlined more than one 'thing' from the same theme
*via 52 initial concepts (456 mentions) → 23 interim themes (448 first-mentions) → 9 themes (403 first-mentions)
**This allowed for multiple mentions of initial comments under the same final theme (e.g. if a responder felt strongly enough to have three related, albeit different, 'things' for the three suggestions)

Table 4: Questionnaire survey of Year 1 medical students at start of 1999/00 (Study-element 1): Ten themes* emerging from answers to Q5 (n=150): "At the outset of your medical career, describe what *you* know about 'preregistration house year"

Theme Pre-registration house year involves...	Students mentioning at least one concept in this overall theme: no.	%
▪ working hard overlong hours, including on-call	87	*58.0*
▪ performing basic clinical duties on clinical rotations in medicine and surgery	77	*51.3*
▪ having an intense opportunity to learn and gain experience, under supervision	68	*45.3*
▪ starting (poorly paid) employment as a junior doctor	54	*36.0*
▪ making a transition, through increasing responsibility, in a compulsory year of provisional registration	47	*31.3*
× *Responders had misconceptions (e.g. little decisionmaking)*	37	*24.7*
▪ having little control, and being treated poorly	29	*19.3*
× *Responders stated that uncertain or that knew nothing*	15	*10.0*
▪ having confidence, a challenge, and excitement	5	*3.3*
▪ teamworking, networking	4	*2.7*

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*via 70 initial concepts (538 mentions) → 32 interim themes (511 first-mentions) → 10 themes (423 first-mentions)

- *"long hours are worked in 4 main disciplines in hospitals for one year. Work supervised and you are registered at the end of the year" [S1-770]*
  Coded as contributing to four of the ten final themes:
  - ✓ working hard overlong hours, including on-call
  - ✓ performing basic clinical duties on clinical rotations in medicine and surgery
  - ✓ having an intense opportunity to learn and gain experience, under supervision
  - ✓ making a transition, through increasing responsibility, in a compulsory year of provisional registration
- *"Preregistration House year is spent as a Junior House Officer working under a Senior H.O./Consultant on various firms/rotations for a whole year. Various Specialities [sic] are experienced. The hours are long. Pay is poor. On Call Duty experienced for the first time." [S1-561]*
  Coded as contributing to four of the ten final themes:
  - ✓ working hard overlong hours, including on-call
  - ✓ performing basic clinical duties on clinical rotations in medicine and surgery
  - ✓ having an intense opportunity to learn and gain experience, under supervision
  - ✓ starting (poorly paid) employment as a junior doctor

One-quarter of responders disclosed some misconceptions such as being 'posted' to the jobs, these not being jobs at all, having 2-month rotations, working in Accident & Emergency, Psychiatry, or Obstetrics & Gynaecology, shadowing a consultant, taking examinations (*"Horrible exams at the end"*), not having responsibility, and not being a doctor yet. The two least common themes involved having confidence/a challenge/excitement (3.3%) and teamworking or networking (2.7%), e.g. (as underlined):

- *"A year spent as a doctor doing (dare I say) mundane rounds and reports. Learning the ropes and gaining in confidence." [S1-150]*
  Coded as contributing to five of the ten final themes:
  - ✓ performing basic clinical duties on clinical rotations in medicine and surgery
  - ✓ having an intense opportunity to learn and gain experience, under supervision
  - ✓ starting (poorly paid) employment as a junior doctor
  - ✓ having little control, and being treated poorly
  - ✓ having confidence, a challenge, and excitement
- *"A year of ongoing training after graduation in a working environment. You're no longer a medical student but part of the team, however you are being monitored and supervised by the senior staff." [S1-710]*
  Coded as contributing to three of the ten final themes:
  - ✓ having an intense opportunity to learn and gain experience, under supervision
  - ✓ starting (poorly paid) employment as a junior doctor
  - ✓ teamworking, networking
- *"You work in 2 (?) different specialities [sic] as part of the 'team'. It's hard work – you don't sleep much & spend a lot of time on call. You do a lot of the basic medical work – bloods, clerking etc. You learn from the SHOs, registrars & consultants & attend patient conferences." [S1-781]*

Coded as contributing to four of the ten final themes:

- ✓ working hard overlong hours, including on-call
- ✓ performing basic clinical duties on clinical rotations in medicine and surgery
- ✓ having an intense opportunity to learn and gain experience, under supervision
- ✓ teamworking, networking

Experience learning at school/college (Table 5)
Q3 "Describe your experience as 'a learner' at school/college

Although students described their learning experience at school within seven themes **(Table 5)**, they commented most commonly under the theme about the control and nature of the learning process. Indeed, 68.8% mentioned such concepts **(Table 5)**, of whom 73.6% described teacher-directed, very structured learning. Overall, 38/154 (24.7%) used the term 'spoonfeeding' and 25/154 (16.2%) used the term 'dictation' and/or indicated that the teacher supplied or dictated the notes/information. The following five responders illustrated the predominant theme (as underlined):

- *"Pretty much fed information, rather than going out – researching for oneself. On occasion, assumptions were made as to knowledge of subject that were not necessarily just." [S1-720]*
  Coded as contributing to one of the seven final themes:
  - ✓ the control of the educational process and its nature… [negative]
- *"Spoon fed, drip fed.*
  No enthusiasm from teachers (even they hate dictation).
  Too much dictation therefore lose concentration." [S1-150]
  Coded as contributing to three of the seven final themes:
  - ✓ feelings about learning… [neutral/indeterminate]
  - ✓ the control of the educational process and its nature… [negative]
  - ✓ learning resources… [negative]
- *"Learning was teacher directed – work was either:*
  i) Notes dictated or copied from the board or
  ii) looked up from references in books by the teacher." [S1-301]
  Coded as contributing to one of the seven final themes:
  - ✓ the control of the educational process and its nature… [negative]
- *"In school one just turns up for lessons, copy or collect notes, using the notes gathered do the homework set.*
  When one comes back to revise notes, read through and learn notes thoroughly and practice [sic] on old exam papers." [S1-911]
  Coded as contributing to one of the seven final themes:
  - ✓ the control of the educational process and its nature… [negative]
- *"Look, listen, copy, learn.*
  Not very relevant (or so it seemed) to anything.
  More a case of regurgitating information than understanding it." [S1-041]
  Coded as contributing to two of the seven final themes:
  - ✓ the control of the educational process and its nature… [negative]
  - ✓ the focus and purpose of the educational process… [negative]

Table 5: Questionnaire survey of Year 1 medical students at start of 1999/00 (Study-element 1): Seven themes* emerging from answers to Q3 (n=154): "Describe your experience as 'a learner' at school/college"

Theme	Potential impact on learning in this curriculum: Spectrum of comments — negative	neutral/ indeterminate	positive	
As a learner at school/college... ...*the responder mentioned at least one concept in this overall theme...* *(as % of responders mentioning at least one concept in this overall theme)* ***(as % of responders answering question, whether or not they contributed to the theme)***				
...*feelings about learning...*	*were negative:* did not enjoy it; lacked motivation; was not interested; was easily distracted; felt unsupported, resented system; felt under external pressure/expectations		*were positive:* enjoyed it; felt motivated; was interested; was focused; felt supported, safe, able to ask for help; liked the system; felt in control	
50/154 (32.5)	4 *(8.0)* ***(2.6)***	26 *(52.0)* ***(16.9)***	20 *(40.0)* ***(13.0)***	50 *(100.0)*
...*difficulties...*	*were encountered*		*were not encountered*	
28/154 (18.2)	7 *(25.0)* ***(4.5)***	10 *(35.7)* ***(6.5)***	11 *(39.3)* ***(7.1)***	28 *(100.0)*
...*insight into adult learning...*	*was minimal* (had narrow view of learning equated with facts given by the teacher)		*was considerable* (gave reflective account; developed own study approach; realized that teacher was not necessarily right; wide view of learning)	
51/154 (33.1)	2 *(3.9)* ***(1.3)***	40 *(78.4)* ***(26.0)***	9 *(17.6)* ***(5.8)***	51 *(99.9)*
...*the control of the educational process and its nature...*	*were mostly: teacher-directed* (told what to learn, made to learn); a *very* structured process (copying from texts/dictation); about memorizing; compulsory		*were mostly: self-directed*; about own learning choices/many personal research opportunities; about understanding	
106/154 (68.8)	78 *(73.6)* ***(50.6)***	27 *(25.5)* ***(17.5)***	1 *(0.9)* ***(0.6)***	106 *(100.0)*
...*the purpose of the educational process...*	*was mostly focused on: passing examinations*; *irrelevant* material; learning *without critical thinking*		*was mostly focused on: learning wider* than passing examinations; *relevant* material; *critical thinking*	
33/154 (21.4)	19 *(57.6)* ***(12.3)***	12 *(36.4)* ***(7.8)***	2 *(6.1)* ***(1.3)***	33 *(100.1)*
...*learning resources...*	*were not good*		*were good*	
53/154 (34.4)	11 *(20.8)* ***(7.1)***	21 *(39.6)* ***(13.6)***	21 *(39.6)* ***(13.6)***	53 *(100.0)*
...*social perspective...*	*had negative effect on learning*		*had positive effect on learning*	
5/154 (3.2)	2 *(40.0)* ***(1.3)***	2 *(40.0)* ***(1.3)***	1 *(20.0)* ***(0.6)***	5 *(100.0%)*

*via 35 initial concepts

Most common theme highlighted

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All totals do not add to 100.0% due to rounding

The most positive comment under this main theme was:

- *"In the school I attended learning, and the depth into which [sic], was left up to the individual, [sic] those that were determined to succeed however were encouraged strongly by their tutors and the head." [S1-621]*
  Coded as contributing to one of the seven final themes:
  ✓ the control of the educational process and its nature… [positive]

Under each of the next three commonest themes, approximately one-third of responders made comments about: learning resources (34.4%); insight into adult learning style (33.1%); and feelings about learning (32.5%). Of the last mentioned (feelings), only 4/50 (8.0%) comments were negative.

While 21.4% of responders commented about the focus or purpose of the educational process (the fifth commonest theme), for 12.3% of responders overall this was *negative*, and mostly related to assessment, e.g.:

- *"[…] Teaching itself was excellent, as were resources, but I still left with the feeling it was little more than an exam factory with knobs on".*
- *"[…] Used by college to get grades without any care for the student as a person."*
- *"Felt tied down, had to learn about irrelevant things only to get good grades. […]"*

Other comments

Some responders' comments on small-groupwork acknowledged that it did not necessarily mean student-centred learning:

- *"The learning was virtually all teacher directed. I was in fairly small classes, which enabled small group discussion, that was [sic] 'led' by the teacher, at times. This was also the more common style of learning in the S-level classes I attended." [S1-520]*
- *"Our work was directed closely by the teachers. We learned directly from notes dictated to us. We rarely had to research any information for ourselves. The tutor groups were smaller and we had more individual attention than at university." [S1-340]*

A mature student noted the added difficulties of taking A-levels much older than usual:

- *"…at first it was difficult to form relationships without me inevitably being viewed as some sort of '[mother/father] figure'. However, by the end of the year, most realised age doesn't necessarily make you 'old-minded', just a bit more sensible…." [S1-130]*

This same responder noted an added stressor to learning at college in this situation, i.e.:

- *"...seeing so many younger students completely wasting the opportunity to learn. I did try to explain that having done exactly the same as them at their age, it really was worth knuckling down and doing it now, but, probably they took as much notice as I would have done [x] years ago!" [S1-130]*

One responder portrayed her desire to think through and understand topics (rather than just learn by rote) as an apparent drawback in the school environment:

- *"At school, my learning experiences tended to be a bit backward compared to everybody elses [sic]. I always grasped the difficult topics in Chemistry and Biology almost straight away, whereas the simplest and most basic topics took me a bit longer to grasp because I always got really confused – I always looked for the more difficult approach to a simple equation (for example) because my natural instinct was to think 'It can't be that easy, there must be a catch.'*
  When writing essays & notes for future revision at school I used to be really swotty and try and get my information + facts from as many different sources as possible because this helped me to thoroughly understand the topics which I was writing about
  I must be able to understand something before I am able to learn it which is difficult when some books don't describe certain topics well enough.
  I've never learnt anything in parrot fashion." [S1-050]

Another responder described the school/college experience all in terms of the previous year spent retaking A-levels:

- *"In my younger years I was well motivated and enthusiastic about all aspects of study. As the transition to A level occured [sic], I lost a little confidence in my abilities and hence motivation. Repeating my A levels was an invaluable experience. I feel as if the extra year was well worth it, not only because of achieving the acquired grades, but also as I have regained my confidence to study. The extra year has given me time to grow up and relax." [S1-441]*

Expectations of learning at University (Table 6)

Q4a "Describe how you think that the following might differ from your experience as a learner at school/college... learning at University" (Table 6)

At the outset, amongst very broad-ranging answers, by far the commonest theme was that responders expected learning at university to require a more active student – to be more self-directed and self-motivated and involve more personal responsibility (84.1%) **(Table 6)**, e.g. summed up by:

Table 6: Questionnaire survey of Year 1 medical students at start of 1999/00 (Study-element 1): Twenty themes* emerging from answers to Q4a (n=151): "Describe how you think that the following *might* differ from *your* experience as a learner at school/college: learning at university…"

Theme **Compared with school/college, expectations of learning at university involve,** *– with examples of comments…*	Students mentioning ≥1 such concept(s) no.	%
▪ **more active, student-centred role:** less spoonfeeding; more student initiative/independence; less directive contribution from tutors, e.g.: – *"much more self-directed learning"; "self-motivation"; "more responsibility… on individual"; "go out and do… background reading"; "writing up your own notes"; "more independent"; "less dependent on teachers"; "it's up to me to find out; self-discipline"* – *"less spoonfed"; "doing the work that we think we should do rather than what we're told to do"; "you decide your parameters"; "more choice of direction"; "free to choose areas of study"; "original thought; greater test of initiative"* – *"supervising of tutors"; "fewer dictated notes"; "not taught directly"; "less information delivered verbatim"; "less… formatted homework"; "less directed learning"; "less direct encouragement"* – *more chance to study on my own"; "left to do our own work more"; "more opportunity to learn the way I enjoy"; "more free time to study by yourself"; "a lot more free time & independence given to learners"* – *"more discussion of work/material covered rather than merely reading pre-prepared notes"*	127	*84.1*
▪ **greater need to manage own time/priorities** in a more relaxed learning environment	39	*25.8*
▪ **harder/more demanding work**	21	*13.9*
▪ **more/better learning resources; better teaching**	21	*13.9*
▪ **more emphasis on in-depth research**	20	*13.2*
▪ **less confined to a narrow 'syllabus';** *"less obvious objectives"*	17	*11.3*
▪ **learning related to curiosity, realistic or practical perspective** *"less chance of merely working for exams*	13	*8.6*
▪ **greater use of the internet and computers**	12	*7.9*
▪ ***"larger setting… less personal approach"***	10	*6.6*
▪ **more juggling of social life, peer pressure, and work**	9	*6.0*
▪ **better relationships with teachers & lecturers** *"less direct personal hassle from teachers/lecturers"; "treated as mature adults"*	8	*5.3*
▪ **more freedom/more independence**	8	*5.3*
▪ ***"smaller groups… learning from each other"***	6	*4.0*
▪ ***"more positive* [enjoyable] *as actually learning information that I want to learn"***	6	*4.0*
▪ ***"may need a little time to get used to";*** *"take a while…to learn… concentrate"; "will find it hard to adapt"; "difficult at first"*	4	*2.6*
▪ ***"go to lots of lectures";*** *"large group lectures"; "being talked at rather than being taught"*	3	*2.0*
▪ ***"more students from a wide range of nationals"; "varied backgrounds"***	2	*1.3*
▪ ***"it's a very big chance and not everyone can have it"***	1	*0.7*
▪ ***"[need more] confidence to ask if not understood/challenged by others on view"***	1	*0.7*
▪ ***"be unsure what work needs to be done… let work pile up and fall behind"***	1	*0.7*

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*via 34 initial concepts (371 mentions) → 20 themes (329 first-mentions)

- *"learning at university will involve a lot more self motivation – it's more about doing the work that we think we should do rather than what we're told to do." [S1-540]*
  Coded as contributing to one of the twenty final themes:
  ✓ more active, student-centred role

The second most common expectation was of a greater need to manage their time and priorities in a learning environment that would be much less authoritarian compared with school/college (25.8%). The following answers, for example, contributed to both these top two themes (coding denoted by underlining):

- *"I have to do the majority of my work on my own. I have to manage my time more effectively as I no longer have a day timetabled for me." [S1-800]*
  Coded as contributing to two of the twenty final themes:
  ✓ more active, student-centred role
  ✓ greater need to manage own time/priorities
- *"have to be more responsible for your own learning – there's no-one to tell you where you have to be when and what work to do.*

  The staff & most of the other students won't know who you are as there's nothing special about you." [S1-470]
  Coded as contributing to three of the twenty final themes:
  ✓ more active, student-centred role
  ✓ greater need to manage own time/priorities
  ✓ larger setting… less personal approach
- *"Instead of being pushed by a teacher I will have to motivate myself and organise my own deadlines with respect to completing study tasks." [S1-051]*
  Coded as contributing to two of the twenty final themes:
  ✓ more active, student-centred role
  ✓ greater need to manage own time/priorities
- *"Doing a lot of things for yourself e.g household things, finding books and structuring your personal timetable" [S1-551]*
  Coded as contributing to three of the twenty final themes:
  ✓ more active, student-centred role
  ✓ greater need to manage own time/priorities
  ✓ more freedom/more independence]
- *"Not taught directly, more time to research own interests. Time management is more important. Confidence to ask if not understood/challenged by others on view." [S1-302]*
  Coded as contributing to four of the twenty final themes:
  ✓ more active, student-centred role
  ✓ greater need to manage own time/priorities
  ✓ more emphasis on in-depth research
  ✓ need more confidence to ask

Only three focused on lecture-based formats, two mistakenly indicating this to be a mainstay of the Liverpool curriculum. Only one student mentioned concerns about uncertainty, i.e. (coding denoted by underlining):

- *"more self directed learning
  you have to organise your time + discipline yourself.
  can also be unsure what work needs to be done at times
  very easy to let work pile up and fall behind or dig a hole for yourself." [S1-981]*

  Coded as contributing to three of the twenty final themes:
  - ✓ more active, student-centred role
  - ✓ greater need to manage own time/priorities
  - ✓ be unsure what work needs to be done

Of those responding to this Q4a, 10/151 (6.6%) indicated that dictation-based classes again figured strongly in their school/college experience, as follows:

> *"Less dictated notes i.e. more self-learning"; "I will take control of my time more + not have it dictated to me."; "...direct change from being note-taking to complete freedom"; "Notes has [sic] to be done personally with less help from tutors"; "...rather than merely reading pre-prepared notes"; "In Uni notes and full explaination [sic] of work is not given..."; "Writing up your own notes on the subject matter"; "You have to figure out what are the important things that you should know from discussions and make notes from it"; "write notes of your own rather than relying on a teachear[sic]/tutor to do it for you."; "quite similar to the teaching style I experienced at school, in that I imagine I will be taking notes from someone talking (or lecturing) to me from the front of the room"*

Expectations of learning to be a doctor... using PBL (Box 11)

Q4b&c "Describe how you think that the following might differ from your experience as a learner at school/college..." "...learning to be a doctor" "...learning using problem-based learning (PBL)"

In comparing how learning to be a doctor might differ from students' learning experience at school/college, amongst a variety of answers **(Box 11)**, 77/152 (50.7%) responders mentioned directly or indirectly the vocational (practical/applied/career-orientated) perspective. This was the most common concept, e.g. comments such as: *"more practical", "being a vocational course", "more practical 'hands-on' approach", "practical applications", "much more of a vocation", "career focused"*. Developing communication skills was mentioned by 36/252 (14.3%). Other perceived differences included taking more responsibility, learning something that they had chosen and in which they were interested, needing to learn to keep up-to-date with medical developments, and the learning being much more demanding.

Responders were generally positive about the potential of the PBL approach, mentioning that it promoted understanding through rehearsing their learning of relevant things, collaboratively in a group, in the context of practical clinical scenarios, and that it required self-motivation, e.g. **(further examples, Box 11)**:

Box 11: Questionnaire survey of Year 1 medical students at start of 1999/00 (Study-element 1): Illustrative linked examples from ten responders of answers to Questions 4b & 4c (n=152 & n=152): "Describe how you think that the following might differ from your experience as a learner at school/college..."

Expectations of learning... compared with school/college:	
...learning to be a doctor... and...	**...learning using problem-based learning (PBL)**
"Much more practically (ie clinical) based learning experiences than ever before. New aspects such as communications skills"	*"More self motivation required, self directed learning in smaller groups than college classes. Much less structured and involves a great amount of independent learning. Harder to get used to – easier to suffer by not doing enough work" [S1-300]*
"Emphasis not so much on percentage points but on actual practical working knowledge."	*"More personal & in a better context" [S1-700]*
"Being surrounded by likeminded students, who all possibly share the same passion and determination to make a good doctor"	*"New PBL learning depends on yourself to be highly motivated Its [sic] not like you will be spoon fed information; its [sic] dependent on yourself to carryout the background work." [S1-910]*
"Learning to be a doctor, will motivate me more than studying to learn what I needed to know for A-level, and therefore I imagine I will enjoy learning to be a doctor more."	*"The content of what is learnt in PBL will come from the PBL group, rather than the teacher, who will only guide the group in the right direction." [S1-520]*
"Will involve a greater range of learning as opposed to school-type learning/education."	*"V. different! At school we had a syllabus that was like a bible – we learnt everything on it. This way we get to decide what is actually relevant and why." [S1-540]*
"More practical a vocational course with emphasis on learning for a career rather than for the sake of it."	*"Learning things with relevence [sic] to a specific problem rather than just general knowledge. A more focused approach." [S1-740]*
"There is responsibility now. What happens in the next five years will shape my attitude to medicine. Before there was little need for memory to last longer than the end of an exam – this is no longer true."	*"Will be different to school in that everything must be questioned where before the attitude was to not question what was put before you." [S1-950]*
"Practical course – combination of theory & clinical skills. More placements in hospitals and time spent studying other professionals. Development of communication skills."	*"Much more independent learning than traditional lecture-based university course. More onus placed on students to set their own objectives, gather information and assymallate [sic] notes from a variety of sources – text books/internet/research papers/lectures etc. Topics based around real-life scenarios and discussed within small tutorial groups" [S1-170]*
"Learning to be a doctor may not be just an academic challenge but also a social challenge where other important skills, such as communication skills must be mastered."	*"From what I've heard about PBL the initiative is handed to the students, where nearly all the work and research must be done by the students. As no syllabus is provided, knowing what depth to study topics in may be a problem." [S1-051]*
"– no one to tell you what to do. -a lot of pressure to get things right -its [sic] not just a question of learning material for marks but you have to know the material, understand and be able to apply it. Tests more than just knowledge but strength of character and communication skills."	*"With PBL the brain is being taught to analyze problems in a certain way to train one to think independently without being spoonfed information. Not only do you use prior knowledge but then once learning objectives have been established you need to be able to explain to others information and share your own knowledge... It not only helps others but tests exactly how much + how well you know a certain topic." [S1-981]*

Liverpool MBChB curriculum, Year 1 medical students, Study (S1)

- *"PBLs differ from previous experience in that it "forces" you to be honest in what knowledge you "think" you know, and amend it. PBLs also give you more confidence within yourself to express what you know and don't know with your peers. It also removes the feeling of "academic competition" between peers." [S1-930]*
- *"Increased self motivation, learning topics as a whole not just set subjects e.g physiology and anatomy but how it relates to population, individuals. Lot more discussion than in school lessons." [S1-160]*
- *"More work to do unsupervised + probably need to be more disciplined + self-motivated. Hopefully will save on learning lots of excess information 'like a parrot' + may look at the wider aspects of a situation" [S1-780]*
- *"It requires deductive reasoning." [S1-751]*
- *"Don't have teachers telling us what to do and how to do it, which in a way could make PBL harder than traditional teaching. Have to explore scenarios ourselves and set our own objectives." [S1-661]*
- *"Learning from other student's [sic] understanding and mistakes rather than being 'spoon-fed' by someone who 'knows' " [S1-602]*
- *"All your study is self motivated rather than being taught directly. You will need to depend upon your peers in your group more heavily in order to cover the work and learn." [S1-422]*

Some responders already had their doubts:

- *"I think initially PBL may be more frustrating because nobody is giving definite answers & rights or wrongs. It will require a much greater degree of co-operation & team work than I'm used to." [S1-781]*
- *"can be frustrating, because you never feel your [sic] doing enough work." [S1-291]*

…but others were more philosophical:

- *"this will be <u>very</u> challenging and different to what I have previously experienced, but I will approach it with the same maturity I approach new things and succeed. I am also impressed that the teaching staff + students have welcomed 1st years so well to make them feel that if any problems arise with PBL there is someone to speak to." [S1-271]*

Closed question: Career

Career intentions (reported elsewhere)

Q6 "At the outset of your medical career, what is your intended career destination?"

Reported linked to all other study-elements **(p272)**.

Summary

In S1:

- At entry to medical school, over two-thirds of responders from the 1999 cohort described their learning at school in terms of its control and nature. Nearly three-quarters of them mentioned teacher-directed, very structured learning. The notion of being 'spoonfed' and receiving 'dictation' and prepared notes was prominent. Describing expectations of university learning, the vast majority (84.1%) considered that this would require a more active approach. Under the main supplementary theme to this, over a quarter highlighted a need for good time-management and priority-setting (25.8%) in an environment perceived to be less authoritarian. Only one responder was explicit about expecting more uncertainty in learning. In describing how learning to be a doctor might differ from previous learning experience, approximately half referred to the vocational/applied aspect. Moving on to the PBL approach, their descriptions revealed general optimism of its potential.
- They mostly envisaged a successful first year at medical school in terms of a positive learning experience (66.9%), performing well in assessments (55.2%), social acceptance and friendship (45.5%), and generally enjoying themselves socially (40.3%).
- They painted a philosophical picture of pre-registration house officer role (five years hence) as: working long hard hours (58.0%), performing basic clinical duties on medical and surgical rotations (51.3%), and gaining much experience while learning under supervision (45.3%). Their descriptions of the good doctor generated nine themes of which compassionate patient-centredness (77.4%) and good communication skills for listening, explaining, etc. (74.2%) predominated. The least prominent themes involved being a well-balanced, insightful 'individual' (8.4%) and an efficient, organized self-manager (7.1%).

Results 2: 1999 cohort S2, end-of-Year 1

Questionnaire response (Table 1a, Ib, 1c, p158, p159)

By the end of Year 1, one student had transferred out, two students had suspended studies and another student had effectively suspended studies (long-term absence), leaving 224 students. (Of the 4, 2 had responded to S1.) The S2 response rate was 137/224 (61.2%), and not statistically significantly different from that (68.0%) in S1 when analysing them as independent samples **(Table 1a, p158)**. Analysing for paired data about responses to S1 or S2, there was no statistically significant difference in whether single-responders responded to the latter (n=32) versus the former (n=48).

There was no statistically significant difference in the proportion of males amongst responders to S1 compared with S2 (36.1% versus 41.6%: Yates-corrected $\chi^2=0.70_1$ and p=0.402; 95% confidence interval on –5.48 difference –16.67 to 5.72). Furthermore, there was no statistically significant difference in the proportion of males amongst double-responders (to both S1 and S2) compared with those responding to neither study-element (41/105, 39.0% versus 16/39, 41.0%: Yates-corrected $\chi^2=0.001_1$ and p=0.981; 95% confidence interval on –2.0 difference –20.02 to 16.06).

Open-ended questions: Learning in a problem-based curriculum

Factors helping learning (Table 7)

Q1 "Outline three things that have particularly helped your learning in this academic year"

In their top three choices of factors that helped their learning, the 136 responders cited diverse factors, generating 24 overall themes **(Table 7)**. The commonest theme involved specific aspects of the problem-based environment and PBL sessions (30.9%). Under various themes, 49/136 (36.0%) responders referred directly to at least one aspect of PBL or something integral to the design of this problem-based curriculum, and others referred to elements facilitated by the problem-based curriculum design.

Table 7: Questionnaire survey of Year 1 medical students at end of 1999/00 (Study-element 2): Twenty-four themes* emerging from answers to Q1 (n=136): "Outline *three* things that have particularly *helped your* learning in this academic year"

Theme *Three* things that have particularly helped my learning in this academic year are:	Students mentioning ≥1 concept(s) in this overall theme: no.	%	(initial comments for this overall theme as a % of n=388 comments for all overall themes)** no.	(%)
▪ **problem-based learning sessions** discussing and sharing, working with others in small-groupwork, good groups, good tutors	42	*30.9*	42	*(10.8)*
▪ **human anatomy resource centre** (sessions, facilities, and specimens with notes to illustrate and reinforce)	38	*27.9*	38	*(9.8)*
▪ **virtual resource centre** (population perspective, X-rays, links, etc.)	38	*27.9*	39	*(10.1)*
▪ **support and encouragement from fellow and older students,** working with others, friends as a resource for advice and motivation	33	*24.3*	34	*(8.8)*
▪ **access to internet/computing/library resources** (books, offprints)	32	*23.5*	38	*(9.8)*
▪ **clinical skills resource centre,** logbooks, booklets, and sessions (practical experience that reinforces learning; well-run; drop-in facility)	30	*22.1*	30	*(7.7)*
▪ **plenaries** that are interesting, relevant to scenario, have broader content	21	*15.4*	22	*(5.7)*
▪ **recommended reading-lists**	16	*11.8*	16	*(4.1)*
▪ **certain textbooks**	16	*11.8*	17	*(4.4)*
▪ **various, good/supportive/friendly academic tutors/staff:** problem-based learning, clinical skills, and/or communications skills; or personal tutors	13	*9.6*	15	*(3.9)*
▪ **self-motivation, enjoyment, interest** for this subject/curriculum	12	*8.8*	14	*(3.6)*
▪ **ability to control own learning,** the self-directed learning process	12	*8.8*	13	*(3.4)*
▪ **working in small groups generally**	8	*5.9*	8	*(2.1)*
▪ **leisure/social life and domestic support**	8	*5.9*	8	*(2.1)*
▪ **various resources available to us,** e.g. physical/practical/information resources	8	*5.9*	8	*(2.1)*
▪ **clinical science resource centre**	8	*5.9*	8	*(2.1)*
▪ **curriculum structure** (integration of practical and theoretical; components complement each other) and philosophy (learning for understanding rather than just examinations)	7	*5.1*	8	*(2.1)*
▪ **(formative) assessment and self-assessment questions**	7	*5.1*	7	*(1.8)*
▪ **past experience/knowledge:** previous degree, retaking year etc.	7	*5.1*	8	*(2.1)*
▪ **student-generated web-pages** (nationally and locally, e.g. 1st year LMSS webpage with appropriate links)	6	*4.4*	6	*(1.5)*
▪ **communications skills component**	3	*2.2*	3	*(0.8)*
▪ **special study module**	3	*2.2*	3	*(0.8)*
▪ **[inappropriate] contribution from problem-based learning tutor:** ward-rounds; telling students what they should know	2	*1.5*	2	*(0.5)*
▪ **enjoyable friendly atmosphere**	1	*0.7*	1	*(0.3)*
			388	*(100.4)*

Total does not add to 100.0% due to rounding *Liverpool MBChB curriculum. Year 1 medical students. Study (S)2*

Eighteen responders outlined 1 or 2 things, and others outlined more than one 'thing' from the same theme

*via 74 initial concepts (for which, 388 mentions in total + 20 blanks = 136X3) → 24 themes (371 first-mentions)

**This allowed for multiple mentions of initial comments under the same final theme (e.g. if a responder felt strongly enough to have three related, albeit different, 'things' for the three suggestions)

The joint second themes (27.9% each) involved two aspects of the tailored learning resources, i.e. the human anatomy resource centre and the virtual [computer-based] resource centre. Close behind were collegial relationships with peers (24.3%) and library and computing resources (23.5%). The contribution of plenaries came in at seventh (15.4%). Various other personal factors contributed, such as self-motivation. Two students favoured PBL tutors' actions that would be deemed inappropriate for the Liverpool role. Only one student specified the *"enjoyable friendly atmosphere"*.

Such answers were illustrated by:

- *"➢Clinical skills sessions ➢The human anatomy resource centre ➢PBL sessions." [S2-530]*
- *"➢Access to books ➢Other members of PBL. ➢Virtual Resource Centre" [S2-090]*
- *"➢Having other students demonstrate their knowledge in PBL – motivating me to do more and indicating what level I should be working at. ➢facilities in HARC. ➢Clinical Skills" [S2-761]*

The order given by the responders was largely unchanged when allowing for multiple mentions of initial comments under the same final theme (i.e. using proportion of total initial comments under all themes that came under this theme). The commonest theme remained specific aspects of the problem-based environment and PBL sessions.

Responders provided an insight into their year with, for example, *"The lovely 2nd year nurse next door but one"*, *"appreciation of being given another chance (to resit 1st year)"*, *"Given the time to go away + read."*, *"2nd year input/discussions"*, *"encouraging girlfriend"*, *"Tutor support (personal tutor)"*, *"Small number of students in PBL group"*, *"University nursery places for my [child/children]"*, and *"Peer pressure"*.

Factors hindering learning (Table 8)

Q2 "Outline three things that have particularly hindered your learning in this academic year"

For their top three perceived hindrances, responders mostly cited concerns about the library-based resources not meeting their needs (29.9%). The themes coming a close joint second covered technical problems (particularly reliability) accessing computer-based resources and their doubts about level and breadth of learning (27.6%) **(Table 8)**. Difficulties with PBL came fourth (22.4%). The seventh theme of perceived hindrances was the same as for perceived helps, i.e. plenaries (13.4%), and was joined by the theme of personal problems (13.4%).

Such answers were illustrated by:

- *"➢Lack of availability of library based resources. ➢Being left to devise my own learning programme at times. ➢Not having 'PBL' work checked/regulated." [S2-520]*
- *"➢Lack of book resources ➢Poor PBL learning objectives ➢Lack of focus on what to learn" [S2-450]*
- *"➢Not everybody in the PBL group works as part of a team or contributes equally ➢Limited access to computer facilities, especially during SSM1. ➢Recommended reading list is not always easily accessible." [S2-001]*
- *"➢The unreliable nature of computer facilities & frequently being unable to log on to the system ➢Availability of resources on the recommended reading list ➢No syllabus?" [S2-301]*

The responders' priorities for perceived hindrances remained largely unchanged when allowing for multiple mentions of initial comments under the same final theme (i.e. using proportion of total initial comments under all themes that came under this theme). The commonest theme remained limitations with library resources.

Responders conveyed hindrances as diverse as, for example, *"Being so far from home"*, *"A Bad Tutor"*, *"Living in Halls!"*, *"Living in halls – noise at irregular times so can't sleep/study"*, *"Homesick"*, *"Financial Pressures ie. Tuition Fees, Costs of Books"*, *"Laziness"*, *"Having Two major leaks + other building Problems + having to co-ordinate, claim, repair buildens [sic] etc during the end of term/exam time"*, *"Library social activities"*, *"Making lots of friends with other students who don't have as much work"*, *"distracting girlfriend"*, *"PBL tutor not having any medical knowledge"*, and *"Alcohol"*. For some responders, all the perceived hindrances were external:

Table 8: Questionnaire survey of Year 1 medical students at end of 1999/00 (Study-element 2): Twenty-six themes* emerging from answers to Q2 (n=134): "Outline *three* things that have particularly *hindered your* learning in this academic year"

Theme ***Three* things that have particularly hindered my learning in this academic year are:**	Students mentioned ≥1 concept(s) in this theme: no.	%	(initial comments for this overall theme as a % of n=356 comments for all overall themes)** no.	(%)
▪ **limited availability in library** of resources/books/offprints on the recommended reading lists	40	*29.9*	42	*(11.8)*
▪ **problems with university computer-network/internet access:** slowness, unreliability, break-down, print-queues	37	*27.6*	39	*(11.0)*
▪ **not knowing what I am supposed to be doing,** to what depth & how much, not 100% sure what to learn, lack of set 'syllabus'	37	*27.6*	38	*(10.7)*
▪ **difficulties in problem-based learning** with: working with others (strangers, laziness, different ideas, no biology, non-teamworkers); sorting out learning objectives; the tutor's knowledge or bad tutor; getting used to it; noone checking work; timing of sessions; motivation required; hypothesizing too much; not being able to use notes	30	*22.4*	32	*(9.0)*
▪ **social life distractions** and alcohol, personal relationships, and outside interests/commitments	26	*19.4*	31	*(8.7)*
▪ **lack of instruction/guidance** on extent of study, little personal teaching contact, lack of teaching or explaining	25	*18.7*	25	*(7.0)*
▪ **plenaries:** too much detail, uninformative, irrelevant, poor, cancellations	18	*13.4*	18	*(5.1)*
▪ **personal problems:** illness, loneliness, financial pressures, part-time work, domestic support difficulties, language difficulties, partaking in a clinical trial, too hot to sleep	18	*13.4*	21	*(5.9)*
▪ **lack of self-discipline/motivation** for self-directed learning; tiredness	16	*11.9*	17	*(4.8)*
▪ **being in halls of residence:** noise, lack of sleep, alcohol, social life	11	*8.2*	11	*(3.1)*
▪ **History of Medicine:** competing with PBL work, irrelevance to modules	10	*7.5*	10	*(2.8)*
▪ **irrelevant/unfocused recommended reading**	10	*7.5*	10	*(2.8)*
▪ **the way we learn anatomy, difficulties with HARC**	10	*7.5*	10	*(2.8)*
▪ **lack of feedback: on work and formative assessment**	9	*6.7*	9	*(2.5)*
▪ **aspects of assessment:** lack of ongoing assessment, lack of practice questions multiple-choice questions, having different examination periods than other students	8	*6.0*	9	*(2.5)*
▪ **programmed activities:** timetable with day very broken up, overlong sessions, physiology practicals, long terms, no break after special study module	7	*5.2*	7	*(2.0)*
▪ **too much to learn, too little time**	5	*3.7*	5	*(1.4)*
▪ **lack of pressure/deadlines, freedom from expectation**	4	*3.0*	4	*(1.1)*
▪ **lack of internet access/facilities in halls of residence**	4	*3.0*	4	*(1.1)*
▪ **administrative difficulties:** slowness/cancellations, limited access to buildings, absent tutors	3	*2.2*	3	*(0.8)*
▪ **not always being able to access resources**	3	*2.2*	3	*(0.8)*
▪ **specific books or lack of specific books**	2	*1.5*	2	*(0.6)*
▪ **other students:** hiding/stealing books, intimidating group	2	*1.5*	2	*(0.6)*
▪ **getting used to change** in establishment/learning/information sources	2	*1.5*	2	*(0.6)*
▪ **special study module: supervision very poor**	1	*0.7*	1	*(0.3)*
▪ **lack of clinical skills resources**	1	*0.7*	1	*(0.3)*
			356	*(100.1)*

Total does not add to 100.0% due to rounding *Liverpool MBChB curriculum. Year 1 medical students. Study (S)2*

38 responders outlined 1 or 2 things, and others outlined more than one 'thing' from the same theme HARC=Human Anatomy Resource Centre

*via 83 initial concepts (for which, 356 mentions in total + 46 blanks = 134X3) → 26 themes (339 first-mentions)

**This allowed for multiple mentions of initial comments under the same final theme (e.g. if a responder felt strongly enough to have three related, albeit different, 'things' for the three suggestions)

- "➢Living in halls – many distractions ➢Many social events ➢Part-time job" [S2-502]

Essential characteristics of PBL (Table 9)
Q3 "Describe what, for you personally, are the essential characteristics of problem-based learning (PBL)" (Table 9)

Responders identified small-groupwork/dynamics (57.4%) (with another 23.5% mentioning 'the group' in passing) and testing understanding through discussion (55.1%) as PBL's two main essential features, followed by being motivated to learn (36.0%) **(Table 9)**. Such features were process-orientated as were many of the remaining suggestions. Setting their own learning objectives (33.1%), studying relevant things in the context of a clinical case (25.0%), undertaking self-directed learning (25.0%), having everyone participate (20.6%), and 'researching' for suitable information (16.2%) were subsidiary characteristics. Examples of descriptions conveying such themes were:

- *"Groups of students working through a common scenario to identify what needs to be learnt & why." [S2-220]*
- *"A senario [sic] that is relevent [sic] is given to small groups of approx. 6 people they then decide on a chair and scribe + go through senario [sic] together, setting up goals, clarifying + sharing any knowledge they have so far. Then they go away + research the goals + try to learn what they have read, so then when they meet again, people are able to share info. without files – any missing info. is clarified + if alls [sic] not covered more research is required before next sesion [sic]" [S2-620]*
- *"--It takes place amongst small groups.*
  --A scenario is discussed
  --Learning objectives are set by the students not by tutors
  --We learn separately + are not 'spoon-fed' knowledge by lecturers." [S2-340]
- *"--working effectively in a group to decide what is important to learn & what isn't*
  --self-motivation to teach yourself the material
  --being able to explain what you have learnt
  --listening as well as talking
  --reviewing & evaluating your work/progress" [S2-470]
- *"--Discussing openly with others [sic] ideas, problems & facts that you come up with.*
  --Working out as a team what is required from the scenario.
  --Allowing everyone in the group to have their say." [S2-631]
- *"Being able to set your own learning objectives + pooling resources from everyone. Learning lots of new info + finding it yourself is quite rewarding." [S2-771]*

Table 9: Questionnaire survey of Year 1 medical students at end of 1999/00 (Study-element 2): Twenty-one themes* emerging from answers to Q3 (n=136): "Describe what, for *you personally*, are the essential characteristics of problem-based learning (PBL)"

Theme The essential characteristics of problem-based learning (PBL) are:	Students mentioned ≥1 concept(s) in this theme: no.	%
▪ **collaborating as a team/group,** getting on with group, good group dynamics, small-groupwork; having a friendly, cheerful group, humour; helping each other learn, sharing knowledge, cooperating to learn from each other; communicating well with others in a group, listening to them	78	*57.4*
▪ **being able to discuss/compare, test/clarify understanding** what students learnt as a group, explain in own words to peers, make links, bounce ideas; testing, clarifying, and establishing understanding, sorting out difficulties, enhancing learning (acquiring/retaining/recalling knowledge) as you go along… that it's a style of learning	75	*55.1*
▪ **motivating yourself (as individual and group) out of interest/enjoyment,** learning because you want to/are enthusiastic; being committed to doing the work for yourself, taking on the responsibility; enjoying learning and being interested in learning; being organized, self-disciplined	49	*36.0*
▪ **deciding what to learn, formulating/setting your own learning objectives** (which are concise/clear), expose gaps in learning and decide what is important to learn	45	*33.1*
▪ **studying a case scenario (for context/relevance);** drawing out important and relevant information, integrating learning in context with real-life situations	34	*25.0*
▪ **self-directed learning,** working independently, using your own initiative, not being told the answer; choosing your own particular interests, challenges and depths you want to go into, being able to work at your own leisure	34	*25.0*
▪ **the group** *[[incidental mention only]]*	32	*23.5*
▪ **having everyone participating** /contributing equally/fully	28	*20.6*
▪ **going out and finding a variety of sources of information** ourselves, tracking down suitable information for notes, researching	22	*16.2*
▪ **having a good/helpful/useful/knowledgeable tutor** intervening appropriately	18	*13.2*
▪ **addressing a problem from many different angles** (looking at social and psychological aspects too, as well as public health issues, etc.; deciding what medical, social, professional, etc. aspects there are); studying in-depth	17	*12.5*
▪ **returning and reporting back, reviewing** what you have learnt, evaluating progress	13	*9.6*
▪ **having/building confidence in the process,** in what you are saying; being open, honest, and able to trust the group	12	*8.8*
▪ **drawing on/activating prior knowledge** (collective and individual), trying to adjust to other people's skills, different backgrounds/experiences	11	*8.1*
▪ **analysing and tackling problems;** being open-minded, thinking, being specific	10	*7.4*
⌧ ***negative aspects:*** *not that useful; not knowing what we really need to know, unequal contributions*	7	*5.1*
▪ **few lectures**	3	*2.2*
▪ **technical aspects of sessions:** deciding on chair and scribe; having at least three sessions a fortnight	2	*1.5*
▪ **good notes**	1	*0.7*
⌧ ***not sure if I have understood the question***	1	*0.7*
⌧ ***inappropriate element:*** *ability to look up appropriate notes*	1	*0.7*

Liverpool MBChB curriculum. Year 1 medical students. Study (S)2

*via 91 initial concepts (610 mentions) → 34 interim themes (560 first-mentions) → 21 themes (493 first-mentions)

The need for all students to participate appropriately was tinged with concerns about striking a balance, e.g.: *"Motivation high within the PBL group otherwise a small number of students end up doing all the work... ", "...If you don't work, it is you who is cheated nobody else. This should be stressed more by faculty initially.", "Input from all members of the group, i.e. not ruled by a couple of 'show-offs' who believe they are correct/have the most valid opinions...".* The contribution of the tutor was acknowledged by 13.2% of responders, e.g. *"...Appropriate amount of input from tutor..." and "...A PBL tutor + students who believe in the PBL process and who are prepared to work at making it successful."*

Individual descriptions of PBL encompassed between one and nine themes (median 3). Seven responders' descriptions were 'one-theme only', and involved five different themes (----- delimiting same theme):

- *"Self-discipline" [S2-700]*

- *"FOFO (+ a small amount of guidance.)" [S2-980]* *[translation note: 'F*** off and find out yourself']*
- *"Choosing your own particular interests, challenges & depths you want to go into." [S2-322]*

- *"Discussion around the structure and function areas in detail to ensure everyone has covered the same aspects and to the same degree of depth. This also ensures of [sic] understanding in a given module and topic." [S2-101]*
- *"Showing others what you know & discussing what you dont [sic] know aids learning." [S2-221]*

- *"Sharing knowledge, helping each other learn" [S2-401]*

- *"PBL puts health and disease into a social/psychological context and widens the students' perspective, so that they understand that patients are people, not just 'cases'." [S2-741]*

The single description incorporating most, i.e. all nine, themes conveyed both 'opportunity' and examples of negative things:

- *"I see PBL as a good opportunity for discussions & exchange of ideas, however, I do get frustrated because there are no guidelines on what we really need to know. Also, PBL can be frustrating when people have different views on how much work needs to be done & some members of PBL are very much less active than others, not making much of an effort. The aspect I most enjoy about PBL is that we have our learning around a clinical case. This makes learning more interesting & helps to put all the information on bodily systems etc into place. I also really like the fact that PBL isn't just about physiology &*

anatomy, but looks at social + psychological aspects too, as well as public health issues etc.
Discussing the learning object [sic] – explaining processes & listening to others' explanations helps to consolidate knowledge & increases confidence. PBL also gives us good experience of working with others, which is a skill that is needed in medicine." [S2-820]

Further responders conveyed the 'opportunities' with PBL:

- *"Working as part of a team to analyse a situation and think laterally about all the possible implications of a medical scenario.*
  Enables flexibility of learning & gives students the opportunity to study particular areas of interest in more depth.
  Promotes a more independent approach to learning and information gathering." [S2-170]
- *"PBL is an opportunity to share ideas & sort out any problems. An opportunity to ask questions and resolve any matters that have been difficult to understand during the week" [S2-611]*
- *"An opportunity to share knowledge and to discuss ideas or difficult concepts with peers, in order to achieve a fuller understanding of the subject." [S2-571]*

Some responders conveyed their understanding of the educational rationale behind this learning strategy:

- *"Working in a group, and being able to trust that group to look up the information accurately and to report it back. To be motivated is essential because the work is done very individually. The essence of it is to keep reinforcing what you knew by having another point of view." [S2-810]*
- *"Picking out and discussing relevant information, sharing knowledge and learning from each other. Being able to relate ideas and opinions to others and listen to them." [S2-621]*
- *"A style of learning that requires self discipline, self motivation, and use of your own initiative. It teaches you to learn that it doesn't matter what other people have learnt or if you get any praise, what matters is that you have done enough work to equip you to be the best doctor you can." [S2-031]*
- *"Using prior knowledge + pooling resources to devise the best way to learn about a topic, reviewing what is learnt to establish understanding." [S2-441]*
- *"Activating prior knowledge, and discussing what you have learnt really helps sort out what you know & what you need to work on." [S2-881]*

One responder described PBL in terms of some personal 'rules' underpinning a PBL session:

- *"▪If you have something to say or a query, ask + don't feel silly*
  ▪Help each other out as much as poss.
  ▪Not one person dominating
  ▪A helpful + useful tutor
  ▪All in the same boat so sharing is good." [S2-780]

Advantages & disadvantages of PBL (reported elsewhere)

Q4a/b "For PBL, what do you see as its ***main*** *advantage and disadvantage?"*

Reported elsewhere linked with S5 **(p203)**.

Characteristics of a good PBL tutor (Table 10)

Q5 "Outline three characteristics of a good PBL tutor:"

In describing the top three characteristics of a good PBL tutor, responders particularly highlighted tutors knowing when and how to intervene without 'taking over' (51.1%) **(Table 10)**. The strongest supplementary themes were:

- tutors acting as a 'guide' to the 'what' and 'how much' (40.0%), illustrated by these six responders:

  e.g. *"tutor who guides you & prevents digression"; "Can point you in the right direction if your group goes off on a tangent."; "Indicates when we are going into too much depth."; "Looks on objectively but occasionally steers group into the right direction or onto a different theme if necessary."; "Able to steer you away from irrelevant topics of study"; "If the group wanders of [sic] topic – returns them to the subject."*

- their approachability and communication skills and their motivational skills in maintaining participation/momentum (both highlighted by 29.6% each)

  e.g. *"Makes a session enjoyable through humour + friendly chat."; "tutor who is friendly & communicative, who I feel at ease with."; "Being friendly and supportive to the group."; "Is not intimidating."; "Doesn't make students feel stupid & thick"; "Sense of humour; not strict (or too strict)";*

  e.g. *"Encourages everyone to speak."; "Ability to draw quiet group members into the proceedings and encourage motivation within the group."; "Keeps a good group momentum"; "One who is supportive."; "is relatively intuitive so recognises when someone is uncomfortable in gp or having problems with work and is able to bring shyer people in more."*

Table 10: Questionnaire survey of Year 1 medical students at end of 1999/00 (Study-element 2): Eighteen themes* emerging from answers to Q5 (n=135): "Outline *three* characteristics of a good PBL tutor"

Theme *Three* characteristics of a good PBL tutor are:	Students mentioned ≥1 concept(s) in this theme: no.	%	(initial comments for this overall theme as a % of the n=387 comments for all overall themes)** no.	(%)
▪ **is able to listen, hold back and allow you to lead** your own discussion, knowing when and how to intervene without interfering, taking over or talking too much, resisting telling you the answers	69	*51.1*	75	*(19.4)*
▪ **guides us on the right track and depth**	54	*40.0*	57	*(14.7)*
▪ **is friendly and approachable,** has a sense of humour, and communicates and empathizes well with students	40	*29.6*	46	*(11.9)*
▪ **encourages full participation,** motivates, supports, maintains momentum	40	*29.6*	41	*(10.6)*
▪ **must have sufficient understanding of the knowledge-base** that you need to know	32	*23.7*	33	*(8.5)*
▪ ***inappropriate*** joins in with group discussion, offering own experiences and gives information, opinions, and explanations, correcting inaccuracies, answering questions, and telling you what you need to know	24	*17.8*	26	*(6.7)*
▪ **shows commitment, interest, responsibility;** giving time and effort to the group	18	*13.3*	19	*(4.9)*
▪ **helps if you are very stuck,** and lets you know if you are missing important areas	18	*13.3*	18	*(4.7)*
▪ **challenges/clarifies understanding and stimulates thinking** by asking questions	17	*12.6*	17	*(4.4)*
▪ **has insight into group dynamics and own input,** contributes to process, allowing session to flow	16	*11.9*	16	*(4.1)*
▪ **creates a friendly, relaxed, safe atmosphere,** is constructive and non-judgemental about the discussion	11	*8.1*	11	*(2.8)*
▪ **helps you formulate specific learning objectives** and is well-aware of the intended learning objectives	8	*5.9*	9	*(2.3)*
▪ **provides feedback** on individual and group performance	6	*4.4*	6	*(1.6)*
▪ **understands and keeps to the problem-based learning process**	5	*3.7*	5	*(1.3)*
▪ **recognizes and understands students' problems**	3	*2.2*	3	*(0.8)*
▪ **does not just focus on his/her own subject-expertise**	2	*1.5*	2	*(0.5)*
▪ **seeks and acts on group feedback**	2	*1.5*	2	*(0.5)*
▪ **makes sure that the group evaluates at the end of session**	1	*0.7*	1	*(0.3)*
			387	*(100.0)*

Liverpool MBChB curriculum. Year 1 medical students. Study (S)2

Seventeen responders outlined 1 or 2 things, and others outlined more than one 'thing' from the same theme
*via 74 initial concepts (for which, 387 mentions in total + 18 blanks = 135X3) → 18 themes (366 first-mentions)
**This allowed for multiple mentions of initial comments under the same final theme (e.g. if a responder felt strongly enough to have three related, albeit different, 'things' for the three suggestions)

- and their having sufficient understanding of the knowledge-base (23.7%), which gave various requirements:

  ◗ *"having the knowledge (medical/science)"*; ◗ *"Must know what is important to know as a doctor!"*; ◗ *"Have a good knowledge of medicine"*; ◗ *"Someone who has a good grounding in Structure + Function"*; ◗ *"having some scientific background"*; ◗ *"Good knowledge of subject so we can't bullshit!!"*; ◗ *"One that works for the NHS ie not a scientist."*; ◗ *"*MEDICALLY QUALIFIED*"*; ◗ *"Some-body who understands the course e.g. a medical proffesional [sic]"*; ◗ *"One who has some knowledge & can ask questions to make us think about topics."*; ◗ *"Needs to have a medical/science (biology) background."*; ◗ *"knows the work you are doing"*; ◗ *"Someone with reasonable awareness of public health issues and scientific knowledge."*; ◗ *"I do think it would help if they were academically suited to the problem."*

Examples of answers combining three of the top five characteristics were:

- *"Motivating*
  Friendly
  Doesn't interupt [sic] too much." [S2-380]
- *"friendly*
  gives basic guidelines – ie keeps group to the point
  has some medical/scientific knowledge." [S2-690]
- *"--Knows when to interupt [sic] to coax or add info to discussion.*
  --Friendly and approachable
  --Knowledgable [sic] in the subject content of the module." [S2-790]
- *"--Encourages quieter members to participate*
  --Suggests further insight may be required.
  --Does not disclose learning objectives" [S2-411]
- *"--Can redirect where necessary.*
  --Lets us listen + think before interrupting.
  --Friendly." [S2-491]
- *"--Lets you know if you're 'on the right path'.*
  --Approachable
  --Supportive + acts 'professionally' – my 1st PBL tutor didn't + the group found that we weren't encouraged by her." [S2-012]

The responders' priorities for the characteristics remained largely unchanged when allowing for multiple mentions of initial comments under the same final theme (i.e. using proportion of total initial comments under all themes that came under this theme). The commonest theme remained knowing when and how to intervene without 'taking over'.

Only 17.8% of the responders suggested characteristics (mostly actions) that conflicted with the problem-based philosophy, such as the tutor joining in discussions of content, correcting inaccuracies, and telling students what they need to learn, as illustrated by these eight responders:

> *"stating the key-point [sic] along as the students are discussing"; "Offer opinions & participate [sic] in discussion"; "At the end will add additional areas of research that they think should be covered."; "One that contributes information from experience ie that which cannot be found in books."; "offer helpful bits of info eg references."; "Corrects any wrong points decided".; "One who answers questions & gives us snippets of information."; "Contributes to the discussion if their area of expertise comes up.".*

Under the showing commitment, interest… theme, two responders highlighted specific personal requirements: *"Tea/coffee/biscuits"* and *"someone who makes good cakes"*.

Exceptions included the single responder mentioning an often neglected but key requirement of PBL, *"Making sure the group evaluates at the end of sessions."* and the 3.7% wanting the tutor to understand and keep to the rules of PBL, e.g. *"Sticking to rules (eg. no notes in tutorial)"* and *"Knowledge of PBL process."*.

Closed question and scored question: Career & characteristics of a good doctor

Reconfirming characteristics of a good doctor

Reported elsewhere with S5 **(p195)**.

Career intentions (reported elsewhere)

Q7 "At this stage in your medical career, what is your intended career destination?"

Reported linked to all other study-elements **(p272)**.

Summary

In S2:

- By the end of the first academic year, considering the main factors that had helped their learning overall, almost one-third of responders from the 1999 cohort cited specific aspects of the problem-based environment and PBL sessions as the main theme. The human anatomy resource centre and the virtual resource centre were the joint runner-up themes. In terms of main perceived hindrances, almost one-third of responders cited inadequate library-based resources for their purposes. Reliability/technical problems accessing computer-based resources and doubts about level and breadth of learning came a close joint second, each being cited by just over a quarter of responders each. Difficulties with PBL came fourth (22.4%).
- Now, after two semesters of PBL, responders' perceptions of the essential features of PBL were mostly process-orientated, focused on small-groupwork/dynamics (57.4%) and testing understanding through discussion (55.1%). Only 13.2% acknowledged, as essential, the role of the tutor in intervening appropriately. When specifically describing the good PBL tutor, however, most responders valued those who knew when and how to intervene without 'taking over' (51.1%), followed by tutors acting as a 'non-telling guide' to the 'what' and 'how much', approachable tutors with good communication skills, and tutors with motivational skills for maintaining participation/momentum.

Results 5: 1999 cohort S5, mid-Year 3

Questionnaire response (Table 1a, Ib, 1c, p158, p159)

By mid-Year 3, 20 further students had suspended studies or left (e.g. long-term absence) since the end of Year 1, with 204 students remaining with the main cohort. The S5 response rate was 159/204 (77.9%). Differences between the response rates across all three study-elements ---68.0%, 61.2%, and 77.9%--- were very highly statistically significant **(Table 1a, p158).** Concerning the source of this difference, the S5 response rate exceeded that of S1 (statistically significant) and that of S2 (very highly statistically significant), when analysing them as independent samples. Analysing for paired data about responses to S1 or S5, the single-responders were statistically significantly more likely to respond to S5 (n=40) than S1 (n=20). Likewise, analysing for paired data about responses to S2 or S5, the single-responders were more likely (very highly statistically significant) to respond to S5 (n=44) than S2 (n=12).

There was no statistically significant difference in the unpaired proportion of males, home (EC), or school-leavers (including resit A-levels and gap-year) between responders to S1, S2, and S5. Furthermore, on Chi-square test (unpaired data), there was no statistically significant difference in the proportion of males amongst:

- double-responders, to both S1 and S5, compared with those not responding to at least one of them (43/119, 36.1% versus 38/85, 44.7%: df=1, Yates-corrected χ^2=1.18$_1$ and p=0.276; 95% confidence interval on 8.6% difference –5.07, 22.22). Accounting for the pairing gave, however, a McNemar's exact p-value of 0.0005, i.e. statistically significantly more females providing a double-response.
- double-responders, to both S2 and S5, compared with those not responding to at least one of them (48/115, 41.7% versus 33/89, 37.1%: df=1, Yates-corrected χ^2=0.28$_1$ and p=0.596; 95% confidence interval on -4.7% difference -18.15 to 8.83). Accounting for the pairing gave, however, a McNemar's exact p-value of 0.001, i.e. statistically significantly more males amongst the double-responders.

Comparing those responding to all three study-elements with those responding to none, there was no statistically significant difference in the proportion of males (34/91, 37.4% versus 7/19, 36.8%; Yates-corrected χ^2=0$_1$ and p=1.000; 95% confidence interval on -0.5% difference –24.38 to 23.34).

Open-ended questions: The experience of PBL and learning about *Population Perspective*

The experience of PBL (Boxes 12a & 12b)

Q22 "Looking back, provide your two main comments on your experience of learning for a medical career via PBL"

Responders' two comments about their experience of learning to be a doctor via PBL appeared to reflect broadly the extent to which they were satisfied with their current curriculum (using *"...would still do Medicine in this Liverpool problem-based curriculum"* as a proxy-measure, **Table 11**). Nevertheless, some of those who were the most satisfied (Likert 4 or 5) harboured negative comments about their experience **(Box 12a)**, and some of those who were the least satisfied (Likert 3, 4, or 5) were more positive **(Box 12b)**, showing the links to be quite complex. Setting aside the seven declining to comment, 28/152 (18.4%) responders made *uniformly* negative comments, with statistically significantly more of these amongst those who were least satisfied with their current curriculum (Likert 3, 2, 1) (16/44, 36.4% versus 12/108, 11.1% for the most satisfied; df=1, Yates-corrected χ^2=18.90, and p=0.00001; 95% confidence interval on 25.25% difference: 9.85, 40.65).

Explicit acknowledgement that PBL requires continued self- and/or group-motivation permeated the comments of 16/152 (10.5%) responders, and four further responders explicitly acknowledged that PBL itself provided the motivation. Negative comments about responders' experience covered issues causing anxiety or fostering underconfidence, such as *perceived*:

- lack of academic support, particularly early in the curriculum (e.g. induction), via expert resources (experts to consult, plenaries), or via PBL tutors for guidance on breadth and depth of learning
- lack of basic science knowledge (10/152, 6.6%), as compared with other undergraduate medical programmes or as highlighted to them by hospital clinical consultants
- conflicts in curriculum design/implementation: mismatch between learning required in hospital clinical placements and that generated by PBL scenarios; and insufficient time allowed for PBL study because of competing commitments.

Box 12a: Questionnaire survey of Year 3 medical students mid-2001/02 (Study-element 5): Examples of Q22: "Looking back, provide your two main comments on *your* experience of learning for a medical career via PBL..." from 25 responders who 'agreed' or 'agreed somewhat' (Likert 4 or 5) with Q21: "If I had my time again, I would still do Medicine in this Liverpool problem-based curriculum"

Two main comments on *your* experience of learning for a medical career via PBL		Likert on 'satisfaction'
"I found the first term absolutely terrible – I felt I was floundering with no guidance as to what level I should be learning at. I started much too deeply but there was noone to tell me where I was going wrong. Once I realized my mistake, PBL began to work for me and now I support PBL...	*...However, support in the early stages is vital + was lacking on this course. Surely illustrating depth of knowledge required with examples is not too hard. Unfortunately, plenaries were often over our heads (in 1st year) + therefore made anxiety even worse." [S5-130]*	5 Agree
"1 Brainstorming ideas/concepts as a team introduces other ideas etc that you never thought of previously.	*2 Increases confidence and banishes 'shyness'" [S5-930]*	
"Very self orientated + without motivation very easy to fall behind.	*Gives us an insight into everyday clinical problems and so prepares us for what we will expect." [S5-040]*	
"it can be very useful but depends on tutor and group.	*v. hard to know how much depth to go into." [S5-250]*	
"Would like a little bit more guidance into what content to learn for exams.	*feels very vocational – starting to feel more like I'm on my way to being a doctor." [S5-850]*	
"inconsistent, depending on good/not so good tutor.	*Frustrating at times when limited time to study scenarios, at times only 1/52" [S5-660]*	
"Confusing at times.	*Better than 9-5 lectures – more productive." [S5-370]*	
"Sometimes it is hard to know how much work we should be doing.	*This can be a problem during revision for exams." [S5-551]*	
Still unsure as to what depth to go into.	*Content is repeated in scenarios later on which makes it easier to understand." [S5-361]*	
"It works really well, as you can decide when to study each particular topic.	*PBL sessions are only beneficial if the group is motivated." [S5-602]*	
"It makes you much better at explaining things + working in a team → v. useful in hospital	*Information makes more sense as different subjects are linked together" [S5-212]*	
"Requires lots of self-motivation	*Rewarding when you do it all well" [S5-712]*	
"PBL makes you think	*PBL makes you work as a team" [S5-600]*	4 Agree somewhat
"Good idea but it needs more regulation between tutors.	*It is very scary to begin with." [S5-220]*	
"relaxed, easy learning atmosphere	*varying consistency in tutors." [S5-140]*	
"No real sense of direction – whole gp [sic] could be going off on a tangent.	*Need to have a 'syllabus'/revision list given to us before exams" [S5-240]*	
"Often I remember more info. than I thought I knew	*The group scenario provides much needed support while studying" [S5-840]*	
"Very little feedback on if you are covering enough and help is often unavailable if you are having difficulties.	*The exams are unrepresentative of what you learn in PBL and on the Wards. Leaving your efforts unrewarded [sic]. It is luck if you pass." [S5-940]*	
"works only for those who work hard anyway	*consultants continually question us + our competence" [S5-470]*	
"There is a very large variation in tutors. Some v. helpful + others not	*It is what you make it. Getting on with your group is v. important in order to learn effectively." [S5-780]*	
"PBL has taught me how to manage my time effectively.	*PBL has made me question things rather than accepting info without really considering it." [S5-611]*	
"works for me because I'm organised and motivated	*Sometimes frustrating when others aren't as keen; don't put in time or effort. This weighs the atmosphere down esp. if they are also negative." [S5-811]*	
"generally positive	*could benefit from more formal teaching back up" [S5-421]*	
"The consultants don't think we know enough.	*Nice to work in groups." [S5-802]*	
"The experience depends a lot [sic] on the PBL group & their enthusiasm & how keen they are to complete the full PBL process.	*To start with facts are learnt in isolation but then everything starts to connect & how things are linked falls into place." [S5-822]*	

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n=158 for Q21; n=152 for Q22 Likert scale from 1 disagree to 5 agree

Box 12b: Questionnaire survey of Year 3 medical students mid-2001/02 (Study-element 5): Examples of Q22: "Looking back, provide your two main comments on *your* experience of learning for a medical career via PBL…" from 22 responders who 'neither agreed/disagreed', 'disagreed somewhat' or 'disagreed' (Likert 3, 2, or 1) with Q21: "If I had my time again, I would still do Medicine in this Liverpool problem-based curriculum"

Two main comments on *your* experience of learning for a medical career via PBL		Likert on 'satisfaction'
"It is often difficult to be motivated to do all the work – as well as find the time to do all that we are expected to.	*Scenarios are often totally unclear, & almost impossible to get the required learning objectives from." [S5-720]*	3 Neither agree/disagree
"Different parts of the course (eg PBL + hospitals) don't seem to communicate with one another at all	*While there must be a reason for everything we are asked to do, it often isn't told to us until after we have done it, which reduces motivation" [S5-640]*	
"Very frustrating not having any idea about what we should learn (reflected in exams: not representative)	*PBL modules don't reflect what we are learning in hospital" [S5-740]*	
"Good: allows more time spent on self-directed learning or individual style of learning.	*Suggestions: reveal some essential learning objectives or general themes that are expected from students." [S5-270]*	
"Encourages working within a group, discussion with colleagues.	*Encourages self-study and self-motivation." [S5-680]*	
"Allows a more relaxed and practical approach to learning.	*Forces self-organisation and time management." [S5-390]*	
"Enables me to work at my own pace	*Has made me better at time management" [S5-751]*	
"You have to maintain a constant self-motivation.	*It is very tempting when work load is great to use only one/two reference texts in coursework for PBL." [S5-002]*	
"seems a patchy way of learning things that are very important	*learn to speak more & explain concepts" [S5-410]*	2 Disagree somewhat
"I don't feel we have covered enough anatomy and Physiology in depth c.f. other medical schools.	*I feel short changed that we don't get a series of lectures, only the odd plenaries." [S5-150]*	
"It can be a very confusing experience (& frustrating).	*As a student, I feel very unsupported and alone in my studies." [S5-450]*	
"It's a brilliant system but has gone too far to the other extreme.	*ie/ All lectures was [sic] rubbish, no one learnt anything BUT All PBL is rubbish, not enough back up from structured teaching." [S5-290]*	
"I don't know if I have learnt what is expected.	*It seems unfair to be examined on untaught subject – ethics." [S5-821]*	
"Clinical experience puts the theory into context	*I have really enjoyed it It is an interesting way of learning – it's never bored me." [S5-351]*	
"Good system of learning in theory but rarely works well	*most of the time PBL work seems to be in the way - never having sufficient time to prepare effectively" [S5-981]*	
"No real teaching. Most of medicine can be self-taught, but there are areas that I feel need detailed explanation, and for me this has been obtained from doctors on hospital placements rather than PBL tutors	*I understand that the PBL tutors are supposed to take a 'back-seat', but some that I have come across needn't have been there because they provided no input." [S5-580]*	1 Disagree
"The tutor can greatly influence the quality of the tutorials.	*You must be focused on doing PBL properly and not allow yourself to drift." [S5-051]*	
"Good but more support needed in the form of some lectures.	*Occasionally feel unsure of what is expected." [S5-651]*	
"It's easy to get away without doing any work.	*Good for group dynamics learn to work with lots of different people." [S5-461]*	
"It is very easy to do no work at all.	*How can we have the knowledge needed for hospital? We obviously don't if they give us lectures before letting us loose on the ward – and now the 1st Yrs are getting proper lectures unlike our year." [S5-971]*	
"Needs more backup in basic sciences i.e. lectures & resources	*When in clinical setup not confident of my own knowledge of basic sciences" [S5-881]*	
"1.It is very difficult to be confident in the knowledge that you are learning what you are supposed to.	*2.The actual derivation of learning objectives seems to me to be a total waste of time." [S5-202]*	

n=158 for Q21; n=152 for Q22 Likert scale from 1 disagree to 5 agree Liverpool MBChB curriculum. Year 3 medical students. Study (S)5

- lack of consistency in quality of tutoring (8/152, 5.3%), given that this input was perceived as crucial

Positive comments about responders' experience covered *perceived*:

- promotion of self-motivated, flexible, enjoyable, productive learning
- cognitive benefits for thinking, generating ideas, retaining/explaining knowledge
- vocational advantage by integrating learning in a clinical context
- personal improvements in time management and organization, confidence, and sense of achievement of doing it properly

Learning about Population Perspective

Reported elsewhere linked to S6 **(p211)**.

Career (also reported elsewhere), characteristics of a good doctor, learning/tutoring & satisfaction data

In S5, learning approaches showed associations with other parameters such as satisfaction with the curriculum **(Table 11)**. Before turning to these more complex relationships, the general distribution of learning approaches should be noted: the median subscale scores out of 30 were 21.0, 22.0, and 15.0 for deep, strategic, and surface, respectively. Reliability was moderately good with Cronbach's alphas from 0.608 (surface) to 0.722 (deep). The alpha for the deep subscale did not fall on deleting any item, indicating that no item was reducing the reliability. For the strategic and surface subscales, however, alpha fell on deletion of one item (noting tutors' written comments) and two items (learning just the things to pass assessments; drowning in work), respectively, indicating that these items were reducing subscale reliability **(Table 12)**. Just over half the responders scored highest on the strategic subscale. Nearly one-quarter of responders had either deep or strategic learning as the least evident approach. Overall, the responders allocated least points (26.9%), of the 90 points available, to the surface subscale and most (37.7%), marginally, to the strategic subscale over the deep subscale.

The vast majority of responders (92.4%) agreed (somewhat) that, given their time again, they would still do Medicine. This percentage decreased for doing Medicine in a problem-based curriculum, and again for Medicine in *this* (Liverpool) problem-based curriculum, but 72.2% still agreed (somewhat) with the latter **(Table 11)**.

Table 11: Questionnaire survey of Year 3 medical students mid-2001/02 (Study-element 5): Satisfaction with the curriculum versus *Short RASI* learning approaches (n=158)

Question If I had my time again... *(median score)*	Agree + Agree somewhat no.		%	Learning approach Deep *(score out of 30.0 on each subscale)*	Strategic	Surface	Deep *(as a % of the total points allocated across all three subscales)*	Strategic	Surface
				Pearson correlation coefficient					
▪...I would still do Medicine *(5.0)*	138	+8	92.4	+0.21**	+0.41**	-0.14=	+0.05	+0.34**	-0.33**
▪...I would still do Medicine in a problem-based curriculum *(4.0)*	56	+63	75.3	+0.17*	+0.37**	-0.14==	+0.04	+0.30**	-0.29**
▪...I would still do Medicine in this Liverpool problem-based curriculum *(4.0)*	53	+61	72.2	+0.18*	+0.41**	-0.25**	+0.09	+0.39**	-0.40**

Liverpool MBChB curriculum, Year 3 medical students. Study (S)5

5=Agree, 4=Agree somewhat, 3=Unsure, 2=Disagree somewhat, 1=Disagree
Statistically significant: **at p=0.05 level; **at p=0.01 level*
only statistically significant with Spearman rank correlation coefficient (at 0.05 level): +0.19=; (at 0.01 level): -0.23==
Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Table 12: Questionnaire survey of Year 3 medical students mid-2001/02 (Study-element 5): *Short RASI* learning approaches (n=159)

Approach *(median score out of 30.0 on each subscale)*	Cronbach's alpha *(standardized item alpha)*	Predominant approach for: no.	%	Least evident approach for: no.	%	% of total points allocated overall %	*[range:*	*minimum*	*maximum]*
▪Deep *(21.0)*	*0.722 (0.729)*	61	*38.4*	17	*10.7*	*35.4*	*[29.5:*	*18.9*	*48.3]*
▪Strategic *(22.0)*	*0.705* (0.720)*	82	*51.6*	21	*13.2*	*37.7*	*[33.0:*	*21.2*	*54.2]*
▪Surface *(15.0)*	*0.608** (0.621)*	16	*10.1*	121	*76.1*	*26.9*	*[32.7:*	*12.8*	*45.5]*
Total		159	*100.1*	159	*100.0*	*100.0*			

Liverpool MBChB curriculum, Year 3 medical students. Study (S)5

All totals do not add to 100.0% due to rounding
* ↑ *to 0.724 if delete Q5: "I look carefully at tutors' comments on course work to see how to get higher marks next time"*
** ↑ *to 0.620 if delete Q4: "I concentrate on learning just those bits of information I have to know to pass"*
** ↑ *to 0.613 if delete Q14: "Often I feel I'm drowning in the sheer amount of material we're having to cope with"*
Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Overall, there was a pattern to the Pearson correlation coefficients between these 'satisfaction' scores and the learning approach subscale scores. There were statistically significant positive correlations for deep learning and strategic learning, and negative correlations for surface learning:

- Responders with higher deep learning and strategic learning scores (and lower surface learning scores) tended to agree that they would still do Medicine, in a problem-based curriculum, in Liverpool.

The strongest correlation for satisfaction with the Liverpool curriculum was with the strategic subscale with an r_p=+0.41. On using the % of points allocated to the subscale rather than the raw score, only the statistical significance of the correlations with the strategic and surface scores remained. The results were broadly similar when Spearman rank correlation coefficient was used instead.

In S2, after their first academic year, the students re-confirmed that they still valued the importance of the nine characteristics of 'a good doctor' derived from the cohort's baseline descriptions at entry **(Table 13a)**, in the form re-presented to them as nine closed scored-items (1 disagree to 4 agree). Likewise, they also agreed that the curriculum promoted all nine themes, albeit with this matching importance for two themes only: the 'thinking, flexible learner' and 'efficient, organized self-manager'. Responders scored the other seven themes as being promoted statistically significantly less so than their scored importance might suggest (according to the mean reductions in scores). Responders were apparently least sure about whether the curriculum promoted the 'decisive, competent diagnostician' (showing the greatest mean reduction in score, of 0.79, and statistically significant). Using the 'importance score' to rank the themes meant that 'compassionate, patient-centred carer' and 'listening, informative communicator' retained the top two places (but swopped over compared with S1), while 'exemplary, responsible 'professional' dropped three places to 6th and 'experienced, knowledgeable expert' dropped from mid-table to last place.

By S5, responders still ranked 'compassionate, patient-centred carer' and 'listening, informative communicator' 1st and 2nd, and 'efficient, organized self-manager' last, as had emerged from their open responses at entry **(Table 13b)**.

Table 13a: Questionnaire survey of Year 1 medical students at end of 1999/00 (Study-element 2): Scoring the importance of each of nine themes about characteristics of a good doctor generated at start of Year 1 and whether curriculum promotes each

Question ...score, 1 disagree to 4 agree, for the extent to which you agree that: ...a good doctor is a(n)...	n=137 This is important: Mean score	Overall rank *(previous)*	n=133 The curriculum promotes this: Mean score	Overall rank	n=131 to 134 Important minus promoted: Mean difference between scores	95% confidence interval
▪ ...compassionate, patient-centred carer	3.84	2 *(1)*	3.40	4	+0.44	(0.33, 0.55)*
▪ ...listening, informative communicator	3.95	1 *(2)*	3.78	1	+0.16	(0.08, 0.25)*
▪ ...exemplary, responsible 'professional'	3.67	6 *(3)*	3.26	6	+0.42	(0.31, 0.53)*
▪ ...experienced, knowledgeable expert	3.53	9 *(4)*	2.89	9	+0.64	(0.51, 0.78)*
▪ ...friendly, inclusive team player	3.77	3.5 *(5)*	3.38	5	+0.39	(0.27, 0.50)*
▪ ...thinking, flexible learner	3.77	3.5 *(6)*	3.69	2	+0.08	(-0.01, 0.18)
▪ ...decisive, competent diagnostician	3.70	5 *(7)*	2.90	8	+0.79	(0.65, 0.92)*
▪ ...well-balanced, insightful 'individual'	3.65	7 *(8)*	3.21	7	+0.44	(0.32, 0.57)*
▪ ...efficient, organized self-manager	3.58	8 *(9)*	3.48	3	+0.10	(-0.02, 0.22)

Rank 1=most important to 9=least important *Liverpool MBChB curriculum. Year 1 medical students. Study (S)2*
***Statistically significant:** *at least at p=0.05 level*

Table 13b: Questionnaire survey of Year 3 medical students mid-2001/02 (Study-element 5): Ranking nine themes about characteristics of a good doctor generated when they were in Year 1 (n=156**) versus satisfaction with the curriculum and versus current *Short RASI* learning approaches**

Question A good doctor is a(n)...	Ranked 1 by... no.	%	n=156 Sum of all ranks	Mean rank	Overall rank *(previous: start-of-Year 1)*	...I would still do Medicine in this Liverpool problem-based curriculum n=155 Spearman rank correlation coefficient	Learning approach: Deep subscale score out of 30 n=156 Spearman rank correlation coefficient
▪ ...compassionate, patient-centred carer	38	*25.2*	537	3.44	1 *(1)*	**-0.20***	-0.12
▪ ...listening, informative communicator	23	*15.2*	545	3.49	2 *(2)*	**-0.19***	-0.05
▪ ...exemplary, responsible 'professional'	3	*2.0*	996	6.38	8 *(3)*	+0.02	+0.05
▪ ...experienced, knowledgeable expert	36	*23.8*	686	4.40	4 *(4)*	-0.06	-0.05
▪ ...friendly, inclusive team player	6	*4.0*	796	5.10	5 *(5)*	-0.04	+0.06
▪ ...thinking, flexible learner	5	*3.3*	843	5.40	6 *(6)*	+0.14	-0.07
▪ ...decisive, competent diagnostician	32	*21.2*	577	3.70	3 *(7)*	+0.08	+0.04
▪ ...well-balanced, insightful 'individual'	6	*4.0*	907	5.81	7 *(8)*	+0.11	-0.004
▪ ...efficient, organized self-manager	2	*1.3*	1,133	7.26	9 *(9)*	+0.12	+0.07
Total	151**	*100.0%*	7,020 (=45X156***)				

Rank 1=most important to 9=least important *Liverpool MBChB curriculum. Year 3 medical students. Study (S)5*
*Learning approach/**Curriculum** satisfaction: 5=Agree. 4=Agree somewhat, 3=Unsure, 2=Disagree somewhat, 1=Disagree*
***Statistically significant:** *at p=0.05 level*
***Excludes the 5/156 responders who distributed 45 points by using some numbers more than once and some not at all*
****Includes the 5/156 responders who distributed 45 points by using some numbers more than once and some not at all*
*****1 further responder completed the ranking question in an unusable way, and the remaining 2 made no attempt to answer*
Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Furthermore, the main movement appeared to be the rise of 'decisive, competent diagnostician' (7th to 3rd) and fall of 'exemplary, responsible 'professional' (3rd to 8th). There were no statistically significant Spearman rank correlation coefficients between any of the nine good doctor themes and the deep subscale score. For the nine themes and the satisfaction score for the problem-based curriculum in Liverpool, there were only two statistically significant, albeit weak, Spearman rank correlation coefficients i.e. a negative correlation with each of the top two ranked themes **(Table 13b)**:

- 'compassionate, patient-centred carer' r_s= -0.20

  The higher the responders ranked this (i.e. ascribing it a low number), the higher the satisfaction score (i.e. higher number)
- 'listening, informative communicator' r_s= -0.19

  The higher responders ranked this (i.e. ascribing it a low number), the higher the satisfaction score (i.e. higher number)

Of the 38 good tutor items, the pre-selected ten key indicators were associated, albeit weakly, with the three learning approach subscales on Pearson correlation coefficients **(Table 14)**. The Likert scores on the two 'good actions' (promoting end-of-session evaluation; understanding and sticking to PBL 'rules') were statistically significantly positively correlated with the deep and/or strategic learning scores. The scores on 5/8 'bad actions' (avoiding questioning students' understanding; avoiding getting them to link different knowledge; ensuring they focus on one theme/topic for a session; telling them exactly what needs covering; telling them answers to difficult objectives) were statistically significantly positively correlated with surface learning. The first was also statistically significantly negatively correlated with deep learning. The other statistically significant correlations were unexpected, i.e. positively correlation for:

- wanting expert-input from the tutor's content-expertise (deep and strategic)
- wanting to be told when they have said something wrong (deep)

Only 'allowing use of notes in sessions' was uncorrelated with learning approach.

In S5, the commonest response for career intention was 'hospital doctor (consultant)' (51.9%), as in the basic analysis of career data from all study-elements **(p272)**. The relationship with learning approach is reported here **(Table 15)**.

Table 14: Questionnaire survey of Year 3 medical students mid-2001/02 (Study-element 5): *Short RASI* learning approach versus the 10/38 notions of a good tutor with particular face validity (n=158)

Question **Ideally, my problem-based learning (PBL) tutor should...**	**Statistically significant Pearson correlation coefficients r_p** **Learning approach:** *(score out of 30.0 on each subscale)* **Deep**	**Strategic**	**Surface**
➢ make sure that the group takes time to evaluate how things are going at the end of each session (Q31)		+0.24**	
➢ understand and stick to the rules of PBL (Q37)	+0.21**	+0.16*	
∢ provide extra input to sessions from his/her particular discipline so as not to waste this expertise (Q33)	+0.27**	+0.18*	
∢ avoid asking questions that worry us into having to go away and recheck our work all the time (Q35)	–0.16*		+0.27**
∢ avoid the messy process of getting us to link various types of knowledge with the scenario (Q39)			+0.32**
∢ ensure we focus on one theme or type of topic for most of a session so we work in neat blocks (Q44)			+0.29**
∢ allow us to report back from notes when we've done the work but not had time to learn it yet (Q46)			
∢ indicate if we've said something silly so I don't waste time on other people's wrong answers (Q49)	+0.17*		
∢ tell me exactly what syllabus I need to cover for each scenario, avoiding uncertainty (Q57)			+0.24**
∢ take responsibility for complicated discussions by telling us the answers to difficult objectives (Q61)			+0.27**

5=Agree. 4=Agree somewhat. 3=Unsure. 2=Disagree somewhat. 1=Disagree *Liverpool MBChB curriculum. Year 3 medical students. Study (S)5*
Statistically significant:* *at p=0.05 level** *(but for Q33 versus strategic. for Q37 versus strategic. for Q35 versus deep. and for Q49 versus deep: does not remain significant with Spearman rank correlation coefficient:* *****at p=0.01 level *Liverpool PBL tutors ➢should do this ∢ should not do this*
Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Table 15: Questionnaire survey of Year 3 medical students mid-2001/02 (Study-element 5): Career intentions versus *Short RASI* learning approaches (n=158)

Question **At this stage in your medical career, what is your intended career destination?**	**Learning approach no. *(%)*** **...predominant** *(from score out of 30.0)* **Deep**	**Strategic**	**Surface**	**...least evident** *(from score out of 30.0)* **Deep**	**Strategic**	**Surface**
• ...reported a choice **n=111**	43 *(38.7)*	57 *(51.4)*	11 *(9.9)*	10 *(9.0)*	15 *(13.5)*	86 *(77.5)*
• ...do not know **n=47**	17 *(36.2)*	25 *(53.2)*	5 *(10.6)*	7 *(14.9)*	6 *(12.8)*	34 *(72.3)*
	Pearson χ^2=0.096, p=0.95		*(100.0)* *(100.0)*	Pearson χ^2=1.191 p=0.55		*(100.0)* *(100.0)*
		Deep + Strategic	**Surface**		**Deep + Strategic**	**Surface**
• ...general practitioner **n=23**		17 *(73.9)*	6 *(26.1)*		10 *(43.5)*	13 *(56.5)*
• ...not general practitioner/do not know **n=135**		125 *(92.6)*	10 *(7.4)*		28 *(20.7)*	107 *(79.3)*
	p=0.02* FE *1 cell (25.0%): expected count <5; minimum=2.33*		*(100.0)* *(100.0)*	**p=0.03* FE** *0 cells: expected count <5; minimum=5.53*		*(100.0)* *(100.0)*
n=105 subset		**Deep + Strategic**	**Surface**		**Deep + Strategic**	**Surface**
• ...general practitioner **n=23**		17 *(73.9)*	6 *(26.1)*		10 *(43.5)*	13 *(56.5)*
• ...hospital consultant [excluding all other choices and do not know] **n=82**		77 *(93.9)*	5 *(6.1)*		14 *(17.1)*	68 *(82.9)*
	p=0.01* FE *1 cell (25.0%): expected count <5; minimum=2.41*		*(100.0)* *(100.0)*	**p=0.01* FE** *0 cells: expected count <5; minimum=5.26*		*(100.0)* *(100.0)*
mean subscale score...	**Deep**	**Strategic**	**Surface**			
• ...general practitioner	19.30	20.70	16.52			
• ...hospital consultant	20.83	22.30	15.39			
t_{103}, p	-1.538, 0.13	-1.561, 0.12	1.110, 0.27			

***Statistically significant:* *at p=0.05 level** FE=Fisher's Exact *Liverpool MBChB curriculum. Year 3 medical students. Study (S)5*
Learning approach: 5=Agree. 4=Agree somewhat. 3=Unsure. 2=Disagree somewhat. 1=Disagree *Highest value of each pair of means is shaded*
Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

There were no statistically significant differences between whether responders reported a career intention (versus uncertainty/'do not know') compared with the predominant of each student's three learning subscale scores (2x3 contingency table), or for the mirror-comparison using the least evident learning approach.

Statistically significantly fewer responders reporting 'GP' (versus the rest, i.e. not GP and do not know) had the deep and strategic combined group (rather than surface) predominating (73.9% versus 92.6%: 95% confidence interval on 18.68% difference 0.20 to 37.16). The least evident category mirrored this (for GP versus the rest, statistical significantly more had deep and strategic learning), and when comparing only GP versus 'hospital doctor (consultant)' rather than all non-GP categories. There was no statistically significant difference (t-test) between the mean scores on any of the three learning approach subscales when compared between those reporting GP versus hospital consultant. Nevertheless, the differences followed the same pattern: with slightly lower mean scores on deep and strategic subscales, and slightly higher for surface subscale amongst responders reporting GP as their career intention.

Summary

In S5:

- By mid-Year 3, 204/228 (89.5%) students who entered in 1999 remained with the main cohort. The S5 response rate (77.9%) was statistically significantly greater than in S1 (68.0%) and S2 (61.2%), but with no clear excess according to sex, home/EC versus non-EC, or school-leavers versus graduate/mature/other at entry. For paired data, while there were statistically significantly more females with a double-response to 1 and 5, statistically significantly fewer provided a double-response to 2 and 5.
- Learning approaches subscales (out of 30) were moderately reliable with strategic and deep outweighing surface learning (median: 21.0, 22.0, 15.0, respectively). Half the responders scored highest on strategic and Liverpool curriculum 'satisfaction' correlated strongest with it (r_p=+0.41, $p<0.01$). Significantly fewer responders intending to be a GP (versus not GP/do not know) had deep or strategic learning predominating compared with surface (73.9% versus 92.6%). Of the pre-selected ten key 'good tutor' indicators, both 'good actions' were statistically significantly, positively, correlated (Pearson) with deep and/or strategic learning, and 5/8 'bad actions' were statistically significantly positively correlated with surface learning.
- Responders' two comments about their PBL experience reflected broadly their Liverpool curriculum satisfaction but also contradictory positions. One-tenth of them proffered that PBL requires continued self- and/or group-motivation. Negative comments cited gaps: in academic support, basic science knowledge, or inter-tutor consistency; or to conflicting curriculum design/ implementation. Positive comments depicted learning as self-motivated, flexible, enjoyable, and productive, with cognitive, vocational, and personal development benefits.
- Of the 'good doctor' themes from S1, confirmed in S2, S5 responders still ranked 'compassionate, patient-centred carer' and 'listening, informative communicator' 1st and 2nd, but ranked 'decisive, competent diagnostician' higher and 'exemplary, responsible professional' lower. Although the Spearman rank correlation coefficients showed no link between any of these themes and deep learning, the most satisfied responders were statistically significantly more likely to rank 'compassionate…' and 'listening…' highly.

Results 2 & 5 linked: 1999 cohort S2, S5; end-of-Year 1 & mid-Year 3

Advantages & disadvantages of PBL (Tables 16&17, 18&19)

*Q4a/b in S2 and Q23a/b in S5 "For PBL, what do you see as its **main** advantage and disadvantage?"*

In S2, responders mostly (21.2%) identified the main advantage of PBL as the encouragement of independent, active learning, followed by various beneficial effects for the cognitive process of learning, the cooperative learning environment, and responsibility/control given to the students (17.5%, 15.3%, 12.4%, respectively) **(Table 16)**. Being able to test and share understanding (9.5%) and being motivated by PBL (8.0%) supplemented these. Only one responder highlighted a social advantage (meeting people).

Responders who contributed to the independent, active learning theme described such things as:

- *"having to go and do work, i.e. not sitting in lectures then forgetting." [S2-640]*
- *"Have to do work! Cannot sit back + day dream through 9-5 lectures." [S2-150]*
- *"More active participation in learning ie not just spoon fed" [S2-690]*
- *"Self directed Doctors" [S2-461]*
- *"Requires active learning – not just passive note-taking." [S2-781]*
- *"less 'spoonfeeding' of information" [S2-222]*

Examples from responders highlighting the cognitive benefits were:

- *"memories last long" [S2-200]*
- *"Information through self directed learning seems to be retained better." [S2-710]*
- *"Absorption + retention of more information as the facts can be related to conditions." [S2-280]*
- *"You do not learn loads of excess detail that would otherwise be just forgotten after exam" [S2-780]*
- *"You learn more by finding things out for yourself than by being given facts." [S2-631]*
- *"What you learn tends to stay in your mind as you've discussed it with your group" [S2-541]*

In S5, responders mostly (20.6%) identified the main advantage of PBL as responsibility/control given to the students, followed by its motivational role, various beneficial effects for the cognitive process of learning, and the encouragement of independent, active learning (16.1%, 15.5%, 13.5%, respectively) **(Table 18)**. Providing relevance, the cooperative learning environment, being able to test and share understanding, and learning how to research for information/use evidence supplemented these (11.0%, 7.1%, 5.2%, 5.2%, respectively). As for S2, only one responder highlighted the social advantage:

- *"Sociable way to learn. w/ [sic] opportunities for students to support each other" [S5-171]*

Only one responder highlighted the relaxed, enjoyable learning process:

- *"Very relaxed approach to learning, better than lectures" [S5-701]*

Examples from responders contributing to the responsibility/control theme comprised:

- *"Makes you in charge of your own learning + skills for future" [S5-240]*
- *"gives us responsibility for our learning – good lifetime attitude to have" [S5-470]*
- *"It allows you to make maximum use of time available to do the work at the level you want. Better than sitting in lectures 9-5 daily" [S5-480]*
- *"You can learn at your own pace" [S5-621]*
- *"We can work when we want – I work best late at night for example" [S5-491]*

Examples from responders highlighting the motivational benefits were:

- *"teaches you to be self–motivated + interested in lots of stuff" [S5-850]*
- *"have to be self motivated – want to learn" [S5-070]*
- *"You learn because you want the knowledge not because your [sic] told to learn" [S5-651]*
- *"The things you are studying are interesting as you've decided what you want to look at" [S5-602]*
- *"The work I do I find more engaging than if it were given in lectures" [S5-512]*

The solitary newly emerging theme, about encouraging a wider perspective on medicine, came from two responders only.

Turning to the main disadvantage, in S2, responders were more focused about this, namely the lack of a 'syllabus' and the related uncertainty about what and how much (breadth and depth) to learn (43.4%) **(Table 17)**:

Table 16: Questionnaire survey of Year 1 medical students at end of 1999/00 (Study-element 2): Twelve themes* emerging from answers to Q4a (n=137): "For PBL, what do *you* see as its *main* advantage...?"

Theme The main advantage of PBL is that it:	Students mentioned 1 concept in this theme: no.	%
▪ encourages more **independent, active learning** (you do the work and find information for yourselves rather than being spoonfed)	29	*21.2*
▪ develops a more productive way of learning, so that you **acquire, retain, recall (core) knowledge more effectively and efficiently** (not just focusing on examinations)	24	*17.5*
▪ promotes **pooling of group resources, sharing ideas/perspectives** in supportive, cooperative small-groupwork	21	*15.3*
▪ encourages you to **take responsibility for what you should know (when/how), manage time,** control and organize your own work agenda (flexibility)	17	*12.4*
▪ gives chance to **discuss, test, and share understanding**	13	*9.5*
▪ **motivates**, generates interest; you learn what you want to learn	11	*8.0*
▪ improves research skills, **learning how to find information/use evidence**	6	*4.4*
▪ is a **relaxed and enjoyable** way to learn	5	*3.6*
▪ provides relevant clinical **context/ practical application/integration**	4	*2.9*
▪ ensures that you **think for yourself, logically**, and tackle uncertainty	4	*2.9*
▪ allows students to **study in-depth**	2	*1.5*
▪ **is a sociable way to learn;** helps you to meet lots of people from your year	1	*0.7*
	137	*99.9*

*via 32 initial concepts
Total does not add to 100.0% due to rounding

Liverpool 1996 MBChB curriculum. Year 1 medical students. Study (S)2

Table 17: Questionnaire survey of Year 1 medical students at end of year, 1999/00 (Study-element 2): Twelve themes* emerging from answers to Q4b (n=136): "For PBL, what do *you* see as its *main*... disadvantage?"

Theme The main disadvantage of PBL is:	Students mentioned 1 concept in this theme: no.	%
▪ **uncertainty/lack of structure & guidance/help:** there is no real direction/unsure as to how much to do/what to learn, no 'set' syllabus, insufficient guidance/direction	59	*43.4*
▪ **it worries you that you might miss things:** worry that - important areas might be overlooked, skimmed over; groups do different objectives resulting in gaps compared with requirements/assessments	25	*18.4*
▪ **it requires self-motivation**: you are able to get away with doing nothing in the sessions, there is nothing to motivate lazy students until too late	21	*15.4*
▪ **noone to explain/check work:** not being able to obtain help from tutor in explanations	7	*5.1*
▪ **its dependence on group dynamics:** if group doesn't get a good start, it can hinder personal learning, others dominating or not contributing, dysfunctional groups, relying on others, not being on others' wavelength:	7	*5.1*
▪ **great potential for sidetracking/timewasting in/between sessions**	6	*4.4*
▪ **difficulty adjusting** initially	3	*2.2*
▪ **pressure of work:** information overload, little time between sessions	3	*2.2*
▪ **sometimes it is difficult to devise appropriate learning objectives**	2	*1.5*
▪ **problematic tutors:** too much variability in tutors	1	*0.7*
▪ **a lack of ongoing assessment**	1	*0.7*
▪ **not enough feedback:** from tutor	1	*0.7*
	136	*99.8*

*via 36 initial concepts
Total does not add to 100.0% due to rounding

Liverpool MBChB curriculum. Year 1 medical students. Study (S)2

- *"You don't know if you are doing the right work or enough of it." [S2-790]*
- *"There is no set syllabus since we set our own learning objectives – this makes it difficult to know what to revise for exams" [S2-351]*
- *"Unsure about what & in what depth you need to know things." [S2-881]*
- *"No syllabus (defined)!" [S2-012]*
- *"lack of good structured week" [S2-422]*

Concern about missing things (18.4%) and the self-motivation required (15.4%) provided the other two main disadvantages, for example (respectively):

- *"The continual worry of potential gaps in knowledge." [S2-710]*
- *"may miss some topics/areas – leading to gaps in our knowledge." [S2-730]*
- *"Still unclear that individual learning matches that of the whole year." [S2-101]*
- *"Worry that I may not have covered essential topics." [S2-741]*
- *"important areas might be overlooked." [S2-981]*

...and...

- *Self motivated – easy to fall behind." [S2-760]*
- *"can be abused by laziness" [S2-180]*
- *"No reinforcement to do work until too late" [S2-311]*
- *"Nothing to motivate lazy students" [S2-551]*
- *"it is easy to do no work for tutorials and get away with it." [S2-271]*

Two responders hinted at the double-edged sword of motivation, where PBL both provided and required motivation:

- *"encourages self-motivation **[advantage]***
  *it's relatively unstructured + easy to get away with doing little work" **[disadvantage]** [S2-540]*

By S5, the same cohort focused on the same <u>main disadvantage</u> (lack of a 'syllabus' and the related uncertainty about what and how much (breadth and depth) to learn (51.0% compared with 43.4% previously: not statistically significant: Yates-corrected χ^2=1.38, and p=0.240) **(Table 19):**

- *"never know exactly what you are expected to know or the depth that you need to go into" [S5-620]*
- *"With little direction, one inevitably covers too much (poorly) or too little of the 'wrong' or inappropriate stuff. It is very confusing & I feel as if we are very much on our own" [S5-450]*

Table 18: Questionnaire survey of Year 3 medical students mid-2001/02 (Study-element 5): Thirteen themes* emerging from answers to Q23 (n=155): "For PBL, what do *you* see as its *main*… advantage?"

Theme The main advantage of PBL is that it:	Students mentioned 1 concept in this theme: no.	%
▪ encourages you to **take responsibility for what you should know (when/how), manage time,** control and organize your own work agenda (flexibility)	32	*20.6*
▪ **motivates**, generates interest; you learn what you want to learn	25	*16.1*
▪ develops a more productive way of learning, so that you **acquire, retain, recall (core) knowledge more effectively and efficiently** (not just focusing on examinations)	24	*15.5*
▪ encourages more **independent, active learning** (you do the work and find information for yourselves rather than being spoonfed)	21	*13.5*
▪ provides relevant clinical **context/ practical application/integration**	17	*11.0*
▪ promotes **pooling of group resources, sharing ideas/perspectives** in supportive, cooperative small-groupwork	11	*7.1*
▪ gives chance to **discuss, test, and share understanding**	8	*5.2*
▪ improves research skills, **learning how to find information/use evidence**	8	*5.2*
▪ ensures that you **think for yourself, logically**, and tackle uncertainty	5	*3.2*
▪ **encourages a wider perspective on medicine****	2	*1.3*
▪ is a **relaxed and enjoyable** way to learn	1	*0.6*
▪ **is a sociable way to learn;** helps you to meet lots of people from your year	1	*0.6*
▪ allows students to **study in-depth**	0	*0*
	155	*100.0*

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*coded against coding-frame from same cohort in Study 2, Table 16→ ∴ same 12 themes, but 1 new theme** (155 responses + 4 blanks = 159)

Table 19: Questionnaire survey of Year 3 medical students mid-year, 2001/02 (Study-element 5): Fifteen themes* emerging from answers to Q23 (n=155): "For PBL, what do *you* see as its *main*… disadvantage?"

Theme The main disadvantage of PBL is:	Students mentioned 1 concept in this theme: no.	%
▪ **uncertainty/lack of structure & guidance/help:** there is no real direction/unsure as to how much to do/what to learn, no 'set' syllabus, insufficient guidance/direction	79	*51.0*
▪ **it worries you that you might miss things:** worry that - important areas might be overlooked, skimmed over; groups do different objectives resulting in gaps compared with requirements/assessments	27	*17.4*
▪ **it requires self-motivation**: you are able to get away with doing nothing in the sessions, there is nothing to motivate lazy students until too late	24	*15.5*
▪ **its dependence on group dynamics:** if group does not get a good start, it can hinder personal learning, others dominating or not contributing, dysfunctional groups, relying on others, not being on others' wavelength:	4	*2.6*
▪ **there can be a mismatch with assessment style/content****	4	*2.6*
▪ **noone to explain/check work:** not being able to obtain help from tutor in explanations	3	*1.9*
▪ **pressure of work:** information overload, little time between sessions	3	*1.9*
▪ **not enough feedback:** from tutor	3	*1.9*
▪ **great potential for sidetracking/timewasting in/between sessions**	2	*1.3*
▪ **problematic tutors:** too much variability in tutors	2	*1.3*
▪ **feeling isolated from others/Faculty****	2	*1.3*
▪ **a lack of ongoing assessment**	1	*0.6*
▪ **learning resources are not orientated for it****	1	*0.6*
▪ **difficulty adjusting** initially	0	*0*
▪ **sometimes it is difficult to devise appropriate learning objectives**	0	*0*
	155	*100.0*

Liverpool MBChB curriculum. Year 3 medical students. Study (S)5

*coded against coding-frame from same cohort in Study 2, Table 17→ ∴ same 12 themes, but 3 new themes** (155 responses + 4 blanks = 159)

- *"uncertainty about areas to cover + depth to cover" [S5-460]*
- *"Sometimes need some guidance, no one to go to except for peers" [S5-911]*
- *"No real way of determining if you are learning the right stuff" [S5-871]*

Analysing paired data from those responders answering in both study-elements, there was no statistically significant difference in whether they contributed under this theme or not, and 29 (25.9%) highlighted it both times (McNemar exact p=0.672, binomial distribution).

Concern about missing things (17.4%) and the self-motivation required (15.5%) still provided the other two main disadvantages, for example (respectively):

- *"Easy to just 'gloss over' things if you don't understand things" [S5-240]*
- *"Less structure than most courses means I am worried about becoming a doctor and not knowing anything about something very important until I see a patient with that illness" [S5-340]*
- *"Anxiety among students → worrying about learning the "wrong" objectives!" [S5-161]*
- *"feel like knowledge is patchy – easy to miss out on important areas [S5-981]"*
- *"Seems to be no set work we should be doing, as groups do different things so we all learn different amounts" [S5-891]*

…and…

- *"It is easy to avoid complicated topics and then to bluff your way in a tutorial – especially for those who are not so good at self-motivation" [S5-710]*
- *"It is difficult to be motivated - for some students – and relatively easy (esp. in 1st year) to get away with doing not enough work" [S5-720]*
- *"You have to be extremely motivated because nobody checks that you are doing your PBL work & nobody checks that you are doing it right" [S5-050]*
- *"Lots + lots + lots of opportunities to do nothing. Partly my fault but if I can see opportunities for free time I'll take it" [S5-361]*
- *"Too much self motivation required. 'No-one else seems to be working – maybe I dont [sic] have to!' " [S5-102]*

Of those responders commenting under the theme of missing things, 7/27 (25.9%) mentioned difficulties learning specific subjects, mostly basic sciences, none of which was mentioned in S2, i.e.:

- *"Concern over level of knowledge in basic sciences ie. anatomy/physiology/biochem" [S5-170]*
- *"Important topics can be missed or skipped through eg. Ethics" [S5-670]*

- *"Some topics are inappropriately taught by PBL ie. embryology Pharmacology" [S5-770]*
- *"Do not have basic knowledge eg anatomy" [S5-001]*
- *"Alot [sic] of the essential basics are missed out I feel embarassed [sic] of our knowledge of anatomy, histology etc compared to other med schools, but we aren't ever told how deep to go into things" [S5-351]*
- *"Lack of teaching sometimes cause problems in understanding especially if it involves complex physiological processes" [S5-951]*
- *"Basic science subjects take disproportionately long to come to terms with + understand; when a lecture/teaching covers it more..." [S5-602]*

Problematic tutors were the main issue for two responders only. Only single responders highlighted lack of ongoing assessment and lack of learning resources geared to this way of learning (not mentioned as a hindrance in S2), i.e.:

- *"It can often be difficult to find information to answer some questions set in PBL particularly on IGS, PP, PVPG*. The library is particularly understocked for a PBL course" [S5-940]*

[*PPD theme was originally called *Professional Values and Personal Growth*]

The three newly emerging themes were in the minority: assessments apparently not matching the style and content of learning, feeling isolated, i.e.:

- *"can be isolating due to lack of contact with peers during some areas of the course eg when there are no lectures" [S5-630]*

...and, thirdly, learning resources being inappropriate.

- *The exams do not reflect the PBL nature of the cause [sic] (true/false)** [S5-550]*

[*...referring to the post-Year 1 use of True-False questions in assessment]

Summary

In S2:

- Responders' answers about the main advantage of PBL were diverse, but mostly generated a theme about its encouragement of independent, active learning (21.2%). Supplementary themes included various benefits related to: cognition; cooperative learning; and more personal responsibility/control. There was more convergence about the disadvantage: lack of a 'syllabus'/uncertainty about what and how much to learn (43.4%). Self-motivation came up as both an advantageous result and a disadvantageous requirement.

In S5:

- Responders mostly (20.6%) identified the main advantage of PBL as the responsibility/control given to the students, followed by its motivational role, the cognitive benefits, and the encouragement of independent, active learning (16.1%, 15.5%, 13.5%, respectively). The main disadvantage remained the same from S2, and at about the same level, both in terms of comparing the group differences and comparing the individual paired differences.

Results 5 & 6 linked: 1999 cohort S5, 2001 cohort S6; mid-Year 3 & end-of-Year 1

Learning Population Perspective (Tables 20a, 20b & 21)

Q63 in S6 and Q62 in S5 "Looking forward, provide your two main comments about how learning Population Perspective relates to your future work as a doctor"

In S6 (2001 cohort, end-of-Year 1), 15 overall themes emerged from responders' two comments on *Population Perspective* in their future work. The 161 responders mostly cited appraising evidence critically (38.5%), and being aware of the broader context on individual patients (31.1%) and of the population distribution, causes, and impact of diseases (29.2%) **(Table 20a)**, as in these paired comments:

- *"--How ill-health can be prevented*
  --The type & causes of illness likely to be encountered" [S6-730]
- *"--Being able to understand/have a better idea about studies/articles, evidence. And to evaluate critically.*
  --Idea of the scale of different problems." [S6-201]
- *"---Relating disease to population demographics*
  ---How I can improve health of people." [S6-701]
- *"---Helps potential doctors recognize and understand the importance and spread of certain health problems*
  ---The student learns stats and thinks of reasonable solutions to health problems." [S6-991]

Knowing about the NHS, disease prevention/health promotion, and population health needs/inequity were much less prominent (11.8%, 9.9%, 9.3%, respectively). Only 8.7% made a negative comment about *Population Perspective* (doubting/not knowing its utility) as a main comment. One of the latter responders was particularly unimpressed opining: ◗*"1. It doesn't -- 2. It REALLY doesn't"*. Only three responders referred to the vocabulary:

> ◗*"understand defns used in Healthcare"*; ◗*"tells us language + terms used in doctors [sic] line of work that are non-scientific"*; ◗*"Familiarises us with the vocabulary & terms we will encounter & need to understand"*

In S5 (1999 cohort, mid-Year 3), responders' comments fell under the same 15 overall themes from the other cohort (S6 above) plus one extra: *"Knowing about reporting communicable disease/births/deaths, etc."*. Under these 16 overall themes, the 144 responders mostly highlighted issues under the same three themes **(Table 20b)** as for S6, but with the top two changing places and the third resulting in the same percentage rounded to no decimal places, i.e.

Table 20a: Questionnaire survey of Year 1 medical students at end of 2001/02 (Study-element 6): Fifteen themes* emerging from answers to Q63 (n=161): "Looking forward, provide your two main comments about how learning *Population Perspective* relates to *your* future work as a doctor"

Theme My *two* main comments: **As a doctor, learning Population Perspective will help:**	Students mentioned ≥1 concept(s) in this theme: no.	%	(initial comments for this overall theme as a % of the n=287 comments for all overall themes)** no.	(%)
▪ **critically appraising journal articles, being evidence-based/up-to-date for better diagnosis, doing research,** e.g. *"Familiarises me with statistics so I will be able to evaluate and understand research": "Will help enormously when reading papers and doing my own research"; "Improving evidence-based Medicine"*	62	*38.5*	67	*(24.1)*
▪ **giving the 'big picture'/ broader context for individual patients, learning about the community and the doctor's impact** *"Helps us to see 'the bigger picture' "; "It will help me to understand how wider social + environmental factors can influence + shape an individual patient's health – rather than just focusing on the "science" behind that one patient"*	50	*31.1*	52	*(18.7)*
▪ **being aware of the distribution, severity/relevance, and causes of diseases in the population,** e.g. *"I will have an idea of how frequent and spread out a disease is"; "gives us idea of how serious/not serious a condition is"; "Gives me an idea of the proportions of various diseases, I'll need to treat"*	47	*29.2*	47	*(16.9)*
▪ **understanding how health systems like the NHS work,** e.g. *"Public health provides me with an understanding of how the NHS works, etc which I will need to be aware of"; "knowing the structure + dynamics of healthcare services; good for a general impression of the Health Service & how it works"*	19	*11.8*	19	*(6.8)*
▪ **tackling population health problems/diseases; health promotion,** e.g. *"recognize ways to reduce these problems/diseases"; "Promote health + Prevent disease in popn"; "doctor's job is not just to treat, but to educate"*	16	*9.9*	16	*(5.8)*
▪ **being aware of community's health care needs, e.g. for planning, prioritising, and targetting resources/services (versus funding),** e.g. *"Understanding the needs in the community"; "It makes me more aware of the existence of health inequalities"; "Would help to understand the population at risk of a condition in order to target resources"*	15	*9.3*	16	*(5.8)*
✗ ***negative comment: doubting/not knowing its relevance or stating that it is overemphasized or only for certain specialties,*** e.g. *"I'm still unsure – many points seem obvious to me"; "since policy change from time to time PP seem not particular [sic] useful (exp statistic part)"; "Understand its importance in the future – feel that perhaps more emphasis should be put on structure and function"*	14	*8.7*	14	*(5.0)*
▪ **understanding of 'statistics' (not otherwise specified)**	8	*5.0*	8	*(2.9)*
▪ **gaining insight into high-risk groups, population perceptions about disease risk, and helping compare patients to a 'normal'**	8	*5.0*	8	*(2.9)*
✗ ***comment on wrong theme or aspect of problem-based learning***	7	*4.3*	8	*(2.9)*
▪ **being aware of government and other health policies and how to influence official medical authorities/groups**	6	*3.7*	6	*(2.2)*
▪ **...because it is important for doctors to understand epidemiology/public health/population perspective issues**	5	*3.1*	5	*(1.8)*
▪ **having background information to explain risks to patients/give examples to patients about what works or does not**	5	*3.1*	5	*(1.8)*
▪ **making better doctors: improving thinking/efficiency/learning**	4	*2.5*	4	*(1.4)*
▪ **providing the vocabulary/concepts for understanding healthcare**	3	*1.9*	3	*(1.1)*
			278	*(100.1)*

44 responders outlined only 1 issue; others outlined >1 issue from same theme   *Liverpool MBChB curriculum. Year 1 medical students. Study (S)6*

Total does not add to 100.0% due to rounding

*via 31 initial concepts (for which, 278 mentions total + 118 blanks = 198X2) → 15 themes (269 first-mentions)

**This allowed for multiple mentions of initial comments under the same final theme (e.g. if a responder felt strongly enough to have three related, albeit different, 'things' for the three suggestions)

Table 20b: Questionnaire survey of Year 3 medical students mid-2001/02 (Study-element 5): Sixteen themes* emerging from answers to Q62 (n=144): "Looking forward, provide your two main comments about how learning *Population Perspective* relates to *your* future work as a doctor"

Theme My *two* main comments: As a doctor, learning Population Perspective will help:	Students mentioned ≥1 concept(s) in this theme: no.	%
▪ **giving the 'big picture'/ broader context for individual patients, learning about the community and the doctor's impact** *"May see the importance of the wider implications of health on different groups"; "Useful in understanding how several small actions can affect the larger population"; "To see a bigger picture"*	60	*41.7*
▪ **being aware of the distribution, severity/relevance, and causes of diseases in the population,** e.g. *"Demonstrates how we measure disease etc. in a population... Illustrates that there are many factors/determinants of ill-health, which must be considered in the care of pts"; "Gives an overall general view of the population so we can have an idea of how common/rare issues are etc."; "It helps to understand what is common in the popn"*	41	*28.5*
▪ **critically appraising journal articles, being evidence-based/up-to-date for better diagnosis, doing research,** e.g. *"It is helpful when reading journals with regards to evidence-based medicine"; "Is equipping me with the skills to understand + evaluate the research that I will have to remain up to date with whatever speciality I choose"; "How to critically appraise studies + the different research study types. Important when making clinical decision based on RESEARCH papers"*	38	*26.4*
▪ **being aware of community's health care needs, e.g. for planning, prioritising, and targetting resources/services (versus funding),** e.g. *"Allows doctors to prioritise treatments + conditions with greatest need"; "Enables us to put resource allocations into perspective"; "Helps us to understand the concept of supply and demand, and needs of patients, and how to adapt in an overstretched NHS"*	26	*18.1*
▪ **tackling population health problems/diseases; health promotion, etc.,** e.g. *"Importance of health promotion & education"; "Will allow the prevention of morbidity by educating the population with the knowledge we have learned through PBL"; "To identify when a public health issue needs acting upon"*	22	*15.3*
× ***negative comment: doubting/not knowing its relevance or stating that it is overemphasized or only for certain specialties,*** *e.g.* *"Still unsure about what P.P actually is, never mind how it relates"; "allows us to pass exams---if going into public health will be useful"; "Hopefully not at all"; "At present, I cannot see how I will use population perspective information in my future work. ....I feel that too much importance is placed on it, compared with other aspects of the course"*	17	*11.8*
▪ **...because it is important for doctors to understand epidemiology/public health/population perspective issues**	10	*6.9*
▪ **being aware of government and other health policies and how to influence official medical authorities/groups**	8	*5.6*
× ***comment about wrong theme or an aspect of problem-based learning***	8	*5.6*
▪ **knowing about reporting communicable disease/births/deaths, etc.****	7	*4.9*
▪ **understanding how health systems like the NHS work, e.g.**	6	*4.2*
▪ **making better doctors: improving thinking/efficiency/learning**	5	*3.5*
▪ **understanding 'statistics' (not otherwise specified)**	5	*3.5*
▪ **having background information to explain risks to patients/give examples to patients about what works or does not**	5	*3.5*
▪ **providing the vocabulary/concepts for understanding healthcare**	3	*2.1*
▪ **gaining insight into high-risk groups, population perceptions about disease risk, and helping compare patients to a 'normal'**	2	*1.4*

Liverpool MBChB curriculum, Year 3 medical students, Study (S)5

25 responders outlined only 1 issue, and others outlined more than one issue from the same theme
*coded against the coding-frame from S6, Table 20a→ ∴ same 15 themes, but also 1 new theme** (263 first-mentions + 25 blanks = 2X144)

- 1st: appreciating the broader context on individual patients (41.7%) (2nd in S6)
- 2nd: being aware of the population distribution, causes, and impact of diseases (28.5%) (3rd in S6):

  One responder used analogy to illustrate how *Population Perspective* prevented 'zebra-type' mistakes: ◗*"Getting some idea of how common/uncommon conditions are so that when we hear hoves [sic] we think of horses first & not zebras first"*.
- 3rd: appraising evidence critically (26.4%) (1st in S6)

These responders illustrated such comments:

◗ *"---Helps you to question the validity of published literature + look at how they've carried out studies, to support conclusions*
---Helps you to identify how illness + disease affects the whole population in a broad sence [sic]." [S5-910]

◗ *"---It enables us to look at a wider level and consider the whole popn implications as oppose [sic] to the individual.*
---It highlights the relevant conditions of importance currently of issue in the popn" [S5-840]

◗ *"---Useful EBM skills. (Evidence-Based-Medicine).*
---Knowledge of epidemiology of disease (ie common are more likely!!)" [S5-002]

◗ *"---Allows you to appreciate the content of your work in relation to the population.*
---Allows you to appreciate how to construct your own research." [S5-402]

◗ *"---For planning & carrying out a study in the future & helping with reading and understanding papers*
---look at broader aspects of medicine." [S5-822]

Knowing about population health needs/inequity (18.1%) and disease prevention (and other elements of health promotion) (15.3%) appeared to be more prominent than for S6, but the NHS as a health care system remained of lower profile (4.2%). The newly emerging theme about reporting communicable diseases, births, and deaths emerged at a similar level (4.9%). Only 11.8% made a negative comment about *Population Perspective* (doubting/not knowing its utility) as a main comment. Four of these responders indicated that the theme was only relevant to certain doctors and not others, e.g.:

◗ *"May be useful if are working as a GP or public health doctor + if we have time"*; ◗ *"Only really useful if I become a GP"*; ◗ *"More so if going to be a GP"*; ◗ *"I do not think it has much bearing on my choice of career"*

One of the more negative comments about how *Population Perspective* would be used was:

- *"---Hopefully not at all".*
  --- ---"

Compared with S6, a similar proportion of responders (around 5%) gave comments apparently relating to a different question or a different theme.

Both study-elements showed similar results for the career intentions and learning approaches of responders whose main comment(s) was/were negative or revealed doubt about the vocational utility of learning about *Population Perspective*. In S6, of 14 responders falling into this group, only one expressed his/her career intention as 'GP', but the difference in proportions compared with those responding 'other than GP' was not statistically significant (7.1% versus 11.6%; difference of 4.5%: df=1, Fisher's Exact p=1.000 [used as 1 cell (25.0%) had expected count <5, i.e. 1.58]; 95% confidence interval on difference: -9.96, 18.96). The mean deep learning score was marginally lower and mean surface learning score was marginally higher for the group of 14, compared with the remainder (main comments not negative/doubting). There was, however, no statistically significant difference for any of the mean learning approach subscale scores between the groups **(Table 21)**. Returning to S5, however, this same pattern was supported by the mean deep learning score being very statistically significantly lower in the 17 responders whose main comment was negative/doubting. Furthermore, their strategic learning score was very highly statistically significantly lower, and the surface learning score marginally (but non-significantly) higher. As for S6, no significant association was demonstrated with intention to be a GP versus the remainder (not GP and do not know), but none of the group of 17 were in the GP group.

Although fewer responders had reported altruistic reasons for choosing Medicine (S3, **p223**) amongst those who then made negative/doubting comments about *Population Perspective* (1/8, 12.5%) versus not (54/120, 45.0%) in S6, this involved small numbers and was not statistically significant. (For the difference of 32.5%: df=1, Fisher's Exact p=0.137 [used as 2 cells (50.0%) had expected count <5, i.e. minimum expected=3.44.1 cell).

Table 21: Questionnaire survey of Year 1 medical students at end of 2001/02 (Study-element (S)6) and Year 3 medical students mid-year, 2001/02 (S5): *Short RASI* learning approaches versus "Looking forward, provide your two main comments about how learning *Population Perspective* relates to *your* future work as a doctor" [Q63 S6, Q62 S5, respectively]

Theme: My *two* main comments about learning Population Perspective (PP):		Learning approach mean subscale score… S6 (n=161*** providing learning approach and PP comments)				Learning approach mean subscale score… S5 (n=144**** providing learning approach and PP comments)		
		Deep	**Strategic**	**Surface**		**Deep**	**Strategic**	**Surface**
•…a main comment about PP was negative/doubting	**n=14**	21.00	22.86	16.43	**n=17**	17.53	18.29	16.59
•…the main comment(s) about PP was/were not negative/doubting	**n=147**	21.71	22.92	15.31	**n=127**	20.94	22.31	15.53
	t_{159}, p	-0.673, 0.50	-0.058, 0.95	0.937, 0.35	t_{142}, p	-3.153, **0.002***	-3.731, **0.0003****	0.970, 0.33

Liverpool MBChB curriculum, Year 1 & 3 medical students, from different cohorts, Study (S)6 & S5

Statistically significant: *at p=0.01 level, **at p=0.001 level

Learning approach: 5=Agree, 4=Agree somewhat, 3=Unsure, 2=Disagree somewhat, 1=Disagree *Highest value of each pair of means is shaded*

****a further 37 S6 responders did not provide both learning approach and PP comments; ****a further 15 S5 responders did not provide both learning approach and PP comments*

Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Summary

In both S6 and S5, responders had quite similar views about how learning *Population Perspective* related to their future work as a doctor:

- Responders mostly highlighted issues under the same three of 15-16 overall themes, i.e. appreciating the broader context on individual patients; being aware of the population distribution, causes, and impact of diseases; and appraising evidence critically.
- There were comparable results concerning the learning approaches of the responders whose main comment(s) was/were negative or revealed doubt about the vocational utility of learning about *Population Perspective*. In both cohorts, this group showed lower deep and strategic learning scores and higher surface learning scores, with the first two of these being very statistically significant for the mid-Year 3 students. There was no association with altruistic reasons for choosing Medicine in S6---S3 linked responses.

Results 3: 2001 cohort S3, start-of-Year 1

Questionnaire response (Table 22)

The response rate was 201/283 (71.0%). Most responders were female (62.7%) and 'home' (EC) students (184/201, 91.5%). The largest ethnic groups were home/White (72.6% overall and 146/184, 79.3% of all home) and home/Indian, home/Pakistani, and home/Black-other (4.0% each), and 16.4% were graduates **(Table 22)**. The proportions did not differ statistically significantly from those of non-responders for being:

- female: 45/82 (54.9%) (Yates-corrected $\chi^2_1=1.18$ and p=0.278; 95% confidence interval on 7.81 difference: -4.87, 20.49)
- graduate [versus remainder]: 8/82 (9.8%) (Yates-corrected $\chi^2_1=1.58$ and p=0.21; 95% confidence interval on 6.66 difference: -1.55, 14.88)
- overseas: 9/82 (11.0%) [versus 8.5% home/EC] (Yates-corrected $\chi^2_1=0.19$ and p=0.661; 95% confidence interval on 2.52 difference: -5.26, 10.30)

The responders' median age at receipt of their questionnaires was 19.1 years, and most (154/201, 76.6%) were school-leavers (+/- A-level/Highers retakes, +/- deferred entry), i.e. similar to the profile for S1 responders of the 1999 cohort.

Table 22: Questionnaire survey of Year 1 medical students at start of and end of 2001/02 (Study-element (S)3 & S6): Demographic profile (n=201, n=198)

Characteristic	S3: start-of-Year 1 (201/283) Response rate: 71.0% no.	years	S6: end-of-Year 1 (198/279) Response rate: 71.0% no.	years	S3+S6: complete sets: n=160*
Age (exact): at receipt of completed questionnaire	201		198		
▪ mean *(& at start 24.9.01)*		20.5 *(20.3)*		21.1 *(20.3)*	
▪ median *(& at start 24.9.01)*		19.1 *(19.0)*		19.8 *(19.0)*	
▪ range		17.4-41.8		18.1-42.4	
Sex	no.	%	no.	%	male vs females Yates-corrected $\chi^2=0.17_1$, $p=0.683$
▪ male	75	37.3	69	34.8	
▪ female	126	62.7	129	65.2	
	201	100.0	198	100.0	
Self-reported ethnic origin: 'home students only'	no.	%	no.	%	
▪ White	146	72.6	146	74.1	
▪ Black-Caribbean	0	0	0	0	
▪ Black-African	8	4.0	7	3.6	
▪ Black-other	0	0	0	0	
▪ Indian	8	4.0	11	5.6	
▪ Pakistani	8	4.0	8	4.1	
▪ Bangladeshi	1	0.5	1	0.5	
▪ Asian-other	7	3.5	5	2.5	
▪ Chinese	0	0	0	0	home/EC vs rest Yates-corrected $\chi^2=0.02_1$, $p=0.889$
▪ Other	6	3.0	4	2.0	
▪ Non-European Community EC)	17	8.5	15	7.6	
	201	100.1	197**	100.0	
Entered as:	no.	%	no.	%	
▪ school-leaver	123	61.2	117	59.1	school-leaver/ resit/ gap year vs rest Yates-corrected $\chi^2=0.01_1$, $p=0.934$
▪ school-leaver: **after gap year**	18	9.0	22	11.1	
▪ graduate	33	16.4	32	16.2	
▪ other (mature)	12	6.0	12	6.1	
▪ school-leaver: **after resit A-levels/Highers**	13	6.5	13	6.6	
▪ mature with non-relevant degree: **admitted on A-levels**	2	1.0	2	1.0	
	201	100.1	198	100.1	

All totals do not add to 100.0 due to rounding *Liverpool MBChB curriculum. Year 1 medical students. Study (S)3, S6*

*excludes 1 responder who removed the unique identifier from the questionnaire in both S3 and S6 so the data were handled separately

df=1, Yates-corrected $\chi^2=0.01$, $p=0.938$ (95% confidence interval (CI) on 0.06 difference: −7.45, 7.56)

*** 1 UK student did not self-report*

n=279 eligible for both studies

McNemar (binomial distribution) on single responders in:

▪ *paired S3---S6 data: n=39 versus n=37 → exact p=0.909*

Of non-responders to:
S3 (n=82)→37 responded to S6: S6 (n=81)→39 responded to S3
Of responders to:
S3 (n=201)→161 responded to S6: S6 (n=198)→161 responded to S3
Both these counts include the responder who removed unique identifier to prevent further linkage

Open-ended questions: Critical incidents in problem-based learning, and choosing Medicine

Critical incidents in problem-based learning sessions (Table 23)

*Q57 "Outline (anonymously) one specific incident with student(s) in your PBL group that contributed to an **unproductive** session"*

When commenting about a critical incident in a PBL session, responders generated 15 overall themes. These included responders unable to recall an unproductive PBL session (17.3%):

- *"I cannot think of any such incident. Fortunately all members of are [sic] group are hard working, friendly and so far we have not reached any problem areas." [S3-160]*
- *"I feel all our sessions have been productive. We have improved every week/module but none have been unproductive!" [S3-171]*

The two most common critical incidents (13.6%, 12.3%, respectively) involved students participating poorly (whether due to lack of work/knowledge/inclination) or students dominating/being self-centred. Examples from responders highlighting non-participation comprised:

- *"One of the group had clearly not done any work and so became increasingly excluded from the discussion – we had agreed to concentrate on Structure & Function for this session so opinions could not be offered by the student, which would maybe have helped if IGS etc were being discussed." [S3-780]*
- *"Failed group dynamic due to shyness of some members – sorted because of friendliness and encouragement" [S3-101]*
- *"Prolonged period(s) of silence with group members unwilling to contribute." [S3-821]*
- *"Students not being sure enough of what they know to speak up in a session, so they get left out slightly. The group them looses [sic] out as the students' information may have been correct and valuble [sic]" [S3-861]*
- *"A couple of students so quiet and saying so little it made me feel guilty for saying anything at all, in case they wanted to be speaking." [S3-212]*
- *"We have a foreign student in our PBL group. One session, we all realised he wasn't contributing. (Most sessions he says nothing at all) We all encouraged him to report back on one aspect; his English was so poor, none of us could understand him and he was totally humiliated." [S3-832]*

Examples from responders highlighting dominating, self-centred students comprised:

- *"One student repeatedly interrupted flow of conversation by saying they had more detail than they mentioned when in reality they had copied notes directly from Tortora[496] without identifiying [sic] important factors. They had no more details & nothing extra to add to discussion so repeated what had already been discussed." [S3-640]*
- *"One person would like to learn everything in too much depth and reports on everything they read taking up a good proportion of the 2nd + 3rd sessions often with meaningless stuff. They do this to impress the tutor not because they like the subject." [S3-050]*
- *"One student dominated the session, questioning every word or statement and slowing down the process completely." [S3-870]*
- *"I felt that some graduate students in the group can lead the group on a learning tangent into their own areas of study." [S3-262]*

The three most prominent supplementary themes involved students: being unfocused/superficial about explaining key concepts; being unfocused/non-specific when setting learning objectives; and using session-time inefficiently by spending too much time on certain things at the expense of others (9.9%, 9.3%, 8.0%, respectively), e.g.:

- *"In MANY sessions so far the more difficult topics where the concepts were difficult to grasp, were simply ignored. The more challanging [sic] topic we [sic] very easy to ignore because 1) the time is short + there is a lot of info. to get through 2) No one actually understands the difficult concepts ∴ everyone agrees to lean [sic] it in their own time! e.g. osmosis in the travellers [sic] health module" [S3-600]*
- *"In the first meeting for a module, we formulated several learning objectives which were too vague. As a result, in the second meeting, little progress was made since no-one was entirely sure what they should have been researching and most of us had covered slightly different topics. This made the session uncomfortable and unproductive." [S3-771]*
- *"One girl tried to cover all topics related to the G.I. tract when we were only concentrating on the large intestine. This led to a lot [sic] of confusion as the rest of us hadn't" [S3-181]*

Few responders highlighted students who undermined, offended, or competed with others (5.6%), but they captured the essence of the incident clearly:

- *"When someone constantly tries to prove you wrong with your information – as if it's a competition – this puts me off wanting to make a point sometimes." [S3-051]*
- *"A group of girls laughed at another member of the group. Reason was wrong answer." [S3-402]*

- *"A large chunk of one PBL session was spent with one student repetatively [sic] saying that travel diarrhoea was frequently caused by "dodgy kebab vendor"" [S3-712]*
- *"One person in my group completely patronized me + made me feel thick + stupid which is not fair because I am not! He feels like he is above us + cleverer but we all got good grades! He always talks too much thakes [sic] control not giving others the chance to speak." [S3-062]*

Although these were amongst the exceptions, the three students who cited being disrupted by use of notes in session (lack of active learning) gave unambiguous examples as did those citing lateness, illness, and absence, i.e.:

- *"Last session in the 1st module: 3 students shouting for attention trying to meet the tutor's eyes, just reading from notes, not caring about the others in the group" [S3-100]*
- *"In the same session people weren't clear of the system. Work was researched but not learnt thoroughly as we did not release [sic] [[??realize]] notes weren't aloud [sic]. The session was therefore slow with large knowledge gaps" [S3-750]*
- *"Raging Thirst – using our notes we simply regurgitated the Krebs cycle onto the board. No-one had learnt the enzymes or steps we simply just transferred our notes onto the board: this felt slightly pointless everyone had the same cycle!" [S3-491]*

…and…

- *"Students arriving late and missing most of the session disrupted the rest of us." [S3-610]*
- *"I was really ill – coughing so disrupted the session a lot – caused a disjointed session" [S3-151]*
- *"Except for the first meeting, the group always in [sic] lack of members (absent), thus making the discussion less lively." [S3-791]*

Responders from seven different PBL groups highlighted issues related to the tutor. Although only five students claimed the tutor to be disruptive (representing four PBL groups), their comments captured their discomfort (----- delimiting same group):

- *"Tutor going off on a tangent to relevant subject." [S3-360]*
- *"Our PBL tutor tends to go off track by telling us long-winded stories and uses up time we could be using to go over PBL work." [S3-590]*

- *"My group is great. We have never had an unproductive session. However sometimes the tutor does go on a bit too much about her family/career that is not always relevant." [S3-860]*

- *"Tutor's complete ignorance towards one's ideas" [S3-091]*

- *"Our tutor decided on the first day who was quiet/loud and has not altered those opinions. He regularly tells people to talk more even though they have and this makes them think they are not doing enough work and they are." [S3-562]*

Five responders from three further groups highlighted the effect of absent tutors:

- *"Mobile phones going off when we had a session when the tutor was ill." [S3-320]*
- *"When the tutor didn't attend the session due to illness" [S3-472]*
- *"did not work as a group in the absence of PBL tutor ⇒ did not finish the learning objectives properly." [S3-460]*
- *"The most unproductive session we had was our very 1st one because our tutor did not turn up and therefore we had no real idea what to do!" [S3-570]*
- *"Tutor did not turn up for session on regular occasions!" [S3-111]*

Choosing Medicine (Table 24)
Q59 "I chose Medicine because..."

Responders commented under 15 overall themes in completing the phrase with their reason(s) for choosing to do Medicine. The main theme was that Medicine would give them something (by its being worthwhile, meaningful, interesting, rewarding as a career, etc.) (51.3%), such as:

> ◗ *"want to have a fulfilling career";* ◗ *"I thought it would be a career that I would love and enjoy for years to come";* ◗ *"The thought of becoming a doctor is exciting!";* ◗ *"it [sic] interesting, challenging & rewarding";* ◗ *"It would give me a varied career...";* ◗ *"it is an ever evolving vocation that requires lifelong learning. Its facinating [sic], and fun!";* ◗ *"It is a diverse, exciting rewarding career... constantly challenging";* ◗ *"Medicine allows for my personal growth and inspires my later working life"*

The next two commonest themes (from similar proportions of responders) conveyed altruistic reasons (they would give something to Medicine) and an interest in science/human biology (40.3% and 39.8%, respectively):

> ◗ *"and make a difference in the community"* ◗ *"I like mixture of care with... to promote health;* ◗ *"I like helping people + this will let me do it";* ◗ *"it is a way to improve people's health, by doing this I can appreciate more what a life is. The best thing is trying to give help for people in need";* ◗ *"I want to be useful to society";* ◗ *"I'll have the capacity to help people in a way no other profession can"* ◗ *"...and be able to help others (cliché, sorry!)"* ◗ *"I wanted a career where I could wake up each morning and know I could make a difference to someone else's life"*

and:

Table 23: Questionnaire survey of Year 1 medical students at start of 2001/02 (Study-element 3): Fifteen themes* emerging from answers to Q57 (n=162): "Outline (anonymously) one specific incident with student(s) in your PBL group that contributed to an unproductive session"

Theme A critical incident in PBL disrupting learning, so far, involved:	Students mentioned 1 concept in this theme: no.	 %
not a problem yet (no unproductive session yet)	28	17.3
participating poorly; having awkward silences: as unwilling, shy; lack of interest/work/prior knowledge/language; lost	22	13.6
being affected by (others/my) taking over /dominating/expecting things to revolve around them	20	12.3
not concentrating on understanding relevant concepts correctly: skipping hard concepts; not exploring enough detail or spending enough time; going off track/not focusing on completing objectives; accepting things uncritically	16	9.9
setting vague /non-specific/irrelevant (or misinterpreting) learning objectives	15	9.3
spending too much time on things (we know/we should have known better/we could not know, unnecessary detail, on one thing, etc.) at the expense of other things	13	8.0
being put down/undermined by others or other students putting people down disregarding contribution; undermining with their questions; competing; being rude; making feel uncomfortable	9	5.6
talking about non-work things too much	7	4.3
having the Chair role go wrong	6	3.7
not doing the work/preparation required, e.g. for the objective(s) discussed or the level of the discussion	5	3.1
not getting on/ arguing about other things/talking over each other	5	3.1
not working when the tutor was not there	5	3.1
being disrupted by the tutor	5	3.1
being overreliant on notes/covering things without thinking about/learning work: reading from notes to impress; have made notes but not learnt it (unable to explain)	3	1.9
being late/absent or ill or other students doing this	3	1.9
Total does not add to 100.0% due to rounding	162	100.2

*coded straight to these overall themes (162 responses + 39 blanks = 201) *Liverpool MBChB curriculum. Year 1 medical students. Study (S)3*

Table 24: Questionnaire survey of Year 1 medical students start-year, 2001/02 (Study-element 3): Fifteen themes* emerging from answers to Q59 (n=191): "I chose Medicine because…"

Theme I chose Medicine because…	Students mentioning ≥1 such concept(s) no.	 %
it will give me something: that is worthwhile/longlasting/meaningful/important/ challenging/rewarding; it is interesting/enjoyable/amazing; because of good career prospects/variety/ job satisfaction	98	51.3
of altruistic reasons: I wanted to help/make a difference to people/society/health care; treat disease	77	40.3
I wanted to work with science, liked biology/how human body works	76	39.8
I wanted to work with people	55	28.8
I have always wanted to do this,** have wanted to do this for a long time/cannot imagine doing anything else	29	15.2
I wanted this type of cognitive challenge/applied knowledge	19	9.9
I want to/it suited me/I am suited to it/I would be good	14	7.3
I was stimulated by previous degree/health care work/work experience	8	4.2
I wanted the teamwork	6	3.1
I wanted the financial rewards	3	1.6
it was not an active choice of mine/was persuaded by others	2	1.0
of an unfulfilling other career	2	1.0
'usual interview reasons'	2	1.0
of my A-level results	1	0.5
personal experience of receiving health care	1	0.5

*[illegible] initial comments coded direct to overall themes (191 responses + 10 blanks=201) *Liverpool MBChB curriculum. Year 1 medical students. Study (S)3*

**Difference in mean satisfaction with Liverpool problem-based curriculum (S6 Q21) for 'under this theme vs not': approached statistical significance (Levene's Test for Equality of Variance): 4.48 (n=23) vs 4.15 (n=130); t=1.902[illegible], p=0.063 (95% confidence interval on difference of 0.324: -0.018, +0.667*

◗ *"I liked human biology..."*; ◗ *"I am interested in science and how specifically the body works"*; ◗ *"I find learning about the body, diseases, etc. very interesting"*; ◗ *"Enjoy science/biology = health + disease"*; ◗ *"I wanted to be involved in a career where I could apply science"*; ◗ *"I am completely fascinated by the structure & function of the human anatomy & physiology and the different aspects affecting the human mind (psychological aspects)"*; ◗ *"combining my interests in both sciences and communication"*; ◗ *"I have always been interested in a career which requires a scientific knowledge as a background..."*

Indeed, 37/191 (19.4%) contributed to both the altruistic theme and the science theme in their answers, as underlined in these full answers.

◗ *"I wanted to use my intelligence & something worthwhile + challenging + with lots of goals I can fulfil – also interested in the working of the body + the practical way we can help people live better, enjoyable lives." [S3-910]*
Coded as contributing to four of the fifteen final themes...
"because...":
- ✓ of altruism
- ✓ of scientific interest/application
- ✓ it will give me something (by its being worthwhile, meaningful, interesting, rewarding as a career, etc.)
- ✓ of the cognitive challenge/applied knowledge/type of learning

◗ *"I have always wanted to enter this profession in which your life (career is dedicated to caring for people with such depth of scientific knowledge" [S3-721]*
Coded as contributing to three of the fifteen final themes...
"because...":
- ✓ of altruism
- ✓ of scientific interest/application
- ✓ of a longstanding or unflinching dedication to this career

◗ *"I wanted to work in a team, have a positive impact on people, and use biological sciences." [S3-361]*
Coded as contributing to three of the fifteen final themes...
"because...":
- ✓ of altruism
- ✓ of scientific interest/application
- ✓ of the teamwork involved

Supplementary themes included wanting to work with people (28.8%) and asserting a longstanding or unflinching dedication to this career (15.2%, whose greater curriculum satisfaction than those not expressing this approached statistical significance **(Table 24)**). For responders wanting to work with people, only two specified working with children, including the only responder citing a clinical specialty to justify his/her choice with, i.e. ◗ *"I would like to be a paediatrician as I love working with children"*). The following responders illustrated these two supplementary themes:

> ◗ *"I enjoy working with people"*; ◗ *"I want a... people orientated career"*; ◗ *"but also involves meeting and talking to people a lot"*

and:

> ◗ *"I always wanted to do it for as long as I can remember"*; ◗ *"I could not see myself doing anything else"*; ◗ *"Can't remember making a choice. I just always wanted to do it, since primary school"*

Amongst the exceptions, only three responders mentioned financial benefits (e.g. in the unfortunate turn of phrase: ◗ *"people pay me to cut them up"*), two gave an answer that suggested such reasons were formulaic (◗ *"Of all the usual "interview" reasons"* and ◗ *"Personal [UCAS] statement" upon request – for debate, to why I chose Medicine"*), and for one, amongst other things it was because of ◗ *"...A-level results"*. The last word should go to the only two responders to admit that it was not particularly their choice, i.e. ◗ *"I let myself be dissuaded from doing Chemistry/Physics"* and ◗ *"did not know what else to do & my fathers [sic] a doctor"*).

Career (reported elsewhere) and learning/tutoring data (reported elsewhere)

Career data are reported linked to all other study-elements **(p272)**.

Learning/tutoring data are reported linked to S6 **(p229)**.

Summary

In S3:

- Besides the one-sixth of responders unable to recall a critical incident that was detrimental to their learning in a PBL session, the two most common themes (13.6%, 12.3%, respectively) involved students participating poorly and self-centred students who dominated proceedings. Supplementary themes involved students skimping with their explanations of key concepts; students not formulating appropriately specific learning objectives; and students wasting session-time on the wrong things (including too much detail). Although much less prevalent, students who undermined (including offensive and competitive behaviour); students who were late/absent; or students who read from their notes had each disrupted the flow of various sessions for this cohort so far. Absent or problematic tutors were the source of the detrimental critical incident for 6.2% of responders.
- Over half the responders had chosen Medicine as it would give *them* something (worthwhile, interesting, rewarding etc.). Similar proportions of responders) (40.3% and 39.8%, respectively) conveyed altruistic reasons and an interest in science/human biology and some (19.4% of all responders) invoked both. A few responders disclosed that they had merely complied with the expectations of others.

Results 6: 2001 cohort S6, end-of-Year 1

Questionnaire response (Table 22, p219)

By the end of Year 1, four students had left the cohort: two changing programmes and two suspending studies. (Of the 4, only 1 had responded to S3.) The S6 response rate was 198/279 (71.0%), and not statistically significantly different from that (71.0%) in S3 when analysing them as independent samples. Analysing for paired data (n=279 paired observations; excluding the one responder in each study-element who removed the unique identifier), there was no statistically significant difference in whether single-responders responded to S3 or S6.

When analysed as independent samples, there was no statistically significant difference in the proportion of males amongst responders to S3 compared with S6 (37.3% versus 34.8%: Yates-corrected $\chi^2_1=0.17$ and p=0.683; 95% confidence interval on 2.46 difference 11.89 to -6.96). Nevertheless, statistically significantly fewer males responded to neither (25/43, 58.1%) versus both (57/160, 35.6%) study-elements (95% confidence interval on 22.51 difference 6.01 to 39.02).

There was no statistically significant difference in the unpaired proportion of males, home (EC), or school-leavers (including resit A-levels and gap-year) between responders to S6 compared with S3.

Open-ended questions: Effective contributions in problem-based learning, and learning about *Population Perspective*

Ineffective contributions in problem-based learning (reported elsewhere)

Reported elsewhere with reference to S3 and S2 **(p253)**.

Learning Population Perspective (reported elsewhere)

Reported elsewhere linked to S5 **(p211)**.

Career (reported elsewhere) and learning/tutoring data

Career data are reported linked to all other study-elements **(p272)**.

Learning/tutoring data are reported linked to S6 **(p229)**.

Results 3 & 6 linked (referring to 5): **2001 cohort S3, S6,** (referring to 1999 cohort S5); **start-of-Year 1, end-of-Year 1** (referring to mid-Year 3)

Career (also reported elsewhere), learning/tutoring & satisfaction data (Table 25a&b, Table 26-29, Table 30a&b)

Both S3 and S6 (start and the end of Year 1) showed the same general distribution of learning approaches, the median subscale scores out of 30 being 22.0, 23.0, and 15.0 for deep, strategic, and surface, respectively (and therefore similar to the 21.0, 22.0, and 15.0 in S5). Reliability was moderately good with Cronbach's alphas from 0.633 (deep) to 0.720 (strategic) in S3, and from 0.671 (strategic) to 0.716 (deep) in S6 **(Table 25a, Table 25b)**. Most of the items were reliably scored by these students in this setting. In neither study-element did the reliability (alpha) for the deep subscale increase on deleting any of the items. In both, reliabilities for the strategic subscales improved on deleting the same item as for S5 (noting tutors' written comments). In S6, surface subscale reliability improved by deleting one item (learning just the things to pass assessments, as for S5), but no deletions affected this alpha in S3.

In both study-elements, just over half the responders (as for S5) scored highest on the strategic subscale. Each time, just under one-fifth of responders had deep or strategic learning as the least evident approach, showing that surface learning was more evident than disclosed by predominant score alone. Nevertheless, in both study-elements, the responders allocated least points (25.2% and 25.5%, respectively), of the 90 points available, to surface learning and most (37.9% and 38.5%, respectively), marginally, to strategic over deep learning.

Analysing the paired data for change (n=160 paired observations), the median change in score from the start (S3) to the end (S6) of Year 1 was 0, +1.0, and +0.5 for deep, strategic, and surface learning (with mean changes of +0.04, +0.79, and +0.33), respectively. There was no statistically significant change in the mean deep or surface learning scores (paired t-test: t_{159}= -0.16, p=0.874; t_{159}= -1.03, p=0.305). There was, however, a small statistically significant increase in the mean strategic score from 22.42 to 23.21 (paired t-test: t_{159}= -2.70, p=0.008; 95% confidence interval on +0.79 difference +0.21 to +1.37). In the paired observations, most change appeared to be away from surface learning, e.g. 72.5% of responders had the same predominant learning approach by the end of the year, which was highest for strategic (79.1%) and lowest for surface (36.4%) learning **(Table 26)**.

Table 25a: Questionnaire survey of Year 1 medical students at start of 2001/02 (Study-element 3): *Short RASI* learning approaches (n=201)

Approach *(median score out of 30.0 on each subscale)*	*Cronbach's alpha (standardized item alpha)*	**Predominant approach for: no.**	**%**	**Least evident approach for: no.**	**%**	**% of total points allocated** *overall %*	*[range:*	*minimum*	*maximum]*
▪ **Deep** *(22.0)*	0.633 *(0.644)*	82	*40.8*	19	*9.5*	*36.8*	*[27.3:*	*23.7*	*51.0]*
▪ **Strategic** *(23.0)*	0.720* *(0.725)*	105	*52.2*	19	*9.5*	*37.9*	*[29.5:*	*22.4*	*51.9]*
▪ **Surface** *(15.0)*	0.706 *(0.705)*	14	*7.0*	163	*81.1*	*25.2*	*[32.0:*	*10.0*	*42.0]*
	Total	201	*100.0*	201	*100.1*	*99.9*			

All totals do not add to 100.0% due to rounding — *Liverpool MBChB curriculum, Year 1 medical students, Study (S)3*

* ↑ *to 0.767 if delete Q5: "I look carefully at tutors' comments on course work to see how to get higher marks next time"*

Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Table 25b: Questionnaire survey of Year 1 medical students at end of 2001/02 (Study-element 6): *Short RASI* learning approaches (n=198)

Approach *(median score out of 30.0 on each subscale)*	*Cronbach's alpha (standardized item alpha)*	**Predominant approach for: no.**	**%**	**Least evident approach for: no.**	**%**	**% of total points allocated** *overall %*	*[range:*	*minimum*	*maximum]*
▪ **Deep** *(22.0)*	0.716 *(0.723)*	80	*40.4*	19	9.6	*36.1*	*[33.6:*	*17.3*	*50.9]*
▪ **Strategic** *(23.0)*	0.671* *(0.685)*	105	*53.0*	13	6.6	*38.5*	*[26.2:*	*22.9*	*49.1]*
▪ **Surface** *(15.0)*	0.684** *(0.687)*	13	*6.6*	166	83.8	*25.5*	*[35.6:*	*10.5*	*46.2]*
	Total	198	*100.0*	198	*100.0*	*100.1*			

Liverpool 1996 MBChB curriculum, Year 1 medical students, Study (S)6

* ↑ *to 0.744 if delete Q5: "I look carefully at tutors' comments on course work to see how to get higher marks next time"*
** ↑ *to 0.706 if delete Q4: "I concentrate on learning just those bits of information I have to know to pass"*

Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Table 26: Questionnaire survey of Year 1 medical students at start (n=283) and end (n=279) of 2001/02 (Study-element (S)3 & S6): Changes in *Short RASI* learning approaches

Question	**Unchanged from:** start-of-Year 1 → end-of-Year 1 (S3→S6) **n=160 response-sets** **no.** 116	**%** *72.5*					
…predominant S3	Deep S6		Strategic S6		Surface S6		
▪ …deep, start-of-Year 1 **n=63 → end-of-Year 1**	44	*69.8*	17	*27.0*	2	*3.2*	*100.0%*
▪ …strategic, start-of-Year 1 **n=86 → end-of-Year 1**	15	*17.4*	68	*79.1*	3	*3.5*	*100.0%*
▪ …surface, start-of-Year 1 **n=11 → end-of-Year 1**	4	*36.4*	3	*27.3*	4	*36.4*	*100.1%*
…least evident S3							
▪ …deep, start-of-Year 1 **n=15 → end-of-Year 1**	6	*40.0*	1	*6.7*	8	*53.3*	*100.0%*
▪ …strategic, start-of-Year 1 **n=15 → end-of-Year 1**	2	*13.3*	2	*13.3*	11	*73.3*	*99.9%*
▪ …surface, start-of-Year 1 **n=130 → end-of-Year 1**	9	*6.9*	6	*4.6*	115	*88.5*	*100.1%*

Liverpool MBChB curriculum, Year 1 medical students (followed for Year 1), Study (S)3, S6

All totals do not add to 100.0% due to rounding

% unchanged

Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

For the responders whose predominant learning approach changed, those with deep learning predominating mostly moved to strategic learning, and vice versa. Movement out of the surface category was mostly to deep learning (36.4%). Most responders still had surface learning as the least evident category (88.5%) by the end the year.

In S6, the vast majority of responders (95.9%) agreed (somewhat) that, if they had their time again, they would still do Medicine. As with S5 in the other cohort, although this percentage decreased for doing Medicine in a problem-based curriculum, and decreased again for doing Medicine in *this* (Liverpool) problem-based curriculum, 80.2% still agreed (somewhat) with the latter **(Table 27)**. This was not statistically significantly higher than the comparable figure of 72.2% for the mid-Year 3 students surveyed around the same time (S5) (Yates-corrected χ^2_1=2.74, and p=0.098).

Overall (as for S5), in S6, there was a pattern to the Pearson correlation coefficients between these 'satisfaction' scores and the learning approach subscale scores **(Table 27)**. There were statistically significant positive correlations for strategic learning, and negative correlations for surface learning, and one of the positive correlations with deep learning (…Medicine in a problem-based curriculum) was also statistically significant. As with the other cohort:

- Responders with higher strategic learning scores (lower surface learning scores, and possibly deep learning scores) tended to agree that they would still do Medicine, in a problem-based curriculum, in Liverpool.

The strongest correlation for satisfaction with the Liverpool curriculum was this time with the surface (rather than strategic) subscale with an r_p= -0.33. On using the % of points allocated to the subscale rather than the raw score, the positive correlation between the Liverpool curriculum satisfaction and deep learning also became statistically significant. The results were broadly similar when Spearman rank correlation coefficient was used instead. As noted previously **(p225)**, there was a suggestion that S3 responders indicating longstanding/unswerving dedication to Medicine (versus no comment under this theme) scored higher on Liverpool curriculum satisfaction if responding to S6, but this only just approached statistical significance **(Table 24, p224)**.

Table 27: **Questionnaire survey of Year 1 medical students at end of 2001/02 (Study-element 6): Satisfaction with the curriculum versus *Short RASI* learning approaches (n=197)**

Question **If I had my time again...** *(median score)*	**Agree + Agree somewhat** no.		%	**Learning approach** Deep	Strategic	Surface	Deep	Strategic	Surface
				(score out of 30.0 on each subscale)			*(as a % of the total points allocated across all three subscales)*		
				Pearson correlation coefficient					
▪ ...I would still do Medicine *(5.0)*	172	+17	95.9	+0.12	+0.23**	-0.15*	+0.08	+0.26**	-0.24**
▪ ...I would still do Medicine in a problem-based curriculum *(5.0)*	104	+62	84.3	+0.18*	+0.28**	-0.26**	+0.15*	+0.31**	-0.34**
▪ ...I would still do Medicine in this Liverpool problem-based curriculum *(5.0)*	100	+58	80.2	+0.13	+0.27**	-0.33**	+0.15*=	+0.37**	-0.38**

Liverpool MBChB curriculum. Year 1 medical students. Study (S)6

5=Agree, 4=Agree somewhat, 3=Unsure, 2=Disagree somewhat, 1=Disagree
Statistically significant: *at p=0.05 level; **at p=0.01 level
Not statistically significant with Spearman rank correlation coefficient (at 0.05 level): +0.12=
Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Of the 38 items used to explore good tutoring, the pre-selected ten key indicators were associated, albeit weakly, with the three learning approach subscales on Pearson correlation coefficients **(Table 28)**. The Likert scores on the two 'good actions' (promoting end-of-session evaluation and understanding and sticking to PBL 'rules') were statistically significantly positively correlated with the deep and/or strategic learning scores in S6 and with the strategic scores for S3. The Likert scores on five of the eight 'bad actions' ---avoiding getting students to link various types of knowledge; telling them exactly what they need to cover; telling them the answers to difficult objectives; avoiding questioning students' understanding; and allowing them to report back from their notes)--- were statistically significantly positively correlated with the surface learning score in S6. The first four of these had emerged similarly in the other cohort (S5, **p195**) and the first three were also highlighted at the start of the year, in S3, which also featured the remaining one highlighted in S5, i.e. 'ensuring they focus on one theme or topic for most of a session'. In both S3 and S6, there were also statistically significantly negative correlations with the deep and strategic learning scores for avoiding getting students to link various types of knowledge, and in S6 for telling students the answers to difficult objectives. In both study-elements (as for S5), there were statistically significant correlations in the unexpected direction, i.e. positive correlation for:

- wanting expert-input according to the tutor's content-expertise (deep and strategic)

In S6 (as for S5), responders ranked 'compassionate, patient-centred carer' and 'listening, informative communicator' 1st and 2nd, and 'efficient, organized self-manager' last (matching the original order emerging from the open responses of the other cohort at entry) **(Table 29)**.

Table 28: Questionnaire survey of Year 1 medical students at start and end of 2001/02 (Study-element (S)3 & 6): Learning approach versus the 10/38 notions of a good tutor with particular face validity (n=201) *[n=198]*, respectively)

Question (S3 *start of Y1*) *[S6 end-of-Y1]*	Statistically significant Pearson correlation coefficients r_p Learning approach: *(score out of 30.0 on each subscale)*		
Ideally, my problem-based learning (PBL) tutor should…	**Deep**	**Strategic**	**Surface**
➢ make sure that the group takes time to evaluate how things are going at the end of each session (Q26) *[Q32]*	*[+0.18]***	(+?)=	
➢ understand and stick to the rules of PBL (Q32) *[Q38]*	*[+0.19]***	(+0.15)* *[+0.25]***	
≺ provide extra input to sessions from his/her particular discipline so as not to waste this expertise (Q28) *[Q34]*	(+0.19)** *[+0.16]**		
≺ avoid asking questions that worry us into having to go away and recheck our work all the time (Q30) *[Q36]*			*[+0.19]***
≺ avoid the messy process of getting us to link various types of knowledge with the scenario (Q34) *[Q40]*	(–0.15)* *[–0.16]**	(–0.14)* *[–?]==*	(+0.32)** *[+0.26]***
≺ ensure we focus on one theme or type of topic for most of a session so we work in neat blocks (Q39) *[Q45]*			(+0.16)*
≺ allow us to report back from notes when we've done the work but not had time to learn it yet (Q41) *[Q47]*			*[+0.17]**
≺ indicate if we've said something silly so I don't waste time on other people's wrong answers (Q44) *[Q50]*			
≺ tell me exactly what syllabus I need to cover for each scenario, avoiding uncertainty (Q52) *[Q58]*	*[–0.15]**		(+0.34)** *[+0.29]***
≺ take responsibility for complicated discussions by telling us the answers to difficult objectives (Q56) *[Q62]*		(–?)=== *[–0.15]**	(+0.38)** *[+0.29**]*

Liverpool MBChB curriculum, Year 1 medical students, Study (S)3

5=Agree, 4=Agree somewhat, 3=Unsure, 2=Disagree somewhat, 1=Disagree
**at p=0.05 level; **at p=0.01 level*
Statistically significant only with Spearman rank correlation coefficient at 0.05 level: +0.16=; -0.18==; -0.14===
? denotes correlation only significant on Spearman rank
➢ *Liverpool PBL tutors should do this*
≺ *Liverpool PBL tutors should not do this*

Table 29: Questionnaire survey of Year 1 medical students end of year 2001/02 (Study-element 6): Ranking nine themes about characteristics of a good doctor generated by the 1999 Year 1 cohort (n=185***) versus satisfaction with the curriculum and versus current *Short RASI* learning approaches**

Question **A good doctor is a(n)...**	**no.**	**%**	n=185 **Sum of all ranks**	**Mean rank**	**Overall rank** *(previous)*	**Spearman rank correlation coefficient**: **...I would still do Medicine in this Liverpool problem-based curriculum** n=184	**Spearman rank correlation coefficient**: **Learning approach: Deep subscale score out of 30** n=185
▪ ...compassionate, patient-centred carer	62	*35.0*	589	3.18	1	-0.09	+0.03
▪ ...listening, informative communicator	26	*14.7*	676	3.65	2	-0.11	+0.003
▪ ...exemplary, responsible 'professional'	8	*4.5*	1,151	6.22	8	+0.17*	+0.10
▪ ...experienced, knowledgeable expert	27	*15.3*	915	4.95	5	+0.16*	+0.21**
▪ ...friendly, inclusive team player	13	*7.3*	851	4.60	3	-0.10	-0.08
▪ ...thinking, flexible learner	5	*2.8*	1,008	5.45	6	-0.02	-0.11
▪ ...decisive, competent diagnostician	19	*10.7*	883	4.77	4	+0.17*	+0.10
▪ ...well-balanced, insightful 'individual'	13	*7.3*	1,020	5.51	7	-0.08	-0.28**
▪ ...efficient, organized self-manager	4	*2.3*	1,232	6.66	9	-0.24**	-0.03
Total	177***	*99.9%*	8,325 (=45X185****)				

Listed in order generated by S1 responders

k 1=most important to 9=least important *Liverpool MBChB curriculum, Year 1 medical students, Study (S)6*

Learning approach: 5=Agree, 4=Agree somewhat, 3=Unsure, 2=Disagree somewhat, 1=Disagree

Total does not add to 100.0 due to rounding

Statistically significant: *at p=0.05 level; **at p=0.01 level

****Excludes the 8/185 responders who distributed 45 points by using some numbers more than once and some not at all*

*****Includes the 8/185 responders who distributed 45 points by using some numbers more than once and some not at all*

******9 further responders completed the ranking question in an unusable way, and the remaining 4 made no attempt to answer*

Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Unlike in S5, in S6, there were some statistically significant, albeit weak, Spearman rank correlation coefficients between some of the nine good doctor themes and the deep subscale score. These were:

- 'experienced, knowledgeable expert' r_s= +0.21

  The higher the deep learning score (i.e. higher number), the less importance that responders ascribed to this (i.e. higher number)
- 'well-balanced, insightful 'individual' r_s= -0.28

  The higher the deep learning score (i.e. higher number), the more importance that responders ascribed to this (i.e. lower number),

Between any of the nine themes and the satisfaction score for the problem-based curriculum in Liverpool, there were four statistically significant, albeit weak, Spearman rank correlation coefficients:

- 'exemplary, responsible 'professional'...', 'experienced, knowledgeable expert', 'decisive, competent diagnostician' r_s= +0.17, r_s= +0.16, r_s= +0.17

  The more importance that responders ascribed to each (i.e. lower number), the lower the satisfaction score (i.e. lower number)
- 'efficient, organized self-manager' r_s= -0.24

  The more importance that responders ascribed to this (i.e. lower number), the higher the satisfaction score (i.e. higher number)

In S3 and S6, the commonest reported career intention was 'hospital doctor (consultant)' (43.2%, 38.3%), as presented with the basic analysis of the career data from all the study-elements **(p272)**, but the relationship with learning approach is reported here. For S6, however, the 'do not know' category (44.4%) was the commonest response.

S3 and S6 showed some similar results to S5 when comparing career intentions with learning approach. There were no statistically significant differences between whether responders reported a career intention (versus reporting uncertainty, i.e. 'do not know') compared with the predominant of each student's three learning subscale scores (2x3 contingency table), or for the mirror-comparison using the least evident learning approach **(Table 30a & Table 30b)**.

Table 30a: Questionnaire survey of Year 1 medical students at start of 2001/02 (Study-element 3): Career intentions versus *Short RASI* learning approaches (n=199)

Question	Learning approach no. *(%)*					
	…predominant *[from score out of 30.0]*			…least evident *[from score out of 30.0]*		
At this stage in your medical career, what is your intended career destination?	**Deep**	**Strategic**	**Surface**	**Deep**	**Strategic**	**Surface**
▪ …reported a choice n=122	49 *(40.2)*	67 *(54.9)*	6 *(4.9)*	7 *(5.7)*	12 *(9.8)*	103 *(84.4)*
▪ …do not know n=77	32 *(41.6)*	38 *(49.4)*	7 *(9.1)*	11 *(14.3)*	7 *(9.1)*	59 *(76.6)*
	Pearson χ^2=1.56, p=0.459		*(100.0)* *(100.1)*	Pearson χ^2=4.19, p=0.123		*(99.9)* *(100.0)*
		Deep + Strategic	**Surface**		**Deep + Strategic**	**Surface**
▪ …general practitioner n=25		23 *(92.0)*	2 *(8.0)*		8 *(32.0)*	17 *(68.0)*
▪ …not general practitioner/do not know n=174		163 *(93.7)*	11 *(6.3)*		29 *(16.7)*	145 *(83.3)*
	p=0.670 FE *1 cell (25.0%): expected count <5; minimum=1.63*		*(100.0)* *(100.0)*	p=0.095 FE *1 cell (25.0%): expected count <5; minimum=4.65*		*(100.0)* *(100.0)*
n=111 subset		**Deep + Strategic**	**Surface**		**Deep + Strategic**	**Surface**
▪ …general practitioner n=25		23 *(92.0)*	2 *(8.0)*		8 *(32.0)*	17 *(68.0)*
▪ …hospital consultant [excluding all other choices and do not know] n=86		85 *(98.8)*	1 *(1.2)*		7 *(8.1)*	79 *(91.9)*
	p=0.127 FE *2 cells (50.0%): expected count <5; minimum=0.68*		*(100.0)* *(100.0)*	**p=0.005** FE** *1 cell (25.0%): expected count <5; minimum=3.38*		*(100.0)* *(100.0)*
mean subscale score…	**Deep**	**Strategic**	**Surface**			
▪ …general practitioner	21.76	21.36	15.56			
▪ …hospital consultant	22.08	23.23	13.74			
t_{109}, p	-0.41, 0.685	-2.20, **0.030***	2.03, **0.045***			

Statistically significant: *at p=0.01 level FE=Fisher's Exact *Liverpool MBChB curriculum. Year 1 medical students. Study (S)3*
Learning approach: 5=Agree, 4=Agree somewhat, 3=Unsure, 2=Disagree somewhat, 1=Disagree
Highest value of each pair of means is shaded
All totals do not add to 100.0% due to rounding
Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Table 30b: Questionnaire survey of Year 1 medical students at end of 2001/02 (Study-element 6): Career intentions versus *Short RASI* learning approaches (n=196)

Question **At this stage in your medical career, what is your intended career destination?**	Learning approach no. *(%)* Deep=D	Strategic=St ...predominant *(from score out of 30.0)*	Surface=S	Deep	Strategic ...least evident *(from score out of 30.0)*	Surface
...reported a choice n=109	48 *(44.0)*	52 *(47.7)*	9 *(8.3)*	8 *(7.3)*	7 *(6.4)*	94 *(86.2)*
...do not know n=87	31 *(35.6)*	52 *(59.8)*	4 *(4.6)*	11 *(12.6)*	5 *(5.7)*	71 *(81.6)*
		Pearson χ^2=3.15, p=0.207	*100.0%* *100.0%*		Pearson χ^2=1.56, p=0.458	*99.9%* *99.9%*
...general practitioner n=24		22 *(91.7)*	2 *(8.3)*		5 *(20.8)*	19 *(79.2)*
...not general practitioner/do not know n=172		161 *(93.6)*	11 *(6.4)*		26 *(15.1)*	146 *(84.9)*
		p=0.663 FE *1 cell (25.0%): expected count <5; minimum=1.59*	*100.0%* *100.0%*		p=0.549 FE *1 cell (25.0%): expected count <5; minimum=3.80*	*100.0%* *100.0%*
...general practitioner n=24		22 *(91.7)*	2 *(8.3)*		5 *(20.8)*	19 *(79.2)*
...hospital consultant [excluding all other choices and do not know] n=75		71 *(94.7)*	4 *(5.3)*		6 *(8.0)*	69 *(92.0)*
		p=0.630 FE *2 cells (50.0%): expected count <5; minimum=1.45*	*100.0%* *100.0%*		p=0.129 FE *1 cell (25.0%): expected count <5; minimum=2.67*	*100.0%* *100.0%*

mean subscale score...	Deep	Strategic	Surface
...general practitioner	22.08	21.54	15.42
...hospital consultant	22.29	23.67	14.16
t_{97}, p	-0.24, 0.807	**-2.40, 0.018***	1.29, 0.200

Liverpool MBChB curriculum. Year 1 medical students. Study (S)6

Nil statistically significant, except mean strategic score. ***p<0.05*** FE=Fisher's Exact
Learning approach: 5=Agree. 4=Agree somewhat. 3=Unsure. 2=Disagree somewhat. 1=Disagree
Highest value of each pair of means is shaded
All totals do not add to 100.0% due to rounding
Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

In both S3 and S6, marginally fewer responders who reported 'GP' (versus all other responses combined, i.e. not GP and do not know) had the deep and strategic combined category (rather than surface) predominating, but without statistical significance. The pattern was mirrored in both study-elements for the least evident category, and when confining the comparison to GP versus 'hospital doctor (consultant)' rather than all non-GP categories. The only (albeit very) statistically significant difference, however, was for S3, where fewer responders in the GP category had surface learning as their least evident score compared with the 'hospital doctor (consultant)' category (68.0% versus 91.9%: 95% confidence interval on –23.86% difference –43.04 to –4.68).

In both S3 and S6, when comparing between those reporting GP versus hospital consultant, there were statistically significantly (t-test) lower mean strategic scores. There was a statistically significantly higher surface score in the GP category in S3 (15.56 versus 13.74; 95% confidence interval on –1.82 difference –3.59 to –0.04). The remaining non-significant differences for deep, strategic and surface scores followed the same pattern as in S5.

Principal components analysis of learning/tutoring data (Tables 31a, bi, bii, c; Figures 3a, 3b)

Good tutoring

The 38 statements that described negative and positive actions of a PBL tutor elicited agreement ('agree' or 'agree somewhat') from between around a tenth of responders to nearly all responders. In S3 and S6, most agreement (99.5% and 98.5% of responders, respectively) was elicited by the positive action, *"know how and when to interrupt the discussion without taking over"* **(Table 31a)**. In S5, this came second (97.5%, jointly with *"guide us subtly back on the right track and depth if going off at a tangent or into too much detail"* and *"be a friendly character who puts the group at ease"*) to *"help get us moving again if we are well and truly stuck and missing things right under our noses"* (98.7%).

Table 31a: Questionnaire survey of Year 1 medical students at start and end of 2001/02 (Study-element (S)3 & S6) and Year 3 medical students mid-2001/02 (S5): Perceptions of a good tutor (38 items; n=210, n=198, n=158)

Ideally, my problem-based learning (PBL) tutor should...	S3, n=210 Agree + Agree somewhat		S6, n=198 Agree + Agree somewhat		S5, n=158 Agree + Agree somewhat	
	no.	%	no.	%	no.	%
•always look to involve everyone in keeping the session moving	123 +61	91.5	123 +56	90.4	91 +57	93.7
•help us by discussing his/her own personal experiences of science and medicine	63 +95	78.6	65 +97	81.8	43 +68	70.3
•look interested enough in what we have to say to want to be there	128 +62	94.5	138 +51	95.5	98 +49	93.0
•act like another member of the group by contributing to the debate	31 +61	45.8	33 +69	51.5	28 +51	50.0
•keep things non-competitive and relaxed so we can make mistakes when trying out explanations	144 +47	95.0	146 +45	96.5	105 +44	94.3
•help get us moving again if we are well and truly stuck and missing things right under our noses	164 +34	98.5	163 +31	98.0	133 +23	98.7
•recognize and understand various students' discomforts and difficulties during the session	150 +43	96.0	137 +57	98.0	106 +46	96.2
•make sure that the group takes time to evaluate how things are going at the end of each session	105 +79	91.5	72 +91	82.3	41 +65	67.1
•allow you to drift for now if you want to – it's only you that misses out if you don't participate!	5 +25	14.9	7 +27	17.2	5 +24	18.4
•provide extra input to sessions from his/her particular discipline so as not to waste this expertise	47 +82	64.2	30 +98	64.6	56 +58	72.2
•know the detailed content and answers of each objective we set	38 +59	48.3	34 +72	53.5	33 +50	52.5
•avoid asking questions that worry us into having to go away and recheck our work all the time	21 +40	30.3	17 +37	27.3	10 +38	30.4
•come right out and regularly judge our group and individual performance	38 +51	44.3	23 +43	33.3	23 +39	39.2
•understand and stick to the rules of PBL	75 +90	82.1	72 +86	79.8	40 +58	62.0
•be enthusiastic even if it is not his/her subject-area	124 +70	96.5	113 +71	92.9	88 +63	95.6
•avoid the messy process of getting us to link various types of knowledge with the scenario	5 +22	13.4	5 +18	11.6	6 +15	13.3
•save time by letting us skip explanations if we say that we've done it before	14 +30	21.9	6 +32	19.2	11 +41	32.9
•be able to recognize what is important for a doctor to know	109 +72	90.0	90 +74	82.8	101 +46	93.0
•remain detached in the background so as not to put us off our discussion	15 +35	24.9	10 +48	29.3	7 +48	34.8
•contribute to the group dynamics and process rather than the content of the discussions	54 +87	70.1	52 +91	72.2	45 +69	72.2
•ensure we focus on one theme or type of topic for most of a session so we work in neat blocks	26 +50	37.8	16 +54	35.4	14 +37	32.3
•keep feedback mostly indirect and descriptive about how individuals and the group do things	30 +71	50.2	29 +87	58.6	13 +56	43.7
•allow us to report back from notes when we've done the work but not had time to learn it yet	70 +83	76.1	59 +83	71.7	17 +79	60.8
•guide us subtly back on the right track and depth if going off at a tangent or into too much detail	150 +46	97.5	124 +69	97.5	112 +42	97.5
•avoid wasting precious time getting us to reflect back on every session	20 +42	30.8	22 +48	35.4	28 +51	50.0
•indicate if we've said something silly so I don't waste time on other people's wrong answers	35 +57	45.8	27 +62	44.9	25 +52	48.7
•avoid wasting session-time on students with personal problems	22 +43	32.3	22 +35	28.8	15 +20	22.2
•communicate with students in a formal way	3 +17	10.0	6 +22	14.1	1 +16	10.8
•help us to formulate specific learning objectives to sort out relevant gaps in group knowledge	91 +88	89.1	78 +90	84.8	79 +68	93.0
•use our time to seek and respond to student feedback about his/her effect on the group	26 +98	61.7	23 +80	52.0	21 +73	59.5
•encourage us to talk through and use what we already know about things, even simple stuff	97 +91	93.5	91 +92	92.4	60 +70	82.3
•be a friendly character who puts the group at ease	171 +24	97.0	152 +41	97.5	117 +37	97.5
•ask questions that challenge us to think whether we really understand what we're talking about	131 +64	97.0	122 +63	93.4	99 +52	95.6
•tell me exactly what syllabus I need to cover for each scenario, avoiding uncertainty	54 +53	53.2	42 +50	46.5	52 +59	70.3
•know how and when to interrupt the discussion without taking over	138 +62	99.5	134 +61	98.5	112 +42	97.5
•ensure that students avoid commenting on his/her tutoring performance	8 +19	13.4	5 +25	15.2	9 +14	14.6
•give us the faculty learning objectives	45 +54	49.3	34 +37	35.9	38 +28	41.8
•take responsibility for complicated discussions by telling us the answers to difficult objectives	17 +33	24.9	12 +44	28.3	11 +30	25.9

■ denotes the 20 negative actions, the others being positive actions *Liverpool MBChB curriculum, Year 1 medical students, Study (S)3 & S6, and Year 3, S5*

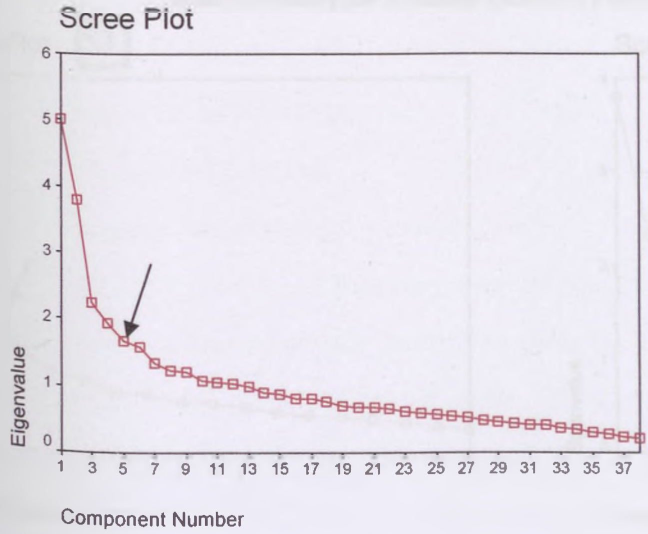
Focusing just on the negative actions, in S3 and S6, most agreement (78.6% and 81.8% of responders, respectively) was elicited by *"help us by discussing his/her own personal experiences of science and medicine"*. In S5, this came second (70.3%, jointly with *"tell me exactly what syllabus I need to cover for each scenario, avoiding uncertainty"*) to *"provide extra input to sessions from his/her particular discipline so as not to waste this expertise"* (72.2%). In all three study-elements, least agreement was elicited by the same two negative actions: *"communicate with students in a formal way"* (10.0%, 14.1%, 10.8%) and *"avoid the messy process of getting us to link various types of knowledge with the scenario"* (13.4%, 11.6%, 13.3%).

Overall, the proportion of answers that were 'agree' or 'agree somewhat' appeared consistent over S3, S6, and S5, respectively:

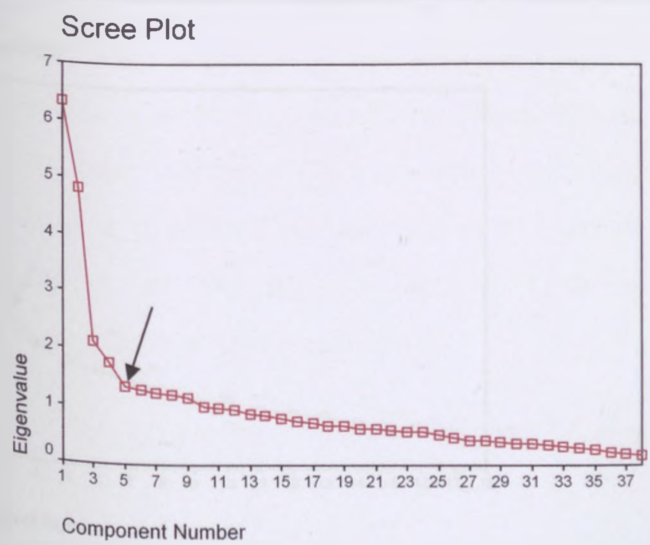
- for the group of 20 negative actions:
  1,528/4,200 (36.4%); 1,476/3,960 (37.3%); 1,250/3,160 (39.6%)
- for the group of 18 positive actions:
  3,199/3,780 (84.5%); 3,095/3,564 (86.8%); 2,421/2,844 (85.1%).

In each of the three good tutoring datasets, the indicators of factorability were good and each selected model retained five components (and all 38 items, as eliminating the few items with low KMOs in S6 and S5 did not improve the models). The relatively small proportion of non-redundant residuals in each model (42.0%, 37.0%, 45%, respectively) indicated reasonable stability. The 'eigenvalue rule' (taking all components with eigenvalues >1.00) would have overestimated the number of components to retain. In arriving at five components each time, more notice was taken of the scree-plots (taking the number of components to the left of the point of inflection on the graph-line when following it right-to-left) **(Figure 3a)** and other indicators related, for example, to sample size, number of variables, and stability of solutions **(Appendix 9)**. (It was noted that, for learning approaches, the scree-plots *did* correspond with the expected 3-component models **(Figure 3b)**).

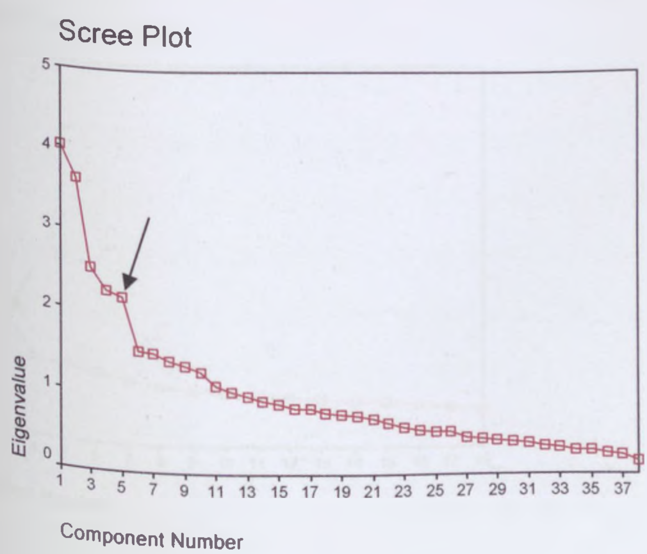
Figure 3a: Questionnaire survey of Year 1 medical students at start and end of year, 2001/02 (Study-element (S)3 & S6) and Year 3 medical students mid-2001/02 (S5): The scree-plots from principal components analysis of their perceptions of a good tutor (38 items)



S3 | 2001 cohort



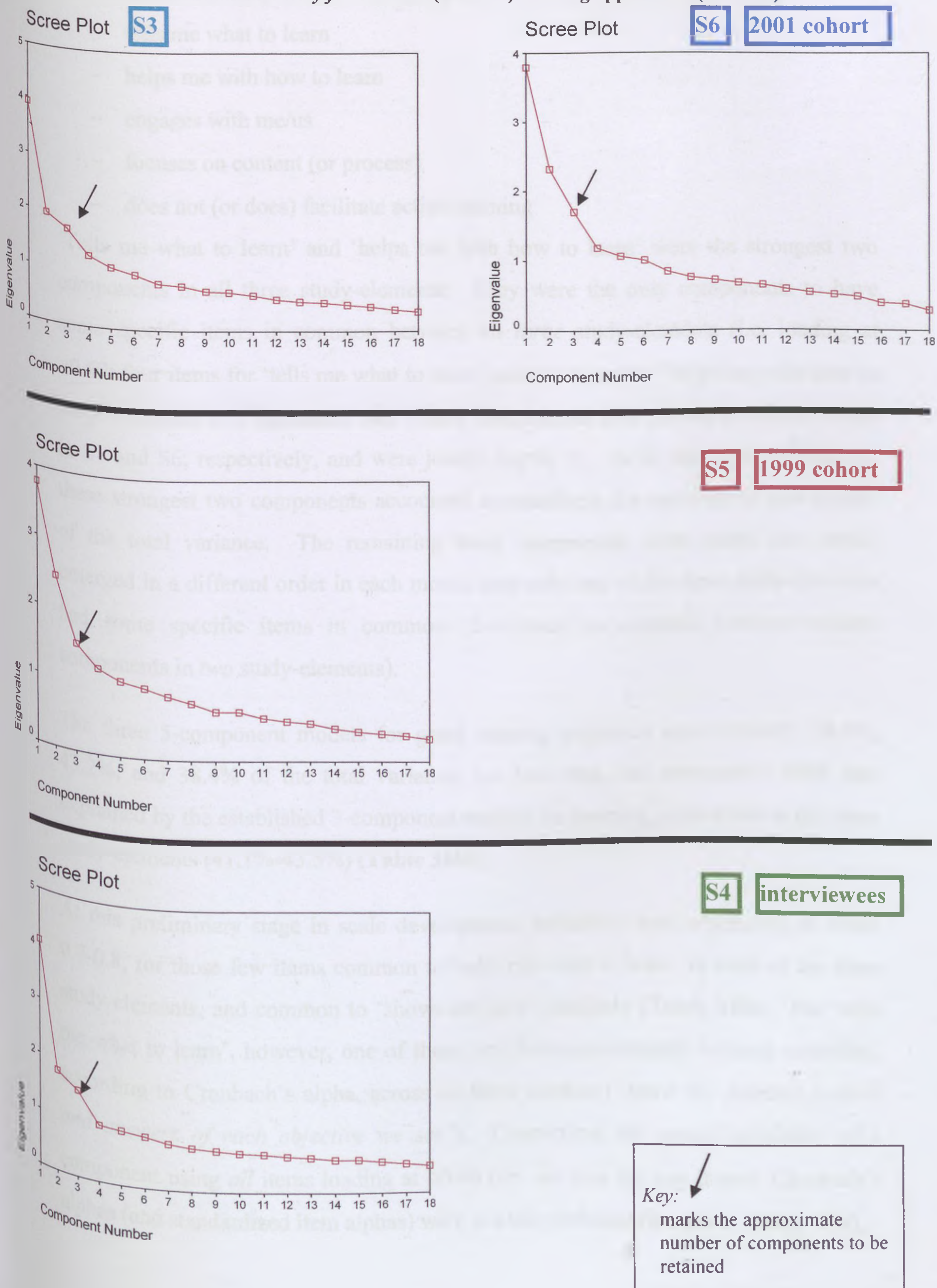
S6



S5 | 1999 cohort

Key: marks the approximate number of components to be retained

Figure 3b: Questionnaire survey of Year 1 medical students at start and end of year, 2001/02 (Study-element (S)3 & S6), Year 3 medical students mid-2001/02 (S5), and interviewees (S4): The scree-plots from principal components analysis of their *Approaches and Study Skills Inventory for Students* (ASSIST) learning approaches (18 items)



The five components emerging were similar but differed in strength between the study-elements **(Table 31bi)**:

- tells me what to learn
- helps me with how to learn
- engages with me/us
- focuses on content (or process)
- does not (or does) facilitate active learning

'Tells me what to learn' and 'helps me with how to learn' were the strongest two components in all three study-elements. They were the only components to have some specific items in common between all *three* study-elements (i.e. loading at ≥0.40: four items for 'tells me what to learn' and six items for 'helps me with how to learn' - marked → in **Appendix 10**). These components took the top positions in turn in S3 and S6, respectively, and were jointly top in S5. In all three study-elements, these strongest two components accounted cumulatively for one-fifth to one-quarter of the total variance. The remaining three components were much less stable, emerged in a different order in each model, and only two of the three study-elements had some specific items in common (1-3 items in common between similar components in *two* study-elements).

The three 5-component models for good tutoring explained approximately 38.6%, 43.2%, and 38.4% of the total variance, i.e. less than, but comparable with, that explained by the established 3-component models for learning approaches in the same study-elements (41.1%-43.5%) **(Table 31bii)**.

At this preliminary stage in scale development, reliability was reasonable, at about 0.7-0.8, for those few items common to 'tells me what to learn' in each of the three study-elements, and common to 'shows me how' similarly **(Table 31bi)**. For 'tells me what to learn', however, one of these key items consistently reduced reliability, according to Cronbach's alpha, across all three models (*"know the detailed content and answers of each objective we set"*). Concerning the overall reliability of a component using *all* items loading at ≥0.40 (i.e. not just the key items), Cronbach's alphas (and standardized item alphas) were not that different **(footnote, Table 31bi).**

Table 31bi: Questionnaire survey of Year 1 medical students at start and end of 2001/02 (Study-element (S)3 & S6) and Year 3 medical students mid-2001/02 (S5): The three 5-component models from principal components analysis of their perceptions of a good tutor (38 items)

		Total variance explained Initial eigenvalues			*After orthogonal rotation* Rotation sums of squared loadings			*Cronbach's alpha (standardized item alpha) of the key items [marked → in Appendix 10], i.e. using only the no. of items shared with other study-elements*
Component (C)		Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	
n=201	S3							
tells me what to learn	C1	5.00	*13.15*	*13.15*	4.18	*11.01*	*11.01*	*0.780* (0.778) [for the 4 items]*
helps me with how to learn	C2	3.80	*10.01*	*23.16*	3.29	*8.65*	*19.66*	*0.669 (0.677) [for the 6 items]*
engages with me/us	C3	2.24	*5.90*	*29.06*	2.77	*7.29*	*26.94*	---
focuses on content	C4	1.94	*5.12*	*34.17*	2.68	*7.05*	*33.99*	---
does not facilitate active learning	C5	1.68	*4.43*	*38.60*	1.75	*4.61*	*38.60*	---
n=198	S6							
helps me with how to learn	C1	6.33	*16.65*	*16.65*	5.68	*14.96*	*14.96*	*0.802 (0.812) [for the 6 items]*
tells me what to learn	C2	4.81	*12.67*	*29.32*	3.55	*9.34*	*24.30*	*0.782** (0.778) [for the 4 items]*
does not facilitate active learning	C3	2.13	*5.60*	*34.93*	2.99	*7.88*	*32.18*	---
focuses on content	C4	1.77	*4.66*	*39.58*	2.22	*5.83*	*38.01*	---
engages with me/us	C5	1.36	*3.57*	*43.15*	1.95	*5.14*	*43.15*	---
n=158	S5							
tells me what to learn	C1	4.03	*10.61*	*10.61*	3.44	*9.05*	*9.05*	*0.735*** (0.737) [for the 4 items]*
helps me with how to learn	C2	3.62	*9.53*	*20.14*	3.44	*9.05*	*18.10*	*0.697 (0.706) [for the 6 items]*
facilitates active learning	C3	2.53	*6.65*	*26.79*	2.68	*7.05*	*25.15*	---
engages with me/us	C4	2.24	*5.89*	*32.67*	2.59	*6.82*	*31.96*	---
focuses on process	C5	2.17	*5.72*	*38.39*	2.44	*6.43*	*38.39*	---

Liverpool MBChB curriculum, Year 1 medical students, Study (S)3 & S6, and Year 3, S5

*If delete: *Q29 ↑ to 0.814 **Q35 ↑ to 0.822 ***Q34 ↑ to 0.741, i.e. same item: "know the detailed content and answers of each objective we set"*
*Cronbach's alphas (standardized item alpha) of ALL items for **'tells me what to learn'** and **'helps me with how to learn'**, respectively, were: S3: 0.795 (0.794): 11 items; 0.567 (0.655): 10 items;S6: 0.700 (0.675) 9 items;0.857 (0.873): 13 items; S5: 0.735 (0.730) 7 items; 0.678 (0.729): 10 items*

Table 31bii: Questionnaire survey of Year 1 medical students at start and end of 2001/02 (Study-element (S)3 & S6) and Year 3 medical students mid-2001/02 (S5): The four 3-component models from principal components analysis of their *Short RASI* learning approaches

		Total variance explained Initial eigenvalues			*After orthogonal rotation* Rotation sums of squared loadings		
Component (C)		Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
n=201	S3						
strategic	C1	3.94	*21.90*	*21.90*	2.84	*15.79*	*15.79*
surface	C2	1.97	*10.97*	*32.86*	2.49	*13.82*	*29.61*
deep	C3	1.72	*9.55*	*42.41*	2.31	*12.81*	*42.41*
n=198	S6						
strategic	C1	3.80	*21.10*	*21.10*	2.70	*15.02*	*15.02*
deep	C2	2.32	*12.89*	*33.98*	2.62	*14.53*	*29.55*
surface	C3	1.71	*9.49*	*43.47*	2.51	*13.92*	*43.47*
n=159	S5						
deep	C1	3.79	*21.03*	*21.03*	2.86	*15.90*	*15.90*
strategic	C2	2.47	*13.74*	*34.78*	2.69	*14.95*	*30.85*
surface	C3	1.55	*8.59*	*43.37*	2.25	*12.52*	*43.37*
n=968	S4						
strategic	C1	4.06	*22.57*	*22.57*	2.69	*14.95*	*14.95*
surface	C2	1.80	*10.00*	*32.57*	2.48	*13.80*	*28.75*
deep	C3	1.54	*8.55*	*41.13*	2.23	*12.38*	*41.13*

Liverpool MBChB curriculum, Year 1 medical students, Study (S)3 & S6, and Year 3, S5 :interviewees, S4

Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Associations between responders' perceptions of the good tutor and their career intentions were minimal. Across the three study-elements, there were only two statistically significant differences on mean scores on any of the five 'good tutor' components between responders wanting to be a GP versus a hospital doctor (consultant) **(Table 31c)**. These were that:

- ...in S6: the 'GP' group scored negatively on 'focuses on content' (i.e. to them, the good tutor was more process-orientated), which was statistically significantly different from that by the 'hospital doctor (consultant)' group
- ...in S5: the 'GP' group scored positively on 'helps me with how to learn' (i.e. to them the good tutor should know when/how to intervene), which was very significantly different from that by the 'hospital doctor (consultant)' group

For the latter, this was also the direction of the non-significant differences in the other two study-elements. The only other discernible pattern, shared by all three study-elements, in the non-significant differences, was for 'tells me what to learn' to score positively in the GP group and very marginally negatively in the 'hospital doctor (consultant)'. This was counterintuitive to the S6 finding about valuing process-orientation, but that was based on a much less stable component.

Across the three study-elements, there were only three statistically significant differences when comparing the mean scores on any of the five 'good tutor' components between responders with deep or strategic as the predominant learning approach versus those with the surface score predominating. These were that, compared with the 'deep or strategic' group, the 'surface' group wanted their tutor to allow them to be passive learners, scoring:

- ...in S3:
  - very highly significantly positive on 'tells me what to learn', 0.556 difference (95% confidence interval 0.014, 1.098)
  - significantly negative on 'engages with me/us'
- ...in S6:
  - significantly positive on 'tells me what to learn'

Table 31c: Questionnaire survey of Year 1 medical students at start and end of 2001/02 (Study-element (S)3 & S6) and Year 3 medical students mid-2001/02 (S5): Career intentions and *Short RASI* learning approaches versus the principal components of their perceptions of a good tutor

Mean score / Component (C)	At this stage in your medical career, what is your intended career destination?			Predominant learning approach		
A good tutor… (components listed in S3 order)	…general practitioner	…hospital consultant	difference in mean scores (95% confidence interval)	deep (De) or strategic (St)	surface (Su)	difference in mean scores, DeSt minus Su, (95% confidence interval)
S3	n=25	n=86	Total=111	n=187 De or St; n=14 Su		Total=201
C1 tells me what to learn	0.162	-0.091	0.253 (-0.212, 0.719)	-0.066	0.883	**-0.949*** (-1.481, -0.418)**
C2 helps me with how to learn	0.096	-0.041	0.137 (-0.292, 0.566)	-0.016	0.218	-0.235 (-0.781, 0.312)
C3 engages	-0.005	0.035	-0.041 (-0.433, 0.352)	0.039	-0.517	**0.556* (0.014, 1.098)**
C4 focuses on content	0.032	-0.026	0.058 (-0.364, 0.481)	-0.002	0.031	*-0.033 (-0.982, 0.916)*
C5 does not facilitate active learning	-0.213	0.031	-0.244 (-0.705, 0.217)	-0.029	0.390	-0.419 (-0.964, 0.125)
S6	n=24	n=75	Total=99	n=185 De or St; n=13 Su		Total=198
C2 tells me what to learn	0.335	-0.039	0.374 (-0.075, 0.824)	-0.044	0.620	**-0.664* (-1.223, -0.104)**
C1 helps me with how to learn	0.106	-0.098	0.204 (-0.357, 0.766)	0.047	-0.673	*0.720 (-0.659, 2.099)*
C5 engages	-0.027	-0.116	0.089 (-0.373, 0.551)	0.027	-0.385	0.412 (-0.152, 0.977)
C4 focuses on content	-0.421	0.064	**-0.485* (-0.953, -0.016)**	-0.015	0.207	-0.222 (-0.788, 0.345)
C3 does not facilitate active learning	0.062	-0.127	0.188 (-0.289, 0.666)	-0.033	0.472	-0.505 (-1.068, 0.057)
S5	n=23	n=82	Total=105	n=142 De or St; n=16 Su		Total=158
C1 tells me what to learn	0.055	-0.011	0.067 (-0.407, 0.540)	-0.036	0.318	-0.354 (-0.873, 0.166)
C2 helps me with how to learn	0.398	-0.089	***0.487** (0.136, 0.838)***	0.033	-0.296	0.329 (-0.191, 0.849)
C4 engages	-0.228	0.046	-0.275 (-0.770, 0.220)	0.027	-0.237	0.264 (-0.257, 0.785)
C5 focuses on process	0.367	-0.051	0.418 (-0.089, 0.924)	-0.036	0.318	-0.354 (-0.873, 0.166)
C3 facilitates active learning	-0.040	0.036	-0.076 (-0.568, 0.416)	0.018	-0.164	0.182 (-0.340, 0.704)

Liverpool MBChB curriculum, Year 1 medical students, Study (S)3 & S6, and Year 3, S5

On t-test: ***Statistically significant *at the 0.05 level; **at the 0.01 level; ***at the 0.001 level***
Italicized: ***when unequal variances assumed from Levene's Test for Equality of Variances***
Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

For the above two components, the remaining non-significant differences were also consistent with the above directions of difference. The non-significant differences for 'does/does not facilitate active learning' suggested that the 'surface' group in each of the three study-elements favoured the tutor not facilitating active learning (i.e. allowing students to skip explanations, justifications, and synthesis).

There were no statistically significant differences in these scores between the sexes, *except for*:

- ...in S3:
  - males scoring more <u>positively on 'focuses on content'</u> (0.209), which was significantly different from the negative score of females (-0.124) (t-test: t_{199}=2.31, p=0.022; 95% confidence interval on 0.333 difference: 0.049, 0.618), but this was a less stable component. The differences in S6 and S5 were consistent in direction, but non-significant.
- ...in S6:
  - males scoring more <u>positively on 'engages with me/us'</u> (0.262), which was significantly different from the negative score of females (-0.140) (t-test: t_{196}=2.74, p=0.007; 95% confidence interval on 0.401 difference: 0.112, 0.691). The differences in both S3 and S5 were in the same direction, but non-significant.

Learning approaches (including S4)

Turning to PCA of each of the four 'learning approaches' datasets (including the interviewees), the factorability indicators were good. The selected solutions retained the expected three components, and all 18 items for S5 and S4, and all except Q5 for S3 and S6 (*"I look carefully at tutors' comments on course work to see how to get higher marks next time"*, i.e. the item less appropriate to the setting, which decreased reliability). Each of the S3, S6; S5; and S4 datasets showed:

- a moderate proportion of correlation coefficients ≥0.3 in the correlation matrix
- all KMOs ≥0.5 on the diagonal of the anti-image matrix (and very small negative partial correlations off-diagonal)
- KMO Measures of Sampling Adequacy at: 0.781, 0.751, 0.745, 0.845, respectively (i.e. all in the good factorability category of 0.7-0.8)

Each of the 3-component solutions of S3, S6; S5; and S4 showed, respectively:

- percentages of non-redundant residuals >0.05 indicating varying stability:
  - 48.0% (5 iterations)
  - 48.0% (5 iterations)
  - 61.0% (5 iterations) (suggesting a possible fourth component)
  - 39.0% (5 iterations)
- extraction communalities relatively low, respectively, of:
  - 0.178-0.618 (mean 0.424)
  - 0.134-0.611 (mean 0.435)
  - 0.218-0.648 (mean 0.434)
  - 0.262-0.575 (mean 0.411)

The 'eigenvalue rule' (≥1.0) would have overestimated the number of components to retain, in arriving at six components for each of S3, S6 and S5, and five for S4. More notice was taken of prior knowledge of the expected number of components, the scree-plots **(Figure 3b, p243)**, and the other indicators above (as illustrated previously with the good tutor solutions **(Appendix 9)**. In S5, the possible 4-component solution (not shown; suggested by the percentage of non-redundant residuals in the 3-component solution) was inappropriate as the first three components did not make sense and the fourth component had only two variables loading at ≥0.40.

The 3-component solutions produced the same components, albeit differing in strength between the study-elements. The order that the components emerged was the same for S3 and S4 (start of Year 1 and interviewees), but differed in the other two study-elements. For all except S5 (mid-Year 3), the strongest component was the strategic learning approach **(Table 31bii, p245)**:

- S3: Strategic Surface Deep
- S6: Strategic Deep Surface
- S5: Deep Strategic Surface
- S4: Strategic Surface Deep

For each of the three subscales in all four study-elements, reliability was mostly 0.7 **(Tables 12, p196; 25a&b, p230; 34a, p267)**. Furthermore, on each subscale, all the expected six items loaded at ≥0.40, except for:

- In S3 and S6:
  - The strategic component omitted Q5, *"I look carefully at tutors' comments on course work to see how to get higher marks next time"*, which loaded weakly and barely at all, at only 0.226 and 0.008, respectively.
- In S3 and S5:
  - The deep component included weak negative loadings (-0.339 and –0.363, respectively) for Q4, *"I concentrate on learning just those bits of information I have to know to pass"*, which otherwise loaded stronger and positively as expected on surface (0.424 and 0.390).
- In S6 and S4:
  - The strategic component also included Q10, *"When I'm working on a new topic, I try to see in my own mind how all the ideas fit together"* (0.382, and even weaker, 0.333, respectively), although this item loaded much more strongly on deep (0.554 and 0.482), as expected.
- In S5:
  - The deep component included Q14, *"Often I feel I'm drowning in the sheer amount of material we're having to cope with"*, loading at 0.467, and rather weaker (0.363) on the expected component, surface.
- In S4:
  - The strategic component included a very weak negative loading on Q1, *"Often I find myself wondering whether the work I am doing here is really worthwhile"* (-0.256), although this item loaded much more strongly on the surface component, as expected (0.536).

Summary

There were some recurring views of career, learning, and tutoring:

- Of the nine good doctor themes, S6 responders (as for S5) ranked 'compassionate, patient-centred carer' and 'listening, informative communicator' 1st and 2nd. Some of the themes correlated with deep learning, and some with satisfaction with the Liverpool curriculum.
- The learning approach distributions were similar in S3 and S6, with just over half the responders scoring most on strategic learning (similar to S5). Nevertheless, nearly one-fifth had either deep or strategic as the least evident approach. By the end of Year 1, the mean strategic score had increased statistically significantly (paired data) from 22.42 to 23.21 (out of 30), and was complemented by the median increase in individual strategic score. Most movement appeared to be away from surface learning. In both study-elements, there were statistically significantly lower mean strategic scores in responders intending to be GP (versus hospital consultant). In S6, four-fifths of responders 'agreed'/'agreed somewhat' that if deciding again, they would still do Medicine in *this* (Liverpool) problem-based curriculum - similar to S5, and correlating similarly with learning approach:
  - Responders with higher strategic learning scores (lower surface learning scores, and possibly higher deep learning scores) tended to 'agree'/'agree somewhat'.
  - The strongest correlation amongst these, however, was with surface learning (rather than with strategic as in S5) and negative, with an r_p= -0.33.
- The good/bad tutoring 'key indicators' (8 negative and 2 positive actions of a PBL tutor) correlated, albeit weakly, with learning approach:
  - Both 'good actions' correlated (statistically significantly positively) with deep and/or strategic learning in S6 (…strategic in S3). The 'bad actions' generally correlated positively (statistically significantly) with surface learning and/or negatively with deep and/or strategic learning.
- In S3, S6, and S5, the datasets of good/bad tutoring actions (all 38 statements) had good indicators of factorability for PCA. Each selected solution retained five components and explained about two-fifths of the variance: 'tells me what

to learn', 'helps me with how to learn' (these being the strongest and most stable two), engages with me/us', 'focuses on content (or process)', and 'does not (or does) facilitate active learning'. There were only two statistically significant differences between mean scores on any of these five scores for those wanting to be a GP versus a hospital doctor (consultant). Likewise there were only three such differences between mean scores for those with deep or strategic (versus surface) as the predominant learning approach, but the non-significant differences in other study-elements reflected these:

- The 'GP' group scored negatively on the weak 'focuses on content' component in S6, and positively on 'helps me with how to learn' in S5
- Compared with the 'deep or strategic' group, the 'surface' group scored, for example, more positively on 'tells me what to learn' in S3 and S6 (very highly significant and significant, respectively), and more negatively on 'engages with me/us' (significant) in S3.
- Non-significant differences in all three study-elements suggested that the 'surface' group favoured the tutor not facilitating active learning (i.e. allowing students to skip explanations, justifications, and synthesis).

In S3, S6, S5, and S4, the datasets of learning approaches (18 items) had good indicators of factorability for PCA. Despite an occasional misplaced or omitted item 'spoiling' the expected loading pattern on each component, each selected solution retained the expected three components with reasonable reliability: deep, strategic, and surface. The strategic component was strongest in all except S5, for which deep was strongest.

Results 6 with reference to Results 2 (linked: 1999 cohort S2, end-of-Year 1 and 2001 cohort S6, end-of-Year 1)

Open-ended questions: Ineffective contributions in problem-based learning

The student: Ineffective contributions in problem-based learning (Table 32a)

*Q22 in S6 "PBL sessions do not work so well for me **if I**..." [with reference to Q57 in S3 "Outline (anonymously) one specific incident with student(s) in your PBL group that contributed to an unproductive session", p220 and Table 23]*

In S6, responders' perceptions about their own role in PBL sessions that do *not* work for them were broadly similar (but with different emphasis) to the issues described by the same cohort in S3 for critical incidents leading to unproductive sessions. No-one claimed that their personal contribution was invariably unproblematic. Responders identified their own lack of work/preparation as by far (54.8%) the most substantial theme of factors making a session less effective **(Table 32a)**, e.g.:

...if I...

- *"haven't prepared well enough" [S6-100]*
- *"do not put in enough effort before sessions" [S6-020]*
- *"don't finish answering the learning objectives" [S6-460]*
- *"have not done the relavant [sic] or enough work for the session." [S6-880]*
- *"Do not prepare properly" [S6-211]*
- *"haven't done any work" [S6-141]*
- *"haven't done as much work before hand [sic] as others in the group" [S6-861]*
- *"Don't do the learning objectives." [S6-981]*
- *"don't read up the topic beforehand." [S6-282]*

The two nearest supplementary themes were much less frequent and involved responders participating poorly (whether due to lack of work/knowledge/inclination), and responders having been overreliant on their notes (not actively learning work) (both 11.2%), for example (respectively):

Table 32a: Questionnaire survey of Year 1 medical students at end of 2001/02 (Study-element 6): Eighteen themes* emerging from answers to Questions 22&23 (n=188, n=190): "PBL sessions do not work so well for me if I…" "…if (an)other student(s)…"

PBL sessions do not work so well for me if I… if (an)other student(s)	**Students mentioned 1 concept in this theme: no.** (Me)	**%** (Me)	***Rank***	**Students mentioned 1 concept in this theme: no.** (Others)	**%** (Others)	***Rank***	***Rank of critical incidents from S3***
▪ ▪**not doing the work/preparation required,** e.g. for the objective(s) discussed or the level of the discussion	103	*54.8*	1	12	*6.3*	4	10
▪ ▪**participating poorly; having awkward silences:** as unwilling, shy; lack interest/work/prior knowledge/language; lost	21	*11.2*	2	64	*33.7*	1	2
▪ ▪**being overreliant on notes/cover things without thinking about/learning work:** reading from notes to impress; have made notes but not learnt it (unable to explain)	21	*11.2*	2	2	*1.1*	9	13
▪ ▪**being tired or not in the right mood/frame of mind****	15	*8.0*	4	1	*0.5*	13	—
▪ ▪**not concentrating on understanding relevant concepts correctly:** skipping hard concepts; not exploring enough detail or spending enough time; going off track/not focusing on completing objectives; accepting things uncritically	13	*6.9*	5	12	*6.3*	4	4
▪ **being put down/undermined by others** ▪ **or other students putting people down** disregarding contribution: undermining with their questions; competing; being rude; making feel uncomfortable	6	*3.2*	6	13	*6.8*	3	7
▪ **being affected by my taking over or others taking over** ▪ **…others taking over** /dominating/expecting things to revolve around them	3	*1.6*	7	60	*31.6*	2	3
▪ ▪**spending too much time on things** (we know/we should have known better/we could not know, unnecessary detail, on one thing, etc.) at the expense of other things	2	*1.1*	8	5	*2.6*	7	6
▪ ▪**not receiving enough external academic support****	2	*1.1*	8	1	*0.5*	13	—
▪ **being late/absent or ill** ▪ **or other students doing this**	1	*0.5*	10	2	*1.1*	9	15
▪ ▪**setting vague/non-specific/irrelevant learning objectives;** misinterpreting the learning objectives	1	*0.5*	10	2	*1.1*	9	5
▪ ▪**not a problem yet**	0	*0*	12	1	*0.5*		1
▪ ▪**not getting on** /arguing about other things/talking over each other	0	*0*	12	9	*4.7*	6	10
▪ ▪**talking about non-work things too much**	0	*0*	12	2	*1.1*	9	8
▪ ▪**having the Chair role go wrong**	0	*0*	12	0	*0*	16	9
▪ ▪**not working when the tutor was not there**	0	*0*	12	0	*0*	16	10
▪ ▪**being disrupted by the tutor**	0	*0*	12	0	*0*	16	10
▪ ▪**being confident and knowing more****	0	*0*	12	4	*2.1*	8	—
	188	*(100.1)*		190	*(100.0)*		

All totals do not add to 100.0% due to rounding — *Liverpool MBChB curriculum, Year 1 medical students, Study (S)6*

*coded against coding-frame from same cohort in S3, Table 23→ ∴ same 15 themes, but 3 new themes** (188 responses + 10 blanks = 198; 190 responses plus 8 blanks). In pale blue is the ranking from Table 23, which supplied the coding-frame from the comparable but different question

Ranked from Table 23, p224, n=162
Q57: "Outline (anonymously) one specific incident with student(s) in your PBL group that contributed to an **unproductive** session", i.e. involves this

...if I...

- *"don't contribute enough." [S6-210]*
- *"find it difficult to follow what is happening and no-one notices" [S6-160]*
- *"do not join in." [S6-570]*
- *"don't feel I have contributed enough" [S6-670]*
- *"have not done enough work to follow the discussion" [S6-762]*

...and... if I...

- *"rely on my notes and don't learn work for PBL sessions" [S6-840]*
- *"don't have enough time to learn the notes I've made." [S6-760]*
- *"haven't learnt the objectives in enough detail to speak without notes" [S6-711]*
- *"Can't remember everything I've learnt and I can't look at my notes" [S6-041]*
- *"do not put in the effort to do constructive, thinking, work beforehand." [S6-812]*

The next commonest supplementary theme was a newly emerging theme not mentioned in the original descriptions of critical incidents, i.e. the responders' tiredness or an otherwise adverse mindset (8.0%), e.g.:

...if I...

- *"am tired or in a bad mood" [S6-280]*
- *"have travelled up from [xxx] that morning." [S6-911]*
- *"am hungover" [S6-772]*

This mindset theme was marginally commoner than the next theme, which was about not concentrating on understanding relevant concepts (6.9%), e.g.:

...if I...

- *"don't ask questions when I'm unsure." [S6-500]*
- *"Allow the session to plod on without serious thought" [S6-941]*
- *"do not concentrate fully" [S6-222]*

Amongst exceptions, three responders highlighted their own domination or their reaction to others dominating the session, such as: ◗ *"...[if I] end up 'teaching' others in the group who haven't done the work + don't contribute"*. Only two responders mentioned the other newly emerging theme for personal factors, i.e. perceiving that academic support was insufficient:

...if I...

- *"cannot find the information and spend ages doing it – when really the department should provide it." [S6-931]*
- *"struggle with understanding a particular area, ie: lack available help." [S6-322]*

No-one admitted to personal factors under the themes of: talking too much about non-work issues, chairing ineffectively, being the person not getting on with (or talking over) others, or their personal reaction to a tutor's presence or absence.

The other students in the group: Ineffective contributions in problem-based learning (Table 32a)

*Q23 in S6 "PBL sessions do not work so well for me **if (an)other student(s)**..." [with reference to Q57 in S3 "Outline (anonymously) one specific incident with student(s) in your PBL group that contributed to an **unproductive** session.", see p220 and Table 23]*

Responders' perceptions about other students' role in PBL sessions *not* working for them were again broadly similar (but again with different emphasis) to the critical incidents described by the same cohort in S3. Only one student claimed that other students' contributions had not been problematic. By far the two commonest themes of factors involved under- and overcontribution, i.e. other students participating poorly (whether due to lack of work/knowledge/inclination) and other students dominating/being self-centred **(Table 32a)**. These were mentioned by 33.7% and 31.6% of responders, respectively, e.g.:

...if another student/other students...

- *"does not contribute at all – makes session much harder." [S6-620]*
- *"do not speak up + voice their opinions" [S6-230]*
- *"doesn't do the share of work" [S6-540]*
- *"stay quiet for the whole session" [S6-050]*
- *"don't share what they have already know [sic]" [S6-460]*
- *"sit there and say nothing, as often happens." [S6-280]*
- *"Donot [sic] contribute to the group to the group dynamic" [S6-101]*
- *"is not prepared to input into the discussion, leaving it to others." [S6-922]*
- *"does not participate even when encouraged time & time again to do so." [S6-232]*
- *"Doesn't participate as fully as others" [S6-072]*

…and…

…if another student/other students…

- *"adopt a 'leader' – one who does most of the talking regularly." [S6-500]*
- *"are always answering questions and give other people no chance to speak for themselves" [S6-160]*
- *"are too outspoken and dominant in discussions" [S6-011]*
- *"dominate the PBL session. I get put off by this + hence remain Quiet" [S6-131]*
- *"keeps interrupting and talking about all the things/prepared for." [S6-702]*
- *"overpower the discussion" [S6-662]*
- *"is overly dominant by starting the conversation of every objective + not giving others a chance" [S6-972]*

Other students putting people down (6.8%), not concentrating on understanding relevant concepts (6.3%), or not working/preparing ahead of Session 2 or 3 (6.3%) were the commonest supplementary themes rendering a PBL session ineffective. The following responders illustrated these three themes, respectively, e.g.:

…if another student/other students…

- *"intimadate [sic] other students by dismissing proposals and ideas." [S6-370]*
- *"are agist [sic]: perhaps some students fail to appreciate that not everyone has the same chances as themselves." [S6-790]*
- *"feels superior to the rest of the group" [S6-911]*
- *"speaks rudely to others" [S6-071]*
- *"Look bored and uninterested when I'm talking" [S6-832]*

…and…

…if another student/other students…

- *"will not expand or explain their views when differing opinions arise in the group." [S6-730]*
- *"don't challenge me when I'm putting a view across that I'm unsure of." [S6-150]*
- *"Skim(s) through things" [S6-301]*
- *"Skim through questions"" [S6-002]*

…and…

…if another student/other students…

- *"haven't done the work" [S6-200]*
- *"haven't done any work." [S6-030]*

- *"have not done relavant [sic] or enough work for the session." [S6-880]*
- *"do not complete the work" [S6-121]*
- *"havnt [sic] completed the work and hence discuss less relevant topics" [S6-012]*

As with personal factors, no-one blamed other students transgressing under the themes of: chairing ineffectively or reacting unfavourably to a tutor's presence or absence. Other students not getting on with (or talking over) others, and other students' confidence/performance registered a mention for making the session less effective, albeit for only 4.7% and 2.1% of responders, respectively. The following illustrate how such issues adversely affected responders' perceptions of PBL sessions: ...if another student/other students...

- *"Argue a lot + don't listen" [S6-320]*
- *"speak at the same time (2 conversations at once)." [S6-861]*
- *"don't socialize [sic] well as a group." [S6-952]*

...and...

...if another student/other students... (all four responders' comments)

- *"have covered material I haven't" [S6-650]*
- *"appear confident about what they have learned" [S6-470]*
- *"knows more" [S6-701]*
- *"talking big hard words" [S6-512]*

Two other exceptions attributed to other students were things to which it was commoner for the responders to confess as their own failing, i.e. referring to notes and poor mindset. Two responders commented under the theme of other students' overreliance on their notes (not actively learning work):

- *"Reads from text. Says 'Oh thats [sic] a simple concept, lets [sic] leave it." [S6-541]*
- *"reads from their notes or a text book." [S6-212]*

...and only one responder commented vaguely under the theme about other students' tiredness or an otherwise adverse mindset, namely:

- *"too enthusiastic to express their view." [S6-421]*

The tutor: Ineffective contributions in problem-based learning (Table 32b)
*Q24 in S6 "PBL sessions do not work so well for me **if the tutor**...", with reference to Q5 in S2 "Outline **three** characteristics of a good PBL tutor", see p186 and Table 10*

Responders' perceptions about the tutor's role in less effective PBL sessions were broadly similar (but with slightly different emphasis) to the issues described by the other (1999) cohort in S2. The current responders were indicating how tutors were *not* fulfilling the characteristics of a good PBL tutor described by their predecessors (when those students were likewise at the end of Year 1). Only one responder claimed that the contribution of the tutor was invariably unproblematic.

The top two themes perceived as being transgressed were also those valued most by the responders' predecessors. Responders identified an unfulfilled expectation, i.e. tutors' knowing when and how to intervene without 'taking over', as the commonest theme (42.6%) that made sessions less effective. (Most of these responders focused on overcontribution from the tutor (52/80, 65.0%), but 21/80 (26.3%) focused on undercontribution, and the remaining 7/80 (8.8%) referred to tutors doing both.) The closest supplementary theme was that of tutors not acting as a 'guide' to the 'what' and 'how much' (20.7%) **(Table 32b)**. These responders illustrated transgressions of these top two themes e.g.:

...if the tutor...

...overcontributes...

- *"leads the sessions instead of the students" [S6-200]*
- *"doesn't [sic] let us get on with it and constantly interrupts [sic]!" [S6-410]*
- *"tells us what we are specifically are suposed [sic] to research." [S6-520]*
- *"keeps interrupting and setting his own agenda." [S6-230]*
- *"interrupts [sic] and tries to direct the course of the PBL sessions too much." [S6-380]*
- *"Talks too much." [S6-541]*
- *"is overly dominant + controlling not allowing group to develop" [S6-972]*

...undercontributes...

- *"is too passive." [S6-020]*
- *"plays a passive role giving the group no form of input." [S6-370]*
- *"never intervenes." [S6-752]*

...either overcontributes or undercontributes...

Table 32b: Questionnaire survey of Year 1 medical students at end of 2001/02 (Study-element 6): Nineteen themes* emerging from answers to Q24 (n=188): "PBL sessions do not work so well for me if the tutor…"

PBL sessions do not work so well for me if the tutor… DOES NOT fulfil this expectation i.e. **PBL sessions work better for me if the tutor… DOES fulfil this expectation**	**Students mentioned 1 concept(s) in this theme:** no.	%	Ranking on original question from S2, 1999 cohort	**Reproduced from Table 10, p187, n=135** Q5: "Outline **three** characteristics of a good PBL tutor", i.e. DOES fulfil this expectation. **Students mentioned ≥1 concept(s) in this theme:** no.	%
▪ **is able to listen, hold back and allow you to lead your own discussion:** knowing when and how to intervene without interfering, taking over or talking too much, resisting telling you the answers	80	*42.6*	1	69	*51.1*
▪ **guides us on the right track and depth**	39	*20.7*	2	54	*40.0*
▪ **shows commitment, interest, responsibility;** giving time and effort to the group	11	*5.9*	7=	18	*13.3*
▪ **creates a friendly, relaxed, safe atmosphere,** is constructive and non-judgemental about the discussion	10	*5.3*	11	11	*8.1*
✶ ***inappropriate answer*** joins in with group discussion, offers own experiences and gives information, opinions, and explanations, corrects inaccuracies, answers questions, and tells you what you need to know	7	*3.7*	6	24	*17.8*
▪ **must have sufficient understanding of the knowledge-base** that you need to know	6	*3.2*	5	32	*23.7*
▪ **is friendly and approachable,** has a sense of humour, and communicates and empathizes well with students	5	*2.7*	3=	40	*29.6*
▪ **encourages full participation,** motivates, supports, maintains momentum	5	*2.7*	3=	40	*29.6*
▪ **helps if you are very stuck,** and lets you know if you are missing important areas	5	*2.7*	7=	18	*13.3*
▪ **understands and keeps to the problem-based learning process**	5	*2.7*	14	5	*3.7*
▪ **challenges/clarifies understanding and stimulates thinking** by asking questions	4	*2.1*	9	17	*12.6*
▪ **has insight into group dynamics and own input,** contributes to process, allowing session to flow	4	*2.1*	10	16	*11.9*
▪ **does not just focus on his/her own subject-expertise**	3	*1.6*	16=	2	*1.5*
▪ **helps you formulate specific learning objectives** and is well-aware of the intended learning objectives	2	*1.1*	12	8	*5.9*
▪ **recognizes and understands students' problems**	1	*0.5*	15	3	*2.2*
✶ ***responder does not recognize this as a problem*****	1	*0.5*	—	0	*0*
▪ **provides feedback** on individual and group performance	0	*0*	13	6	*4.4*
▪ **seeks and acts on group feedback**	0	*0*	16=	2	*1.5*
▪ **makes sure that the group evaluates at the end of session**	0	*0*	18	1	*0.7*
	188	*(100.0)*			

Liverpool MBChB curriculum, Year 1 medical students, Study (S)6

*coded against coding-frame from the other cohort in S2, Table 10, p187→ ∴ same 18 themes, but 1 new theme** (188 responses + 10 blanks = 198). In pink is a copy of part of Table 10, which supplied the coding-frame from the comparable but different question. That was phrased in the positive as opposed to what the tutor was NOT doing, allowed up to 3 answers. The previous ranking is added.

- *"is too quiet or overly helpful." [S6-901]*
- *"either gets too involved, or not involved at all. A balance of the two is preferable [sic]." [S6-441]*

…and…

…if the tutor…

- *"Lets the group discussion wander off down the wrong path." [S6-741]*
- *"Does not keep us from drifting off the subject. it helps if they remind us of the work if we wander too far off the track." [S6-781]*
- *"leads topics into unhelpful or useless areas" [S6-602]*
- *"If completely silent, and does not steer the group when necessary. – it means, there is somewhat a lack of respect for the tutor when they criticize later" [S6-072]*
- *"does not prompt us & guide us." [S6-372]*
- *"Asks alot [sic] of questions, throwing the group off their chain of thought." [S6-572]*

The closest supplementary themes involved tutors not showing commitment or interest and tutors not fostering a friendly, relaxed, safe atmosphere, e.g.

…if the tutor…

- *"nearly falls asleep because they're so bored, but then will randomly spend 5-10 mins talking about irrelevant things" [S6-830]*
- *"Stares out of the window day dreaming while we wonder if what we're doing is right." [S6-850]*
- *"does not turn up." [S6-570]*
- *"is not giving 100% concentration + effort like their students" [S6-122]*

…and…

…if the tutor…

- *"singles out students in front of the group" [S6-160]*
- *"picks on people to explain concepts." [S6-360]*
- *"tries to target a student by making them talk more – it just embarrasses that student and makes PBL awkward." [S6-051]*
- *"laughs at students [sic] ideas" [S6-022]*
- *"forces every student to input – people will put in ideas when they have them – it's no good putting people on the spot." [S6-722]*

Tutors not understanding and keeping to the rules of PBL featured (2.7%), e.g. ◗ *"is inexperienced, does not know how to deal with the process" [S6-721]* and ◗ *"allows* *us to look at our notes during the session" [S6-652].* Tutors not using motivational skills to maintain participation/momentum (2.7%), e.g. ◗*"Allows the 'dominant' (i.e. me!), student to do all the talking! (n.b this doesn't happen often)" [S6-780]*, and tutors not challenging/clarifying or stimulating thinking (2.1%), e.g. ◗*"does not push the group to fully explain an idea" [S6-730]* also featured as minor themes.

Only 3.7% of the responders suggested transgressions that were not transgressions under this problem-based philosophy, such as tutors not joining in discussions of content, not correcting inaccuracies, and not telling students what they needed to learn, e.g.: ◗*"is unable to correct us" [S6-301];* ◗*"doesn't teach". [S6-701]*

No-one highlighted tutors' transgressions under the themes of: providing feedback, seeking and acting on feedback, and ensuring that evaluation took place.

Summary

In S6, regarding less effective PBL sessions, responders perceived their own role and that of other students as being broadly similar (but with different emphasis) to the S3 descriptions of critical incidents that impaired learning:

- *Their own role:* They reported their own lack of work/preparation as by far the most substantial theme (54.8%), with their own poor participation and their own overreliance on their notes during PBL sessions as two nearest supplementary themes (each from only one-tenth of responders).
- *Other students' role:* By far the two commonest themes (each from approximately one-third of responders) were other students participating poorly and other students dominating/being self-centred.

In S6, responders perceived the tutor's role in less effective PBL sessions consistent with (but with slightly different emphasis) deficiencies in characteristics of a good tutor described by the other (1999) cohort in S2. The main deficiency was in tutors knowing when and how to intervene without 'taking over' (42.6%), mostly highlighting *over*contribution. Tutors not understanding and keeping to the rules of PBL featured as an exception (2.7%). Only 3.7% of the responders suggested tutoring transgressions that were not transgressions under this problem-based philosophy, e.g. tutors who: did not join in discussions of content, did not correct the group's mistakes, and did not tell students what to learn.

Results 4 (of the interviewees for 2002 Cohort S4)
Questionnaire response (Table 33)

The S4 response rate from campus interviewees was 973/1,064 (91.4%), and excluded 'late'/'special' interviews outwith formal interview time and interviews in Malaysia **(Table 33).** Most responders were female (62.7%) and 'home' (EC) (946/973, 97.2%); and 138/955 (14.5%) had at least one medical parent. England & Wales median Townsend deprivation score (for 'home students') was -0.400. The largest ethnic groups were home/White (75.2% overall; 727/940, 77.3% of all 'home' who self-reported) and home/Indian (6.8%), and 13.9% were graduates.

Half the interviews were in the morning (49.9%). The formal interview-period spanned 152 days from November 2001. Responders and non-responders were interviewed a similar mean number of days from Day 1 (Day 64.7 versus Day 68.2; t-test: $t_{1,062}$= -0.71, p=0.475; 95% confidence interval on –3.48 difference: -13.02, 6.07). For the two other variables available from the interview-list for all interviewees (sex and am/pm), the proportions did not differ statistically significantly from those of non-responders:

- female: 60/91 (65.9%) (Yates-corrected χ^2=0.25$_1$ and p=0.618; 95% confidence interval on –3.24 difference: -13.44, 6.96)
- morning interview: 37/91 (40.7%) (Yates-corrected χ^2=2.51$_1$ and p=0.113; 95% confidence interval on 9.29 difference: -1.28, 19.86)

Responders' median age at receipt of questionnaire was 18.8 years. Most (787/973, 80.9%) were school-leavers (+/- A-level/Highers retakes, +/- deferred entry). Response rates were similar between interviewees who were admitted (the entry-cohort) versus not admitted (93.0% versus 734/807, 91.0%: Yates-corrected χ^2=0.79$_1$ and p=0.373; 95% confidence interval on 2.04 difference: -1.65, 5.74). Of responding interviewees, those subsequently admitted (2002, or deferring to 2003) were not statistically significantly different from those not entering for:

- age, sex, whether a morning interview, whether 'home' responders reported 'white' for ethnic group **(Table 33)**
- whether they had at least one medical parent (33/233, 14.2% versus 105/722, 14.5%: Yates-corrected χ^2=0.001$_1$ and p=0.971)
- whether they were from the most affluent postcodes (137/211, 64.9% versus 376/644, 58.4%: Yates-corrected χ^2=2.57$_1$ and p=0.109)

Table 33: **Questionnaire survey of medical school interviewees 2001/02 (Study-element 4): Demographic profile and response rate for those interviewed and admitted**

Characteristic	S4 responders: overall		S4 responders: admitted/registered 2002/03 (221) or 2003/04 (18 deferrals) = 239/973, 24.6%		S4 responders: not admitted/ registered
	Response rate: 973/1064, 91.4%		Response rate in those admitted: 239/257, 93.0%		Comparison between those responders admitted versus not
	no.	years	no.	years	
Age (exact) at receipt of completed questionnaire, i.e. on interview day *(and at entry 23.9.02 for those not deferring)*	973 *(955)*		239 *(221)*		mean age at interview in admitted versus not (19.0) t=1.75$_{971}$, p=0.08
▪ mean *(& at entry 23.9.02)*		19.1 *(19.8)*		19.4 *(20.1)*	
▪ median *(& at entry 23.9.02)*		18.0 *(18.8)*		18.2 *(18.9)*	
▪ range		16.25-37.36		16.49-36.00	
Sex	no.	%		%	
▪ male	363	*37.3*	83	*34.7*	male in admitted versus female (280/734, 38.1%) Yates-corrected χ^2=0.76$_1$, p=0.383
▪ female	610	*62.7*	156	*65.3*	
	973	*100.0*	239	*100.0*	
Interviewed					
▪ morning session (am)	486	*49.9*	124	*51.9*	am in admitted versus pm (362/734, 49.3%) Yates-corrected χ^2=0.38$_1$, p=0.539
▪ afternoon session (pm)	487	*50.1*	115	*48.1*	
	973	*100.0*	239	*100.0*	
Self-reported ethnic origin: 'home students only'	no.	%	no.	%	
▪ White	727	*75.2*	184	*78.0*	white in admitted versus not (543/731, 74.3%) Yates-corrected χ^2=1.11$_1$, p=0.293
▪ Black-Caribbean	2	*0.2*	0	*0*	
▪ Black-African	23	*2.4*	1	*0.4*	
▪ Black-other	2	*0.2*	0	*0*	
▪ Indian	66	*6.8*	17	*7.2*	
▪ Pakistani	46	*4.8*	5	*2.1*	
▪ Bangladeshi	5	*0.5*	0	*0.*	
▪ Asian-other	25	*2.6*	5	*2.1*	
▪ Chinese	10	*1.0*	4	*1.7*	
▪ Other	34	*3.5*	9	*3.8*	
▪ Non-European Community	27	*2.8*	11	*4.7*	
	967*	*100.0*	236*	*100.0*	
Entered as:	no.	%	no.	%	
▪ school-leaver	656	*67.4*	150	*62.8*	76.2% school-leaver, including gap-years and resits in admitted versus not (606/734, 82.6%) Yates-corrected χ^2=4.41$_1$, **p=0.036****
▪ school-leaver: **after gap year**	91	*9.4*	24	*10.0*	
▪ school-leaver: **after resit A-levels/Highers**	40	*4.1*	8	*3.3*	
▪ graduate	135	*13.9*	40	*16.7*	
▪ other: **mature; retake/recommence Year 1; school-leavers on non-standard route**	51	*5.2*	17	*7.1*	
▪ mature: **non-relevant degree, admitted on A-levels** (unlikely to be detected in this study)	---	---	---	---	
	973***	*100.0*	239	*99.9*	

All totals do not add to 100.0% due to rounding *Liverpool MBChB curriculum, medical school interviewees and subsequent entrants. Study (S)4*
6 and 3 'home' candidates did not self-report ethnic origin; 2/6 and 1/3 ticked 'home' and the remainder were probably 'home'
****Statistically significant at the 0.05 level*** ***Entry-status of 27 of these were retrieved/deduced solely from central records

There were, however, statistically significantly fewer school-leavers (+/- A-level/Highers retakes, +/- deferred entry), 76.2%, in the entry-cohort compared with the remaining candidates (graduate, mature and other non-standard entry), 82.6% (95% confidence interval on –6.41 difference: -12.47, -0.35) consistent with competition for places being all but stratified, i.e. between: school-leavers only; graduates only, etc. and applicants/places ratio being lower for the latter.

Career (also reported elsewhere) and learning data (Tables 34a&b)

S4 showed the same general distribution of learning approaches as the 1999 cohort and the 2001 cohort, but with higher scores for deep and strategic learning and lower scores for surface learning. The median subscale scores out of 30 were 24.0, 27.0, and 13.0 for these, respectively. Reliability was moderate with Cronbach's alpha from 0.648 (deep) to 0.723 (strategic). Reliability of the deep and strategic subscales was not compromised by any of the items (alpha did not fall on deleting any item), but one item compromised the reliability of the surface subscale (learning just the things to pass assessments, as for S5 and S6, but not S3), i.e. alpha fell on deleting it. Surface scoring appeared minimal compared with the other cohorts. Over two-thirds of responders scored highest on strategic learning and only 1.0% on surface learning **(Table 34a)**. Looking at other expressions of surface learning (to avoid social desirability bias), only just under one-twentieth of responders had deep or strategic learning as the least evident approach, i.e. this showed some surface learning tendencies more than just focusing on the predominant approach. Likewise, overall, the responders allocated least points (22.0%) of the 90 points available to surface learning, but of a similar magnitude to: 25.2% S3, 25.5% S6 **(Table 25a/25b, p230)**, 26.9% S5 **(Table 12, p196)**. The most points were allocated, marginally, to strategic over deep learning (40.5%, i.e. similar to: 37.9%, S3 38.5% S6; 37.7% S5).

Assessed via mean subscale scores and the proportion of responders for whom each approach predominated, there were no statistically significant differences between those admitted/registered and those not admitted/registered **(Table 34b)**. Nevertheless, the pattern of non-significant differences showed higher deep and strategic learning, and lower surface scoring (albeit all very small differences), amongst those admitted. Of the 238 responders who were admitted/registered, 18 deferred entry to 2003/04 and the remainder entered in 2002/03. Comparing learning

Table 34a: Questionnaire survey of medical school interviewees 2001/02 (Study-element 4): *Short RASI* learning approaches (n=968*)

Approach *(median score out of 30.0 on each subscale)*	*Cronbach's alpha (standardized item alpha)*	**Predominant approach for:** no.	%	**Least evident approach for:** no.	%	**% of total points allocated** *overall %*	*[range:*	*minimum*	*Maximum]*
▪ **Deep** *(24.0)*	*0.648 (0.655)*	299	*30.9*	24	*2.5*	*37.4*	*[32.4:*	*21.4*	*53.8]*
▪ **Strategic** *(27.0)*	*0.723 (0.731)*	659	*68.1*	18	*1.9*	*40.5*	*[34.8:*	*19.0*	*53.8]*
▪ **Surface** *(13.0)*	*0.673**(0.682)*	10	*1.0*	926	*95.7*	*22.0*	*[50.4:*	*9.1*	*59.5]*
	Total	968	*100.0*	968	*100.1*	*99.9*			

Liverpool MBChB curriculum interviewees, Study (S)4

All totals do not add to 100.0% due to rounding
**5 responders did not answer this set of items*
*** ↑to 0.679 if delete Q4: "I concentrate on learning just those bits of information I have to know to pass"*
Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Table 34b: Questionnaire survey of medical school interviewees 2001/02 (Study-element 4): *Short RASI* learning approaches (n=968): Interviewees admitted versus the rest

Of those interviewed and providing learning approach scores…	***mean subscale score on interview day*** *De*	*St*	*Su*	***'mean' of % of overall points allocated to that subscale score on interview day*** *De*	*St*	*Su*	*Total*	***on interview day*** *Deep + Strategic* …predominant *no.*	*%*	…least evident *no.*	*%*
▪ **admitted/registered*** n=238	24.1	26.4	13.0	*38.0*	*41.6*	*20.5*	*100.1*	237	*(99.6)*	10	*(4.2)*
▪ **not admitted/registered** n=730	24.1	26.2	13.4	*37.8*	*41.2*	*21.0*	*100.0*	721	*(98.8)*	32	*(4.4)*
t_{966}	0.28,	0.89,	-1.08					p=0.466 FE	1 cell (25.0%): expected count <5: minimum=2.46	Yates-corrected $\chi^2=0_1$,	p=1.000
p	0.783	0.373	0.283								

Of 238 admitted/registered:

	De	*St*	*Su*	*Total*
▪ **2002/03** n=220	*37.9*	*41.8*	*20.3*	*100.0*
▪ **2003/04** n=18	*38.7*	*39.5*	*21.8*	*100.0*
t_{236}	-0.78	*1.63***	-1.06	
p	0.439	*0.120*	0.291	

Liverpool MBChB curriculum interviewees, Study (S4)

All totals do not add to 100.0% due to rounding
*Responders included 18/19 students who deferred entry to 2003/04
This is when *unequal variances are assumed*, because Levene's Test for Equality of Variances has F=6.64, p=0.011. If equal variances had been assumed: t_{236}=2.20, **p=0.028 [variances =16.2 and 33.1, respectively]
Highest value of each pair is shaded
De=Deep; St=Strategic; Su=Surface; FE=Fisher exact
Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

approaches between these two groups gave equivocal results that were not statistically significant. When treating the % of points allocated to the strategic subscale as a continuous variable (mean), the deferred entrants allocated fewer points to strategic learning (39.5% versus 41.8%). This was non-significant when assuming unequal variances (because of the Levene's test), but statistically significant if equal variances were assumed (p=0.028, 95% confidence interval on 2.25 difference: 0.24, 4.27).

For the characteristics of a good doctor, responders ranked 'compassionate, patient-centred carer' and 'listening, informative communicator' 1st and 2nd, and 'efficient, organized self-manager' last (matching the original order emerging from the open responses of the 1999 cohort at entry) **(Table 35)**. There were no statistically significant Spearman rank correlation coefficients between the nine good doctor themes and the deep subscale score.

The commonest reported career intention was 'hospital doctor (consultant)' (44.0%) versus 17.7% opting to be a GP, as reported with the basic analysis of the career data from all the study-elements **(p272)**. One-third of responders were in the 'do not know' category. The relationship with learning approach is reported here.

S4 showed some similar results to S5, S3, and S6 when comparing career intentions with learning approach. There was no statistically significant difference between which of the three learning approaches predominated according to whether responders reported a career intention (versus reporting uncertainty, 'do not know') (2x3 contingency table), or for the mirror-comparison using the least evident learning approach **(Table 36)**. While very marginally fewer responders who reported 'GP' (versus all other responses combined, i.e. not GP and do not know) had the deep and strategic combined category predominating (rather than surface), this was not statistically significant and was insubstantial – likewise for the mirror-pattern for the least evident category.

Responders reporting GP versus hospital consultant as their career intention had a statistically significantly (t-test) higher mean surface score (13.69 versus 12.89; 95% confidence interval on 0.80 difference 0.04 to 1.55).

Table 35: Questionnaire survey of medical school interviewees 2001/02 (Study-element 4): Ranking nine themes about characteristics of a good doctor [generated by the 1999 Year 1 cohort] (n=904**) versus current *Short RASI* learning approaches**

Question A good doctor is a(n)...	Ranked 1 by... no.	 %	n=904 Sum of all ranks	 Mean rank	 Overall rank	Learning approach: Deep subscale score out of 30 n=900 Spearman rank correlation coefficient
▪ ...compassionate, patient-centred carer	252	*30.5*	3,065	3.39	1	+0.005
▪ ...listening, informative communicator	168	*20.3*	3,219	3.56	2	+0.06*
▪ ...exemplary, responsible 'professional'	34	*4.1*	5,620	6.22	8	-0.03
▪ ...experienced, knowledgeable expert	99	*12.0*	4,548	5.03	5	+0.03
▪ ...friendly, inclusive team player	35	*4.2*	4,353	4.82	4	+0.04
▪ ...thinking, flexible learner	37	*4.5*	4,937	5.46	6	-0.03
▪ ...decisive, competent diagnostician	122	*14.8*	3,898	4.31	3	-0.03
▪ ...well-balanced, insightful 'individual'	60	*7.3*	5,231	5.79	7	-0.02
▪ ...efficient, organized self-manager	19	*2.3*	5,809	6.43	9	-0.008
Total	826**	*100.0%*	40,680 (=45X904***)			

Listed in order generated by S1 responders

Rank 1=most important to 9=least important *Liverpool MBChB curriculum. medical school interviewees. Study (S)4*

Learning approach: 5=Agree, 4=Agree somewhat, 3=Unsure, 2=Disagree somewhat, 1=Disagree

*p=0.058. *All other p values much more than the 0.05 level of statistical significance*

For 'listening, informative communicator' versus deep learning, r_s= +0.12 and approached statistical significance (p=0.089) with the much smaller sample size (n=216) of those subsequently admitted.

***Excludes the 78/904 responders who distributed 45 points by using some numbers more than once and some not at all*

****Includes the 78/904 responders who distributed 45 points by using some numbers more than once and some not at all*

*****37 further responders completed the ranking question in an unusable way, and the remaining 32 made no attempt to answer*

Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Table 36: Questionnaire survey of medical school interviewees 2001/02 (Study-element 4): Career intentions versus *Short RASI* learning approaches (n=957)

Question **At this stage in your medical career, what is your intended career destination?**	**Learning approach no. *(%)*** …predominant *(from score out of 30.0)* **Deep**	**Strategic**	**Surface**	…least evident *(from score out of 30.0)* **Deep**	**Strategic**	**Surface**
▪ …reported a choice **n=642**	194 *(30.2)*	440 *(68.5)*	8 *(1.2)*	14 *(2.2)*	15 *(2.3)*	613 *(95.5)*
▪ …do not know **n=315**	100 *(31.7)*	213 *(67.6)*	2 *(0.6)*	9 *(2.9)*	3 *(1.0)*	303 *(96.2)*
	Pearson χ^2=0.94$_2$, p=0.624 *1 cell (25.0%): expected count <5: minimum= 3.29*		*(99.9)* *(99.9)*	Pearson χ^2=2.57$_2$, p=0.277		*(100.0)* *(100.1)*
		Deep + Strategic	**Surface**		**Deep + Strategic**	**Surface**
▪ …general practitioner **n=169**		167 *(98.8)*	2 *(1.2)*		8 *(4.7)*	161 *(95.3)*
▪ …not general practitioner/do not know **n=788**		780 *(99.0)*	8 *(1.0)*		33 *(4.2)*	755 *(95.8)*
	p=0.692 FE *1 cell (25.0%): expected count <5; minimum=1.77*		*(100.0)* *(100.0)*	Yates-corrected χ^2=0.01$_1$, p=0.913		*(100.0)* *(100.0)*
n=591 subset		**Deep + Strategic**	**Surface**		**Deep + Strategic**	**Surface**
▪ …general practitioner **n=169**		167 *(98.8)*	2 *(1.2)*		8 *(4.7)*	161 *(95.3)*
▪ …hospital consultant [excluding all other choices and do not know] **n=422**		417 *(98.8)*	5 *(1.2)*		18 *(4.3)*	404 *(95.7)*
	p=1.0 FE *2 cells (50.0%): expected count <5; minimum=2.00*		*(100.0)* *(100.0)*	Yates-corrected χ^2=0.06$_1$, p=0.977		*(100.0)* *(100.0)*
mean subscale score…	**Deep**	**Strategic**	**Surface**			
▪ …general practitioner	23.74	26.56	13.69			
▪ …hospital consultant	24.19	26.26	12.89			
t_{589}, p	-1.48, 0.140	1.070, 0.285	2.07, **0.039***			

Liverpool MBChB curriculum, medical school interviewees, Study (S)4

Nil statistically significant, except mean surface score, ****p<0.05*** FE=Fisher's Exact
Learning approach: 5=Agree, 4=Agree somewhat, 3=Unsure, 2=Disagree somewhat, 1=Disagree
Highest value of each pair of means is shaded
All totals do not add to 100.0% due to rounding
Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Summary

The S4 response rate was very high (91.4%). There were no obvious differences between responders and non-responders, including their likelihood of being in the entry-cohort. School-leaver interviewees (+/- A-level/Highers retakes, +/- deferred entry) were, however, statistically significantly less likely to enter compared with the other candidates (graduate, mature, and other non-standard entry), related to stratified competition for places and a lower applicants/places ratio for graduates. Less deprived postcodes and having at least one medical parent did not appear to increase the likelihood of entry to Liverpool MBChB programme.

Career data showed similar patterns to the other two cohorts, as did learning approaches, with strategic learning predominating and higher scores overall for deep and strategic learning and lower scores for surface learning:

- Assessed via the mean subscale scores and the proportion of responders for whom each of the three approaches predominated, there were no statistically significant differences between those admitted/registered and those not admitted/registered. Those admitted did, however, have a non-significant pattern of higher deep and strategic and lower surface learning.
- Comparing the % of points allocated to the subscales as a continuous variable, the deferred group might have allocated relatively fewer points (than the 2002/03 entrants) to strategic learning, but this was not statistically significant.
- For the nine characteristics of a good doctor, responders ranked 'compassionate, patient-centred carer' and 'listening, informative communicator' 1st and 2nd, matching the original order emerging from the open responses of the 1999 cohort at entry. There were no statistically significant correlations with the deep subscale score.
- Similar to the other cohorts, there was no statistically significant difference between which of the three learning approaches predominated according to whether responders reported a career intention (versus reporting uncertainty, 'do not know'). Responders reporting GP versus hospital consultant as their career intention had a statistically significantly (t-test) higher mean surface score (13.69 versus 12.89; 95% confidence interval on 0.80 difference 0.04 to 1.55), as for S3 (and non-significantly for S6 and S5).

Results 1, 2 & 5; 3&6, and 4 (linked: 1999 Cohort: S1, S2, S5; 2001 Cohort: S3, S6, and interviewees for 2002 Cohort S4)

Material deprivation

From all three cohorts, 'home' England & Wales responders' median Townsend deprivation scores were similar and slightly negative (where the more positive the score, the greater the material deprivation):

- -0.400 (S4; n=851)
- -1.659 (S1, S2, and/or S5; n=174)
- -0.660 (S3 and/or S6; n=188)

The frequency distributions were slightly right-skewed.

Career data (Tables 37, 38a, 38b, 38c)

Across the three cohorts, there was no statistically significant difference in the proportion of responders with at least one medical parent (Pearson χ^2=0.58$_2$ and p=0.748):

- 28/183 (15.3%) for 'S1 and/or S2'
- 33/200 (16.5%) for S3
- and the 14.5% reported for S4 **(p264)**

  (NB S5 and S6 omitted the question; and 4, 1, and 6 responders did not answer the question in the three cohorts, respectively)

S4 England & Wales 'home' responders from the most deprived postcodes were statistically significantly less likely to have at least one medical parent than those in the least deprived postcodes although the difference was only 6.1 percentage-points (35/330, 10.3% versus 83/505, 16.4%; Yates-corrected χ^2=5.12$_1$ and p=0.024).

Responders to all study-elements except S2 (i.e. all three cohorts) 'ranked' the same two descriptions of a good doctor 1st, 2nd, and 9th out of nine descriptions:

- 'compassionate, patient-centred carer' (1st)
- 'listening, informative communicator' (2nd)
- 'efficient, organized self-manager' (9th)

This included the ordering from S1 responders' original descriptions in answering the open-ended question. Even S2 responders (with ranks derived from nine confirmatory questions, rather than one overall ranking-question) had 'listening, informative communicator' as 1st, 'compassionate, patient-centred carer' as 2nd, and 'efficient, organized self-manager' as 8th **(Table 37).** 'Exemplary, responsible professional' was most valued by S1 responders (at 3rd) but otherwise ranked relatively low. Of the nine descriptions, S4 England & Wales 'home' responders from the most deprived postcodes valued the good doctor being 'efficient, organized self-manager' very highly statistically significantly more (r_s= -0.108; p=0.002) and gave the largest of the correlation coefficients *(data not shown)*. Only well-balanced, insightful 'individual' otherwise approached significance (r_s= +0.061; p=0.085), i.e. possibly those from the most deprived postcodes not valuing this as much.

Of responders to the six study-elements, those reporting their career intention to be 'hospital doctor (consultant)' ranged from **(Table 38a):**

- 38.3% (end-of-Year 1, 2001 cohort, which was surpassed by 'do not know') to
- 51.9% (mid-Year 3, 1999 cohort).

'Hospital doctor (consultant)' was the commonest intention in all except end-of-Year 1 responders of the 2001 cohort. Over all study-elements, responders opting for 'GP' ranged from **(Table 38a):**

- 9.5% (end-of-Year 1, 1999 cohort) to
- 17.7% (interviewees, 2001/02)

Generally in the 1999 cohort and the 2001 cohort, most career intentions remained unchanged. Comparing mid-Year 3 with the start of Year 1 for the 1999 Cohort **(Table 38b)**, 52.1% of responders reported their career intention unchanged (63.5% for end of Year 1 compared with start of Year 1). Comparing the end of Year 1 with the start of Year 1 for the 2001 cohort **(Table 38c)**, 72.0% of responders reported their career intention unchanged. Where they did change, they did not generally move towards being a GP. In the 1999 cohort, the main general direction from start of Year 1 was from:

- *GP* → 'do not know' and 'hospital doctor (consultant)'
- *'hospital doctor (consultant)'* → 'do not know' and 'GP' (but more so by mid-Year 3 rather than by the end of Year 1)

Table 37: Compilation table from: Questionnaire survey of two cohorts of medical students (1999, 2001) and one cohort of interviewees (2001/02): Study-element (S)1, S2 & S5; S6; & S4: Ranking of nine themes* emerging from answers to Q1 (n=155) S1: "Describe what, for *you*, makes a good doctor"

[[compiled from other tables, so repeating the data]]

Question A good doctor is a(n)...	**2002 cohort Interviewees 2001/2002** S4 n=904*	**1999 cohort Overall rank *(previous, Year 1 open) (previous end-of-Year 1 closed) Year 3*** S1 *(n=155)*	S2 *(n=137)*	S5 n=156**	**2001 cohort Overall rank end-of-Year 1** S6 n=185***
▪ ...compassionate, patient-centred carer	1	*(1)*	*(2)*	1	1
▪ ...listening, informative communicator	2	*(2)*	*(1)*	2	2
▪ ...exemplary, responsible 'professional'	8	*(3)*	*(6)*	8	8
▪ ...experienced, knowledgeable expert	5	*(4)*	*(9)*	4	5
▪ ...friendly, inclusive team player	4	*(5)*	*(3.5)*	5	3
▪ ...thinking, flexible learner	6	*(6)*	*(3.5)*	6	6
▪ ...decisive, competent diagnostician	3	*(7)*	*(5)*	3	4
▪ ...well-balanced, insightful 'individual'	7	*(8)*	*(7)*	7	7
▪ ...efficient, organized self-manager	9	*(9)*	*(8)*	9	9

Rank 1=most important to 9=least important *Liverpool MBChB curriculum, medical students and interviewees, Study (S)1, S2, S5; S6; S4*

**Includes the 78/904 responders who distributed 45 points by using some numbers more than once and some not at all; 37 further responders completed the ranking question in an unusable way, and the remaining 32 made no attempt to answer*

***Includes the 5/156 responders who distributed 45 points by using some numbers more than once and some not at all; 1 further responder completed the question in an unusable way, and the remaining 2 made no attempt to rank the characteristics*

****Includes the 8/185 responders who distributed 45 points by using some numbers more than once and some not at all; 9 further responders completed the ranking question in an unusable way, and the remaining 4 made no attempt to answer*

Compilation from Tables 2 (generating the themes), 13a (confirming the themes), 13b, 29, 35 (p161; 198; 198; 235; 269)

Table 38a: Questionnaire survey of two cohorts of medical students (1999, 2001: Study-element (S)1, S2 & S5; and S3 & S6) and one cohort (2002: S4) of interviewees: Career intentions

Question	2002 cohort S4: interviewees 2001/02 (n=962*)		1999 cohort S1: at start-of-Year 1 1999/00 (n=153**)		S2: end-of-Year 1 1999/00 (n=137)		S5: mid-Year 3 2001/02 (n=158***)		2001 cohort S3: at start-of-Year 1 2001/02 (n=199**)		S6: end-of-Year 1 2001/02 (n=196**)	
At this stage, what is your intended medical career destination? (interviewees) At (the outset of)/(this stage in) your medical career, what is your intended career destination? (start-of-Year 1) (later Year 1 onwards)	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
▪ general practitioner (GP)	170	*17.7*	18	*11.8*	13	*9.5*	23	*14.6*	25	*12.6*	24	*12.2*
▪ hospital doctor (consultant)	423	*44.0*	68	*44.4*	62	*45.3*	82	*51.9*	86	*43.2*	75	*38.3*
▪ community doctor (consultant)	8	*0.8*	0	*0.0*	2	*1.5*	1	*0.6*	3	*1.5*	3	*1.5*
▪ public health doctor (consultant)	12	*1.2*	0	*0.0*	0	*0.0*	0	*0*	1	*0.5*	1	*0.5*
▪ other	31	*3.2*	10	*6.5*	7	*5.1*	5	*3.2*	7	*3.5*	6	*3.1*
▪ do not know	318	*33.1*	57	*37.3*	53	*38.7*	47	*29.7*	77	*38.7*	87	*44.4*
total	962	*100.0%*	153	*100.0%*	137	*100.1%*	158	*100.0%*	199	*100.0%*	196	*100.0%*

Liverpool MBChB curriculum, medical students and interviewees. Study (S)1, S2, S5; S3, S6; S4
Highest proportion of each set is shaded
11, **2, and 1*responders, respectively, did not complete this question*
All totals do not add to 100.0% due to rounding

Comparison between those responders admitted versus not admitted

	S4: interviewees 2001/02, subsequently <u>admitted</u> (n=239)	
	no.	%
▪ general practitioner (GP)	45	*18.8*
▪ hospital doctor (consultant)	99	*41.4*
▪ community doctor (consultant)	1	*0.4*
▪ public health doctor (consultant)	3	*1.3*
▪ other	6	*2.5*
▪ do not know	85	*35.6*
total	239	*100.0%*

→ 'GP' in admitted versus in not admitted (125/723, 17.3%) Yates-corrected χ^2=0.20$_1$, p=0.658

→ 'do not know' in admitted versus in not admitted (233/723, 32.2%) Yates-corrected χ^2=0.76$_1$, p=0.383

	S4: interviewees 2001/02 (n=845) Career decision Yes		No		
Townsend deprivation score:	no.	(%)	no.	(%)	
most affluent (three quintiles)	317	*(62.2)*	193	*(37.8)*	*(100.0)*
least affluent (two quintiles)	240	*(71.6)*	95	*(28.4)*	*(100.0)*

Yates-corrected χ^2=7.68$_1$, p=0.006

Table 38b: Questionnaire survey of Year 1 medical students at start (n=228) and end (n=224) of 1999/00 and when in Year 3 in mid-2001/02 (n=204) (Study-element (S)1, S2 & S5): Career intentions

Question **At this stage in your medical career, what is your intended career destination?**	**Unchanged answer from:** start-of-Year 1 → end-of-Year 1 **(S1→S2)** **n=104 response-sets**		start-of-Year 1 → mid-Year 3 **(S1→S5)** **n=117 response-sets**		end-of-Year 1 → mid-Year 3 **(S2→S5)** **n=115 response-sets**		
	no.	**%**	**no.**	**%**	**no.**	**%**	
	66	*63.5*	61	*52.1*	71	*61.7*	

no. %	general practitioner		hospital doctor (consultant)		community doctor (consultant)		public health doctor		other		do not know		
▪...general practitioner, start-of-Year 1 **n=16 →end-of-Year 1 S2**	7	*43.8*	4	*25.0*	0	*0*	0	*0*	0	*0*	5	*31.3*	***100.1%***
▪...general practitioner, start-of-Year 1 **n=17 → mid-Year 3 S5**	5	*29.4*	5	*29.4*	0	*0*	0	*0*	0	*0*	7	*41.2*	***100.0%***
▪...hospital doctor (consultant), start-of-Year 1 **n=45 → end-of-Year 1 S2**	3	*6.7*	32	*71.1*	1	*2.2*	0	*0*	3	*6.7*	6	*13.3*	***100.0%***
▪...hospital doctor (consultant), start-of-Year 1 **n=50 → mid- Year 3 S5**	6	*12.0*	34	*68.0*	1	*2.0*	0	*0*	2	*4.0*	7	*14.0*	***100.0%***
▪...do not know, start-of-Year 1 **n=36 → end-of-Year 1 S2**	1	*2.8*	10	*27.8*	0	*0*	0	*0*	1	*2.8*	24	*66.7*	***100.1%***
▪...do not know, start-of-Year 1 **n=42 → mid-Year 3 S5**	5	*11.9*	18	*42.9*	0	0	0	0	0	0	19	*45.2*	***100.0%***
▪...general practitioner, end-of-Year 1 **n=12 → mid-Year 3 S5**	5	*41.7*	4	*33.3*	0	*0*	0	*0*	0	*0*	3	*25.0*	***100.0%***
▪...hospital doctor (consultant), end-of-Year 1 **n=50 → mid-Year 3 S5**	3	*6.0*	39	*78.0*	0	*0*	0	*0*	1	*2.0*	7	*14.0*	***100.0%***
▪...do not know, end-of-Year 1 **n=45 → mid-Year 3 S5**	7	*15.6*	15	*33.3*	0	*0*	0	*0*	0	*0*	23	*51.1*	***100.0%***

Related data from complete S1-S2-S5 response-sets for career closed-question, n=90 Reported...	start-of-Year 1		end-of-Year 1		mid-Year 3		
	no.	**%**	**no.**	**%**	**no.**	**%**	
▪a career intention	57	*63.3*	59	*65.6*	66	*73.3*	
▪do not know	33		31		24		
	90		90		90		*Cochran's Q 3.62* *p 0.164₂*
▪general practitioner (GP)	15	*16.7*	10	*11.1*	12	*13.3*	
▪do not know or intention other than GP	75		80		78		
	90		90		90		*Cochran's Q 1.73* *p 0.422₂*

Liverpool MBChB curriculum. Year 1 medical students (followed to Year 3). Study (S)1, S2, S5

% unchanged

All totals do not add to 100.0% due to rounding

Notes: Cochran's Q is used for binary responses and is an extension of the McNemar test to the k-sample example.

Table 38c: Questionnaire survey of Year 1 medical students at start of (n=283) and end (n=279) of 2001/02 (Study-element (S)3 & S6): Career intentions

Question At this stage in your medical career, what is your intended career destination?	Unchanged answer from: start-of-Year 1 → end-of-Year 1 (S3→S6) n=157 response-sets	
	no.	%
	113	*72.0*

	general practitioner		hospital doctor (consultant)		community doctor (consultant)		public health doctor		other		do not know		
▪ …general practitioner, start-of-Year 1 n=24 → end-of-Year 1 S6	14	*58.3*	2	*8.3*	1	*4.2*	1	*4.2*	1	*4.2*	5	*20.8*	***100.0%***
▪ …hospital doctor (consultant), start-of-Year 1 n=62 → end-of-Year 1 S6	1	*1.6*	48	*77.4*	0	*0*	0	*0*	1	*1.6*	12	*19.4*	***100.0%***
▪ …do not know, start-of-Year 1 n=64 → end-of-Year 1 S6	2	*3.2*	10	*15.9*	1	*1.6*	0	*0*	1	*1.6*	49	*77.8*	***100.1%***

Related data from complete S3-S6 response-sets for career closed-question, n=157 **Reported…**	a career intention S6		do not know S6	
	no.	%	no.	%
▪ a career intention S3	75	*47.8*	19	*12.1*
▪ do not know S3	14	*8.9*	49	*31.2*

157	*100.0*	exact p=0.487, McNemar, binomial distribution

	general practitioner (GP) S6		do not know or intention other than GP S6	
	no.	%	no.	%
▪ general practitioner (GP) S3	14	*8.9*	10	*6.4*
▪ do not know or intention other than GP S3	4	*2.5*	129	*82.2*

157	*100.0*	exact p=0.180, McNemar, binomial distribution

Liverpool MBChB curriculum, Year 1 medical students (followed for Year 1), Study (S)3, S6

% unchanged

All totals do not add to 100.0% due to rounding

- *'do not know'* → 'hospital doctor (consultant)' and, to a much lesser extent, GP (and even then only 2.8% and 11.9% of the 'do not knows' changed to it by the end of Year 1 and by mid-Year 3, respectively)

There was a similar pattern on tracking the main general direction from end of Year 1.

Where career intentions did change in the 2001 cohort, the main general direction from start of Year 1 was similarly from:

- *GP* → 'do not know'
- *'hospital doctor (consultant)'* → 'do not know'
- *'do not know'* → 'hospital doctor (consultant)'

There was no statistically significant difference in whether responders reported a career intention versus 'do not know' between the three rounds for 1999 Cohort (Pearson χ^2=3.07$_2$ and p=0.215), or between the two rounds of 2001 Cohort (Yates-corrected χ^2=1.09$_1$ and p=0.295) when treating these data as independent. Analysing 90 complete-sets of 'related data' from responders to all three 1999 Cohort study-elements, there was no statistically significant difference in whether they reported a career intention versus 'do not now', despite a small (10 percentage points) increase over time (start-Year 1, S1, 63.3%→end-Year 1, S2 65.6%→mid-Year 3, S5, 73.3%). Likewise, there was no statistically significant difference in whether they reported 'GP' versus any other answer **(Table 38b)**. Furthermore, analysing 157 complete-sets of paired data from responders to both 2001 Cohort study-elements showed no statistically significant differences in whether they changed between reporting a career intention to 'do not know' and vice versa (12.1% versus 8.9%) and between 'GP' to any other answer and vice versa (6.4% versus 2.5%) **(Table 38c)**. For S4, there were no statistically significant differences between those interviewees who were subsequently admitted (versus the rest) in whether they reported 'do not know' (or a career intention), and similarly between these two groups for reporting GP versus any other answer. For S4 responders overall, interviewees from the most deprived versus least deprived postcodes, were very statistically significantly more likely to report a career intention (71.6% versus 62.2%) rather than 'do not know' **(Table 38a)**. There was, however, no difference in their likelihood of reporting GP versus non-GP *(data not shown)*.

Assessment outcomes data (Tables 39a-c, 40a-b, 41a-c)

Cumulative assessment outcomes (versus learning approach)

Most of the students who continued as part of the 1999 cohort passed their summative assessments taken under examination conditions, and this performance showed an association with their learning approach **(Tables 39a, 39b, 39c)**. Of the 228 students starting medical school with the 1999 cohort, 224, 204, then 190 were still with the cohort to take the relevant summative assessments for Level 1 (end-of-Year 1), Level 2 (mid-Year 3), and Level 3 (end-of-Year 4) **(Table 39a)**. Of these students, 75.0%, 77.0%, and 83.7% passed at their first attempt, respectively ---overall, 118/188 (62.8%) students progressing through Level 3 had failed nothing along the way. Failing one or more retake assessments (3.6%, 4.4%, 1.1%, respectively), thus triggering departure from the cohort, appeared commoner in the second of the three assessments. In the 190 students who reached and progressed through the Level 3 assessments with the cohort (assigning the original retake Year 1s to the retake group), however, there was no statistically significant difference for passing first time versus at retake (Cochran's $Q=1.524_2$, $p=0.467$) between Levels 1, 2 or 3 assessments.

At each of the three assessment levels, the general pattern was of higher mean (mid-Year 3) deep and strategic learning scores and lower surface learning scores in those who passed all the elements first time. (This pattern was also reflected in the percentage of responders for whom each of the three scores, in turn, was the predominant and the least evident.) The only statistically significant difference (albeit marginal) was for the mean surface learning score as related back to the end-of-Year 1 assessments. This was slightly higher in the group having to pass one or more retakes to progress (17.0) versus those passing all elements at the first attempt (15.3) (95% confidence interval on –1.64% difference: -3.27, -0.004).

Table 39a: Assessment outcomes for those medical students still progressing with the 1999 cohort to take each of the three summative assessments in normal time (n=224, n=204, n=190, respectively)

On taking	...end-of-Year 1 assessments: P1, P2, CoSk, ClSk		...mid-Year 3 assessments: P1, P2, P3, CoSk, ClSk		....end-of-Year 4 assessments: P1, P2, P3, CoSk, ClSk, Long case	
	no.	**%**	**no.**	**%**	**no.**	**%**
▪ **passed all elements first time (*& passed if retaking Year 1, n=5)**	168*	75.0	157	77.0	159	83.7
▪ **passed after retaking at least one element**	48	21.4	38	18.6	29	15.3
▪ **failed on retaking an element**	8	3.6	9	4.4	2	1.1
Total	224	100.0	204	100.0	190	100.1

All totals do not add to 100.0% due to rounding *Liverpool MBChB curriculum. 1999 entry-cohort of medical students. outcomes*
P=written paper; CoSk=Communications skills; ClSk=Clinical Skills
**The 5 students retaking Y1 were treated as part of the cohort for this analysis*
By the time of each of these assessments, respectively, the number of students who had left the original cohort of 228 was 4. then 20 (including one of the five who had retaken Year 1 as part of the 1999 cohort), then 14, respectively
For n=190 reaching & progressing through Y4 assessments in-cohort (assigning the retake Year 1s to the retake group), comparing pass 1st time versus at retake in Years 1, 3, or 4 assessments: 151, 39; 155, 35; 159, 31 (Cochran's Q=1.524$_2$, p=0.467)

Table 39b: Assessment outcomes for those students, still progressing with the 1999 cohort to take each of the three summative assessments in normal time, who responded to questionnaire survey of Year 3 medical students mid-2001/02 (Study-element 5) and provided *Short RASI* learning approaches (n=159, n=150, n=146, respectively)

Of students taking and progressing through this summative assessment...	*mean subscale score mid-Year 3*			*'mean' of % of overall points allocated to that subscale score mid-Year 3*				*mid-Year 3* Deep + Strategic ...least evident		...predominant	
	De	***St***	***Su***	***De***	***St***	***Su***	***Total***	**no.**	**%**	**no.**	**%**
End-of-Year 1											
▪ **passed all its parts*** n=127	20.7	22.1	15.3	*35.6*	*37.9*	*26.5*	*100.0*	26	*(20.5)*	115	*(90.6)*
▪ **failed ≥1 part but passed retake** n=32	20.3	21.6	17.0	*34.3*	*36.8*	*28.9*	*100.0*	12	*(37.5)*	28	*(87.5)*
	Difference −1.64 t= -1.98. p=0.049 95% CI (-3.27, -0.004)							*p=0.074. Yates-corrected χ^2_1=3.19*		*p=0.742. FE. 1 cell (25.0%): exp. count 5; min=3.22*	
Mid-Year 3											
▪ **passed all its parts** n=120	20.7	22.2	15.4	*35.3*	*38.2*	*26.5*	*100.0*	25	*(20.8)*	111	*(92.5)*
▪ **failed ≥1 part but passed retake** n=30	20.2	21.0	16.5	*35.0*	*36.2*	*28.8*	*100.0*	9	*(30.0)*	25	*(83.3)*
								p=0.407. Yates-corrected χ^2_1=0.69		*p=0.157, FE 1 cell (25.0%): exp. count 5; min.=2.80*	
End-of-Year 4											
▪ **passed all its parts** n=124	20.8	22.1	15.5	*35.5*	*37.9*	*26.6*	*100.0*	26	*(21.0)*	*115*	*(92.7)*
▪ **failed ≥1 part but passed retake** n=22	19.5	21.5	15.6	*34.2*	*38.0*	*27.9*	*100.1*	6	*(27.3)*	*19*	*(86.4)*
								p=0.577, FE 1 cell (25.0%): exp. count <5; min.=4.82		*p=0.391, FE 1 cell (25.0%): exp. count <5; min.=1.81*	

Liverpool MBChB curriculum. 1999 entry-cohort of medical students. outcomes. plus Year 3 medical students. Study (S)5
De=Deep; St=Strategic; Su=Surface *All totals do not add to 100.0% due to rounding*
**includes the 4 students who retook and passed Year 1 as part of the cohort and provided mid-Year 3 learning approach scores – when excluded, p=0.061 for De+St as least evident*
Highest value of each pair is shaded FE=Fisher exact exp. = expected; min.=minimum

↓ *indicates the 95 % confidence intervals and t-testing on the difference in these means showing only the one* ***statistically significant difference at the 5% level****, for which p=0.053 when excluding those retaking Year 1*
Other differences approaching statistical significance were in:
End-Year 1 S2: 'mean' % of overall points allocated to surface score →p=0.065. 95% CI on difference on −2.49 (-5.13. 0.16)
Mid-Year 3 S5: 'mean' % of overall points allocated to strategic score →p=0.090. 95% CI on difference on 2.03 (-0.32. 4.38)
Mid-Year 3 S5: 'mean' % of overall points allocated to surface score at →p=0.085. 95% CI on difference on -2.34 (-5.01. 0.33)
Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Table 39c: Cumulative assessment outcomes for those students still progressing with the cohort after end-of-Year 4 assessments (n=188), and linked to responses to questionnaire survey of Year 3 medical students mid-2001/02 (Study-element 5): *Short RASI* learning approaches

	By the time of having taken end-of-Year 4 summative assessment, students had…	no.	%
P	▪ passed all [P] elements first time at each of three stages Y1, Y3, and Y4	118	*62.1*
F/PR	▪ failed at least one element at one stage [F/PR] of three (Y1, Y3, or Y4), but passed retake to progress	47	*4.7*
F/PR	▪ failed at least one element at two stages [F/PR] of three (Y1, Y3, or Y4), but passed retakes to progress	14	*7.4*
F/PR	▪ failed at least one element at all three stages [F/PR] of three (Y1, Y3, or Y4), but passed retakes to progress	9	*4.7*
	▪ failed at least one element of Y4 assessment, failed the retake(s) and left the cohort to retake Y4	2	*1.1*
	Total	190	*100.0*

	no.	*%*
male		
P	41/118	*(34.7)*
F/PR	28/70	*(40.0)*
		p=0.532
White 'home'		
P	83/103	*(80.6)*
F/PR	46/65	*(70.8)*
		p=0.189
mean age (years,		
P	20.1	
F/PR	19.9	
	t=0.352, p=0.725	

38 students had left original cohort of 228 between entry and taking end-of Year 4 assessments, including 1 of the five who had retaken Year 1 successfully (the other four's retake Year 1 being counted as failing at least one element at one stage)

By the time that they had taken end-of-Year 4 summative assessment, students who had…	***mean***	difference (95% confidence interval)	*[t]* *p value*	***'mean' overall % of points allocated***	difference (95% confidence interval)	*[t]* *p value*
	Deep learning approach: mean subscale score, at mid-Year 3			**Deep** learning approach subscale score, as a % of total points allocated, at mid-Year 3		
▪ passed all n=89	21.2			36.0		
▪ failed ≥1 part at ≥1 stage but passed retake n=57	19.6			34.1		
		1.6 **(0.28, 3.08)**	*[2.36]* ***0.019***		1.9 **(0.29, 3.48)**	*[2.33]* ***0.021***
	Strategic learning approach: mean subscale score, at mid-Year 3			**Strategic** learning approach subscale score, as a % of total points allocated, at mid-Year 3		
▪ passed all n=89	22.4			38.0		
▪ failed ≥1 part at ≥1 stage but passed retake n=57	21.6			37.7		
		0.80 (-0.62, 2.22)	*[1.11]* *0.268*		0.30 (-1.64, 2.24)	*[0.31]* *0.760*
	Surface learning approach: mean subscale score, at mid-Year 3			**Surface** learning approach subscale score, as a % of total points allocated, at mid-Year 3		
▪ passed all n=89	15.2			25.9		
▪ failed ≥1 part at ≥1 stage but passed retake n=57	15.9			28.1		
		-0.72 (-2.09, 0.66)	*[-1.03]* *0.305*		-2.2 **(-4.37, 0.00)**	*[-1.974]* ***0.050***
				Total 99.9		
				Total 99.9		

All totals do not add to 100.0% due to rounding

146/188 (77.7%) who progressed with the cohort at every stage had responded to the learning approaches in S5

	no.	*%*	*no.*	*%*
	Deep + Strategic			
	…least predominant		…predominant	
▪ passed all n=89	15	*(16.9)*	84	*(94.4)*
▪ failed ≥1 part at ≥1 stage but passed retake n=57	17	*(29.8)*	50	*(87.7)*
		p=0.069		*p=0.217*

Highest value of each pair is shaded

Liverpool MBChB curriculum, Year 3 medical students. Study (S)5, and the cumulative outcomes of that 1999 entry-cohort

Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Concerning the 'related data' over the three study-elements, 62.1% of students had passed all elements of their assessments, at all three levels, at their first attempt **(Table 39c)**. For this cumulative outcome (passed all the elements first time versus passed at least one retake to progress), the general pattern was once again of higher mean (mid-Year 3) deep and strategic learning scores and a lower surface learning score. The difference was statistically significant for the deep score, the mean score of 21.2 for responders passing all elements first time being 1.6 points higher than in those having passed at least one retake to progress. This pattern was again reflected in the percentage of responders for whom each of the three scores, in turn, were the predominant and the least evident. This pattern was also reflected in the 'mean' percentage allocation of points to each of the three subscales, with further statistical significance emerging, namely in the higher allocation of points to surface learning in the group required to pass at least one retake **(Table 39c)**. There were no statistically significant differences between the sexes, between White 'home' students versus others, or between mean ages. Comparing the mean scores on the two most stable of the 'good tutor' scores, there were also no statistically significant differences between those passing all parts first time versus those passing a retake along the way:

- 'tells me what to learn': -0.12 versus 0.12 (t= -1.395, p=0.165)
- 'helps with how to learn': 0.13 versus -0.19 (t=1.895, p=0.060)

These non-significant differences scores, albeit extremely marginal, did however suggest that students expecting PBL tutors to tell them what to learn, or not valuing the tutor's role in helping them with the learning process, were less likely to have passed all assessments first time.

As with the 1999 cohort, most of the students who continued with the 2001 cohort passed their Year 1 summative assessments taken under examination conditions, and likewise this performance was associated with their learning approach **(Tables 40a, 40b)**. Of the 283 students starting medical school with the 2001 cohort, 279 stayed in-cohort to take the relevant summative assessments for Level 1 (end-of-Year 1) **(Table 40a)**. Of these students, 72.0% passed first time. Failing one or more retakes (or opting to leave), resulting in departure from the cohort, affected 5.7%.

Table 40a: Assessment outcomes for those medical students still progressing with the 2001 cohort to take the end-of-Year 1 summative assessment in normal time (n=279)

	On taking end-of-Year 1 assessments: P1 P2 CoSk ClSk	
	no.	%
▪ passed all elements first time (*& passed all if retaking Year 1, n=4)	201*	72.0
▪ passed after retaking at least one element (**& passed after retaking element(s) if retaking Year 1, n=5)	62**	22.2
▪ failed on retaking an element (***& failed retake Year 1 or left rather than retaking, n=6)	16***	5.7
Totals does not add to 100.0% due to rounding — *Total*	279	99.9

Liverpool MBChB curriculum. 2001 entry-cohort of medical students. outcomes
P=written paper; CoSk=Communications skills; ClSk=Clinical Skills
The 11 students retaking Y1 were treated as part of the cohort for this analysis
By the time of this assessment, the number of students who had left the original cohort of 283 was 4

Table 40b: Assessment outcomes for those students, still progressing with the 2001 cohort to take the end-of-Year 1 summative assessment in normal time, who responded to questionnaire surveys of Year 1 medical students, at start and/or end of 2001/02 (Study-element (S)3 & S6), and provided *Short RASI* learning approaches (n=189, n=192)

Of students taking and progressing through this summative assessment…	*mean subscale score*			*'mean' of % of overall points allocated to that subscale score*				Deep + Strategic			
	De	**St**	**Su**	**De**	**St**	**Su**	**Total**	**no.**	**%**	**no.**	**%**
End-of-Year 1 *(*includes 1 student who retook & passed Year 1 as part of the cohort and provided learning approach scores)*								…least evident		…predominant	
measured start-Year 1 S3											
▪ **passed all its parts n=148**	21.9	22.8	14.4	*37.1*	*38.5*	*24.4*	*100.0*	24	*(16.2)*	141	*(95.3)*
▪ **failed ≥1 part but passed retake n=41**	21.8	21.5	16.8	*36.4*	*35.7*	*27.9*	*100.0*	10	*(24.4)*	36	*(87.8)*
			Difference −2.39 t= -3.06, p=0.003 95% CI (-0.85, -3.93)		*Difference 2.80 t= 2.75, p=0.007 95% CI (0.79, 4.81)*	*Difference −3.52 t= -2.86, p=0.005 95% CI (-1.09, -5.94)*		FE *p=0.329* *p=0.329, Yates-corrected* χ^2_1*=0.95*		*p=0.138. FE. 1 cell (25.0%): exp. count 5: min=2.60*	
End-of-Year 1 *(**includes 3 students who retook & passed Year 1 as part of the cohort and provided learning approach scores)*								…least evident		…predominant	
measured end-of-Year 1 S6											
▪ **passed ali its parts n=154**	21.6	23.1	15.0	*36.1*	*38.7*	*25.2*	*100.0*	26	*(16.9)*	144	*(93.5)*
▪ **failed ≥1 part but passed retake n=38**	22.2	23.0	16.3	*36.1*	*37.4*	*26.5*	*100.0*	4	*(10.5)*	36	*(94.7)*
								p=0.473. Yates-corrected χ^2_1*=0.51*		*p=1.000. FE. 1 cell (25.0%): exp. count <5; min=2.38*	

Liverpool MBChB curriculum. Year 1 medical students. Study (S)3 & S6. and the Y1 outcomes of that 2001 entry-cohort
Highest value of each pair is shaded **De=Deep; St=Strategic; Su=Surface;** FE=Fisher exact
** and ** : When these are excluded. no notable changes to report*
*↓ indicates the 95 % confidence intervals and t-testing on difference in means and **statistically significant differences at the 5% level***
Other differences approaching statistical significance were in:
Start-Year 1 S3: mean strategic score → p=0.066. 95% CI on difference on 1.30 (-0.09. 2.69)
End-of-Year S6: mean surface score → p=0.079 95% CI on difference on 1.32 (-2.79. 0.16) and p=0.074 if exclude those retaking the year
Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

The general pattern was of higher mean deep and strategic learning scores and lower surface learning score measured at the start of Year 1, in those who passed all the elements first time. This was not so for the end of Year 1, where only the surface score corresponded, and the strategic score only kept to the pattern when assessed via the points allocated to that subscale. (The general pattern was also reflected in the start-of-Year 1 percentage of responders for whom each of the three scores were the most and least evident approach, but the end-of-Year 1 pattern was unsupportive.)

For the mean scores, the only statistically significant difference was, again, for surface learning at the start of Year 1 (with points allocated to that score also being significant). This was slightly higher in the group passing one or more retakes to progress (16.8) versus those passing all first attempts (14.4) (95% confidence interval on –2.39% difference: -0.84, -3.93). The only other statistically significant result was the higher points-allocation to strategic learning in the group passing all the elements first time.

Multiple regression analysis on assessment outcomes (Tables 41a, b, & c)

Multiple logistic regression models for the 1999 and 2001 cohorts with the **criterion variable** as ever-failing (but still in cohort), and eight **predictor variables** (three learning approach subscales, the two most stable perceived good tutor components, age, sex, and whether home (EC)) showed consistent findings:

- **In the 1999 cohort:** of the 146 S5 responders who ultimately kept up with the cohort and progressed through Level 3, having passed all their summative assessments along the way (+/- retakes), only the 143 with no missing data on the predictor variables were analysed. On the 'entry' method (entering all/removing no variables; *data not shown*), the only statistically significant predictor was deep learning with p=0.026, exp(B)=0.894. With the backward stepwise method (and least likelihood removal testing), the model ultimately contained only deep learning to predict the odds of having ever-failed (and passed the retake). For this variable, exp(B)=0.902 (statistically significant at the 5% level), i.e. an increase of 1 unit on the deep learning score would be associated with a slightly decreased odds (i.e. multiplying by 0.902) of failing at least one assessment along the way. The model was statistically significantly reliable (Omnibus test; Hosmer and Lemeshow test). The model **(Table 41a)** accounted for minimal variance in 'fail' status (4.1%-5.6%; Cox

& Snell R^2, Nagelkerke R^2, respectively), with 88.4% of students 'never-failing' being predicted successfully. Nevertheless, only 21.1% of students 'ever-failing' were predicted, giving an overall prediction success of 61.5% (which only slightly improved on the 'Block 0' default prediction of 60.1%). The casewise list showed no outliers. Indicators such as tolerance showed no obvious multicollinearity.

- **In the 1999 cohort:** using end of Year 1 (instead of cumulative end of Year 4) for the assessment criterion variable, 156 kept up with the cohort by progressing through Level 1 and also subsequently responded to S5. For the 153 with no missing data on the predictor variables, on the 'entry' method (*data not shown*), the only statistically significant predictors were age and the second good tutor factor, 'helps me with how to learn', with p=0.017, exp(B)=1.162, and p=0.038, exp(B)=0.660, respectively. With the backward stepwise method (and least likelihood removal testing), the model *[data not tabulated]* ultimately contained both of these. The model contained: age (exp(B)=1.134, p=0.034) and the second good tutor component 'helps me with how to learn' (exp(B)=0.641, p=0.018), plus surface learning (exp(B)=1.112, p=0.026) to predict the odds of having failed something at the end of Year 1 (and passed the retake). The model was statistically significantly reliable (Omnibus test; Hosmer and Lemeshow test). The model *[data not tabulated]* accounted for minimal variance in 'fail' status (7.3%-11.1%; Cox & Snell R^2, Nagelkerke R^2, respectively), but twice as much as predicting Y4 cumulative outcome above. Therefore, more students (99.2%) 'not-failing' were predicted successfully. Nevertheless, fewer (11.1%) students 'failing' were predicted, giving an overall prediction success of 78.8% (which only slightly improved on the 'Block 0' default prediction of 76.9%). The casewise list showed five outliers ('studentized residuals' >2.000). There was, however, no obvious reason to delete these (all females, home (EC) and all failing something: three resitting clinical skills solely because they failed on sharps disposal or basic life support, one resitting Paper 2, and the last included by being a retake-Year 1 due to Paper 1). Indicators such as tolerance showed no obvious multicollinearity.

Table 41a: Predicting cumulative assessment outcomes for medical students still in-cohort after end-of-Year 4 assessments, who responded to Year 3 questionnaire survey mid-2001/02 (Study-element 5) and had complete data on all predictor variables (n=143); backward stepwise logistic regression (least likelihood removal testing)

Failed ≥1 element but passed retake	Predictors retained	B	standard error	Wald	degrees of freedom (df)	p value	Exp(B)	95.0% confidence interval for Exp(B)
Step 8 of 8*	**deep learning (mid-Y3)**	-0.103	0.043	5.679	1	**0.017**	0.902	0.829, 0.982
	Constant	1.696	0.895	3.588	1	0.058	5.452	

*Variables entered overall: deep, strategic, & surface learning *Short RASI* (mid-Y3); good tutor components 1 [tells me what to learn] & 2 [helps me with how to learn] (mid-Y3); age at entry; whether male; whether 'home'/European Community (EU) or other country

Omnibus Test of Model Coefficient	χ^2*=6.00,* **p=0.014**	*df=1*
Hosmer and Lemeshow Test	χ^2*=11.17, p=0.192*	*df=8, H_0=no difference between observed and predicted*
−2 log likelihood (initial value): 186.314 (192.318)		*Cox & Snell R^2 and Nagelkerke R^2: 0.041 and 0.056*
		tolerance range for the 8 variables (derived from entry method) [must be ≥0.0001]: 0.75-0.91

Liverpool MBChB curriculum. 1999 entry-cohort of medical students. end-of-Year 4 cumulative outcome versus mid-Year 3 predictors. Study (S)5

Table 41b: Predicting assessment outcomes for medical students still in-cohort after end-of-Year 1 assessments, who responded to start-of-Year 1 questionnaire survey 2001/02 (Study-element 3) and had complete data on all predictor variables (n=188); backward stepwise logistic regression (least likelihood removal testing)

Failed ≥1 element but passed retake	Predictors retained	B	standard error	Wald	degrees of freedom (df)	p value	Exp(B)	95.0% confidence interval for Exp(B)
Step 6 of 6*	**surface learning (Y1 start)**	0.101	0.043	5.564	1	**0.018**	1.107	1.017, 1.204
	home/EU	-1.193	0.583	4.187	1	**0.041**	0.303	0.097, 0.951
	age at entry	-0.148	0.095	2.455	1	0.117	0.862	0.716, 1.038
	Constant	1.148	2.137	0.289	1	0.591	3.153	

*Variables entered on Step 1: as for Table 41a but *Short RASI* learning approaches & good tutor components from start of Y1

Omnibus Test of Model Coefficient	χ^2*=17.15,* **p=0.001**	*df=3*
Hosmer and Lemeshow Test	χ^2*=5.92, p=0.656*	*df=8, H_0=no difference between observed and predicted*
−2 log likelihood (initial value): 180.051 (197.202)		*Cox & Snell R^2 and Nagelkerke R^2: 0.087 and 0.134*
		tolerance range for the 8 variables (derived from entry method) [must be ≥0.0001]: 0.72-0.95

Liverpool MBChB curriculum, 2001 entry-cohort of medical students, Y1 outcome versus start-of-Year 1 predictors. Study (S)3

Table 41c: Predicting assessment outcomes for medical students still in-cohort after end-of-Year 1 assessments, who responded to end-of-Year 1 questionnaire survey 2001/02 (Study-element 6) and had complete data on all predictor variables (n=188); backward stepwise logistic regression (least likelihood removal testing)

Criterion variable = **failed ≥1 element but passed retake**	Predictors retained	B	standard error	Wald	degrees of freedom (df)	p value	Exp(B)	95.0% confidence interval for Exp(B)
Step 7 of 7*	**home/EU**	-1.627	0.575	8.013	1	**0.005**	0.197	0.06, 0.61
	age at entry	-0.137	0.095	2.070	1	0.150	0.872	0.72, 1.05
	Constant	2.700	1.951	1.914	1	0.166	14.879	

*Variables entered on Step 1: as for Table 41a but *Short RASI* learning approaches & good tutor components measured at end-of-Y1, and components 1 & 2 comprised 'helps me with how to learn' and 'tells me what to learn', respectively (i.e. opposite order)

Omnibus Test of Model Coefficient	χ^2=10.91, **p=0.004**	df=2
Hosmer and Lemeshow Test	χ^2=7.37, p=0.497	df=8, H_0=no difference between observed and predicted
−2 log likelihood *(initial value)*: 169.802 *(180.714)*		Cox & Snell R^2 and Nagelkerke R^2: 0.056 and 0.091
		tolerance range for the 8 variables (derived from entry method) [must be ≥0.0001]: 0.71-0.96

Liverpool MBChB curriculum. 2001 entry-cohort of medical students. Y1 outcome versus start/end-of-Year 1 predictors. Study (S)3 & S6

Notes: Tables 41a-c: Multiple binary logistic regression: produces the log odds of a particular categorical outcome (criterion variable) given a set of predictor variables. Performance measures of model: The −2 log likelihood measures predictive success: the higher the value → worse it is. Similarly, for the Hosmer and Lemeshow Test: the higher the p value → better. Conversely, for the Omnibus test: the lower the p value → better. The Wald statistic measures how good a variable is as a predictor.
Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

- **In the 2001 cohort:** of the 188 S3 responders who ultimately kept up with the cohort and progressed through Level 1, having passed their summative assessments (+/- retakes), all had complete data on the predictor variables. On the 'entry' method (*data not shown*), the only statistically significant predictor was whether a 'home (EC)' student or not, with p=0.043, exp(B)=0.296. With the backward stepwise method (and least likelihood removal testing), the model ultimately contained only surface learning, whether home (EC), and age at entry to predict the odds of failing (but passed the retake). Their exp(B)s indicated the effects of an increase of 1 unit on the surface learning score, home (EC) status, and an increase of 1 year on entry age, respectively (although only the first two were statistically significant, both at 5% level). These would be associated with:
  - [for surface] a very slightly increased odds (i.e. multiplying by 1.107)… of failing at least one of the Year 1 assessments
  - [for home] a decreased odds (0.303)…
  - and possibly [with age] a decreased odds (0.862), respectively…

  The model was statistically significantly reliable (Omnibus test; Hosmer and Lemeshow test). The model **(Table 41b)** accounted for minimal variance in 'fail' status (8.7%-13.4%; Cox & Snell R^2, Nagelkerke R^2, respectively), with 98.0% of students 'not-failing' being predicted successfully. Nevertheless, only 9.8% of students 'failing' were predicted, giving an overall prediction success of 78.7% (which only marginally improved on the 'Block 0' default prediction of 78.2%). The casewise list showed two outliers ('studentized residuals' >2.000), but there was no obvious reason to delete these (one a female graduate, the other a male who apparently retook A-levels; both home (EC). Indicators such as tolerance showed no obvious multicollinearity.
- **In the 2001 cohort:** of the 189 S6 responders who ultimately kept up with the cohort and progressed through Level 1, having passed their summative assessments (+/- retakes), only 188 had complete data. On the 'entry' method (*data not shown*), the only statistically significant predictor remained the same: whether a 'home (EC)' student or not with p=0.014, exp(B)=0.232. With the backward stepwise method (and least likelihood removal testing), the model ultimately contained only whether home (EC) and age at entry to

predict the odds of having ever-failed (and passed the retake). Of these two variables, whether home (EC) was very statistically significant (at the 1% level). Their exp(B)s indicated the effects of home (EC) status and an increase of 1 year on entry age, respectively. These would be associated with, respectively:

- [for home] a decreased odds (i.e. multiplying by 0.197)...
- and possibly [for age] a decreased odds (0.872) *[similar direction, reasonably similar magnitude, compared with S3 model, but still not statistically significant]*

The model was statistically significantly reliable (Omnibus test; Hosmer and Lemeshow test). The model **(Table 41c)** accounted for even less variance in 'fail' status (5.6%-9.1%; Cox & Snell R^2, Nagelkerke R^2, respectively) than the S3 model, with 98.7% of students 'not-failing' being predicted successfully. Nevertheless, a mere 5.7% of students 'failing' were predicted, giving an overall prediction success of 81.4% (i.e. not improved on 'Block 0' default prediction of 81.4%). Overall, using S6 variables did not apparently improve on the S3 model. The casewise list showed four outliers ('studentized residuals' >2.000). There was, however, no obvious reason to delete these (the same female graduate; two other graduates, one male, one female; and another male who retook A-levels; all home (EC) and all failing something). Indicators such as tolerance showed no obvious multicollinearity.

Satisfaction data (Tables 42a-b)

Multiple regression analysis on satisfaction with curriculum

For the 1999 and 2001 cohorts, multiple linear regression models, in which the **criterion variable** comprised 'satisfaction' with the Liverpool problem-based curriculum, were consistent despite only small effects. Of the 10 and 11 **predictor variables** used, respectively (three learning approach subscales, the two most stable perceived good tutor components, age, sex, whether home (EC), whether intending to be a GP, and rankings of one or two of the good doctor themes), strategic learning predicted satisfaction in all models presented here:

- **In the 1999 cohort:** There were 153 S5 responders with complete data on predictor variables. On the 'entry' method (entering all/removing no variables; *data not shown*), the only statistically significant predictor was strategic learning (p=0.000, $3.27x10^{-5}$, B=0.104), although surface learning approached statistical significance (p=0.088, B= -0.044). With the forward stepwise method, the model ultimately contained strategic learning (very highly statistically significant; 0.1% level) and the good tutor component, 'tells me what to learn' (highly statistically significant; 1% level) to predict being satisfied with still doing Medicine in this problem-based curriculum **(Table 42a)**. Effects were, however, minimal. An increase of 1 unit on:

- strategic learning score would be associated with an increased satisfaction score, albeit by only 0.115 units (B=0.115).
- perceiving a good PBL tutor's role as 'tells me what to learn' would be associated with a decreased satisfaction score by 0.254 units (B= -0.254).

Nevertheless, strategic learning had about twice the influence of 'tells me what to learn' (i.e. standardized beta coefficients: 0.4 versus –0.2 standard deviations). The model excluded surface learning at p=0.083 and B= -0.143). The model was very highly statistically significant at the 0.1% level (ANOVA test; $F_{2,150}$ ratio: average improvement in prediction/average inaccuracy in the model =19.805), and accounted for 19.8% of the variance in 'satisfaction' (adjusted R^2). The assumption of independent residuals, i.e. no autocorrelation, held (as Durbin-Watson statistic of 1.916, on a scale of 0-4, was sufficiently close to 2). The residuals were approximately Normally distributed on histogram and Normal probability plot (not shown). The casewise list showed no outliers. There were no high values in the correlation matrix, and indicators such as tolerance (average=0.998) also showed no obvious multicollinearity.

In the 2001 cohort, using S3 and S6 versions of the predictors: There were 147 S3 responders, who also responded to S6 (providing predictors not included in S3 questionnaire), with complete data on predictor variables. On the 'entry' method (*data not shown*), the only statistically significant predictors were strategic learning (p=0.021, B=0.054), perceiving the good doctor theme 'efficient, organized self-manager' as less important (low ranking) (p=0.031, B= -0.091), and surface learning (p=0.35, B= -0.047). Perceiving the 'exemplary, responsible professional' as less important (low ranking) approached statistical significance (p=0.088, B=0.060). With the forward stepwise method, the model ultimately contained those four predictors for end-of-Year 1 satisfaction with still doing Medicine in this problem-based curriculum **(Table 42b)**. Effects were, however, minimal (but all statistically significant; 5% level). An increase of 1 unit on:

- strategic learning score would be associated with an increased satisfaction score, albeit by a mere 0.046 units (B=0.046).
- perceiving the good doctor theme 'efficient, organized self-manager' as less important would be associated with a decreased satisfaction score, albeit again by a very small amount, i.e. 0.093 units (B= -0.093). **[The 'good doctor' units may appear non-intuitive compared with direction of B, as lowest ranking/least important = high number, i.e. 9.]**
- surface learning score would be associated with decreased satisfaction score, albeit again by a very small amount, i.e. 0.045 units (B= -0.045).
- perceiving the good doctor theme 'exemplary, responsible professional' as less important would be associated with increased satisfaction score, albeit again by very little, i.e. 0.070 units (B=0.070).

All four predictors influenced the model similarly (standardized beta coefficients: average +/-0.2 standard deviations). The model was very highly statistically significant at the 0.1% level (ANOVA test; $F_{4,142}$ ratio: average improvement in prediction/average inaccuracy in the model=6.383), and accounted for 12.9% of the variance in 'satisfaction' (adjusted R^2). The assumption of independent residuals, i.e. no autocorrelation, held (as Durbin-Watson statistic of 2.143, on a scale of 0-4, was sufficiently close to 2). The residuals were approximately Normally distributed on histogram and Normal probability plot (not shown). The casewise list showed no outliers. There were no high values in the correlation matrix, and indicators such as tolerance (average=0.907) also showed no obvious multicollinearity.

- **In the 2001 cohort, using only the S6 versions of the predictors:** There were 182 S6 responders with complete data on predictor variables. On the 'entry' method (*data not shown*), the only statistically significant predictors were the same four that were prominent at the start of Year 1: surface learning (p=0.001, B= -0.064), strategic learning (p=0.001, B=0.077), low ranking in the good doctor theme 'efficient, organized self-manager' (p=0.008, B= -0.097), and low ranking in 'exemplary, responsible professional' approaching

Table 42a: Predicting 'satisfaction' for medical students responding to Year 3 questionnaire survey mid-2001/02 (Study-element 5) who had complete data on all predictor variables (n=153); stepwise (forward) multiple regression*

Would still do Medicine... in a problem-based curriculum... in Liverpool (mid-Year 3) Predictors retained	B	standard error	standardized B	t	p value	95% confidence interval for B
strategic learning (mid-Y3)	0.115	0.021	0.400	5.507	**0 (1.54X10^{-7})**	0.074, 0.157
good tutor component 1 [tells me what to learn] (mid-Y3)	-0.254	0.090	-0.205	-2.820	**0.005**	-0.431, -0.076
Constant	1.255	0.470		2.672	0.008	0.327, 2.183

*Variables used: deep, strategic, & surface learning *Short RASI* (mid-Y3); good tutor components 1 [tells me what to learn] & 2 [helps me with how to learn] (mid-Y3); age at entry; whether male; whether 'home'/European Community (EU) or not; ranking of good doctor theme 'listening, informative communicator' (mid-Y3); whether GP career intention (versus other answers) (mid-Y3)

Analysis of variance (ANOVA)	*sum of squares*	*degrees of freedom (df)*	*mean square*	*F*	*p value (significance of model)*
Regression	*48.616*	*2*	*24.308*	*19.805*	*0 (2.33X10^{-8})*
Residual	*184.103*	*150*	*1.227*		
Total	*232.719*	*152*			

R	*R^2*	*adjusted R^2*	*standard error of estimate*	*Change statistics: R^2 change*	*F change*	*df 1*	*df 2*	*significance of F change*	*Durbin-Watson*
0.457	*0.209*	*0.198*	*1.108*	*0.042*	*7.954*	*1*	*150*	*0.005*	*1.916*

Liverpool MBChB curriculum, 1999 entry-cohort of medical students, mid-Year 3 satisfaction versus mid-Year 3 predictors, Study (S)5
Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Table 42b: Predicting 'satisfaction' for medical students responding to start-of-Year 1 questionnaire survey 2001/02 (Study-element 3) who had complete data on all predictor variables (n=147); stepwise (forward) multiple regression*

Would still do Medicine... in a problem-based curriculum... in Liverpool (end-Year 1) Predictors retained	B	standard error	standardized B	t	p value	95% confidence interval for B
strategic learning (start-of-Y1)	0.046	0.022	0.173	2.044	**0.043**	0.002, 0.090
good doctor as 'efficient, organized self-manager' (end-of-Y1) *low ranking*	-0.093	0.041	-0.180	-2.270	**0.025**	-0.174, -0.012
surface learning (start-of-Y1)	-0.045	0.020	-0.189	-2.269	**0.025**	-0.085, -0.006
good doctor as 'exemplary, responsible professional' (end-of-Y1) *low ranking*	0.070	0.033	0.164	2.107	**0.037**	0.004, 0.135
Constant	4.046	0.816		4.960	0 (1.99X10^{-6})	2.433, 5.659

*Variables used: deep, strategic, & surface learning (Short RASI) (start-of-Y1); good tutor components 1 [tells me what to learn] & 2 (start-of-Y1) [helps me with how to learn] (start-of-Y1); age at entry; whether male; whether 'home'/EU or not; ranking of good doctor theme 'exemplary, responsible professional' and 'efficient, organized self-manager' (end-of-Y1); whether GP career intention (versus other answers) (start-of-Y1)

Analysis of variance (ANOVA)	*sum of squares*	*degrees of freedom (df)*	*mean square*	*F*	*p value (significance of model)*
Regression	*25.235*	*4*	*6.309*	*6.383*	*0 (9.43X10^{-5})*
Residual	*140.357*	*142*	*.988*		
Total	*165.592*	*146*			

R	*R^2*	*adjusted R^2*	*standard error of estimate*	*Change statistics: R^2 change*	*F change*	*df 1*	*df 2*	*significance of F change*	*Durbin-Watson*
0.390	*0.152*	*0.129*	*0.994*	*0.026*	*4.439*	*1*	*142*	*0.037*	*2.143*

Liverpool MBChB curriculum, 2001 entry-cohort of medical students, end-of-Year 1 satisfaction versus start(/end-of-Year 1) predictors, Study (S)3(& S6)
Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

statistical significance (p=0.077, B=0.016) *plus* the good tutor component, 'tells me what to learn' (p=0.009, B= -0.205). With the forward stepwise method, the model ultimately contained the same five predictors plus for the good tutor component, 'tells me what to learn', to predict satisfaction with still doing Medicine in this problem-based curriculum by the end of Year 1 **(Table 42c)**. Effects were, however, minimal (but all statistically significant; first two at the 0.1% level, the others at the 1% level). An increase of 1 unit on:

- surface learning score would be associated with a tiny decrease in satisfaction, i.e. 0.060 units (B= -0.060).
- strategic learning score would be associated with a tiny increase in satisfaction, i.e. 0.065 units (B=0.065).
- perceiving the good doctor theme 'efficient, organized self-manager' as unimportant would be associated with a tiny decrease in satisfaction, i.e. 0.098 units (B= -0.098).
- perceiving the good doctor theme 'exemplary, responsible professional' as unimportant would be associated with a tiny increase in satisfaction, i.e. 0.071 units (B=0.071).
- perceiving a good PBL tutor's role as 'tells me what to learn', would be associated with a tiny decrease in satisfaction, i.e. 0.203 units (B= -0.203).

All predictors had a similar influence (standardized beta coefficients: average +/-0.2 standard deviations). The model was very highly statistically significant at the 0.1% level (ANOVA test; $F_{5,176}$ ratio: average improvement in prediction/average inaccuracy in the model=10.896). The model accounted for 21.5% of the variance in 'satisfaction' (adjusted R^2), i.e. about 1.5 times that when using S3 predictors (learning approaches, good tutor components, etc.). The assumption of independent residuals, i.e. no autocorrelation, held (as Durbin-Watson statistic of 2.142, on a scale of 0-4, was sufficiently close to 2). The residuals were approximately Normally distributed on histogram and Normal probability plot (not shown). The casewise list showed no outliers. Indicators such as tolerance (average=0.961) showed no obvious multicollinearity.

There was no association between satisfaction and assessment outcome on logistic regression in either cohort (*data not shown*).

Table 42c: Predicting 'satisfaction' for medical students responding to end-of-Year 1 questionnaire survey 2001/02 (Study-element 6) who had complete data on all predictor variables (n=182); stepwise (forward) multiple regression*

Would still do Medicine... in a problem-based curriculum... in Liverpool (end-Year 1) Predictors retained	B	standard error	standardized B	t	p value	95% confidence interval for B
surface learning (end-of-Y1)	-0.060	0.019	-0.222	-3.231	**0.001**	-0.097, -0.023
strategic learning (end-of-Y1)	0.065	0.020	0.218	3.279	**0.001**	0.026, 0.105
good doctor as 'efficient, organized self-manager' (end-of-Y1) *low ranking*	-0.098	0.035	-0.186	-2.811	**0.005**	-0.167, -0.029
good tutor component 2 [tells me what to learn] (end-of-Y1)	-0.203	0.076	-0.184	-2.673	**0.008**	-0.352, -0.053
good doctor as 'exemplary, responsible 'professional' (end-of-Y1) *low ranking*	0.071	0.030	0.158	2.399	**0.018**	0.013, 0.130
Constant	3.784	0.649		5.831	0 ($2.59X10^{-8}$)	2.503, 5.065

*Variables used: deep, strategic, & surface learning (*Short RASI*) (end-of-Y1); good tutor components 1 [helps me with how to learn] & 2 [tells me what to learn] (end-of-Y1); age at entry; whether male; whether 'home'/EU or not; ranking of good doctor theme 'exemplary, responsible professional' and 'efficient, organized self-manager' (end-of-Y1); whether GP career intention (versus other answers) (end-of-Y1)

Analysis of variance (ANOVA)	*sum of squares*	*degrees of freedom (df)*	*mean square*	*F*	*p value (significance of model)*
Regression	*52.408*	*5*	*10.482*	*10.896*	*0 ($3.80X10^{-9}$)*
Residual	*169.312*	*176*	*0.962*		
Total	*221.720*	*181*			

R	*R^2*	*adjusted R^2*	*standard error of estimate*	*Change statistics: R^2 change*	*F change*	*df 1*	*df 2*	*significance of F change*	*Durbin-Watson*
0.486	*0.236*	*0.215*	*0.981*	*0.025*	*5.753*	*1*	*176*	*0.018*	*2.142*

Liverpool MBChB curriculum. 2001 entry-cohort of medical students. end-of-Year 1 satisfaction versus end-of-Year 1 predictors. Study (S)6

Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Admissions data (Table 43)

Whether admitted

A multiple logistic regression model for the S4 interviewees to predict 'not admitted' to this curriculum, using three learning approach subscales, age, and sex) was not statistically significant:

- **In the interviewees** for medical school places: of the 973/968 S4 responders, with complete data on the predictor variables, on the 'entry' method (*data not shown*), the age at interview approached statistical significance as a predictor with p=0.058, exp(B)=0.956. With the backward stepwise method (and least likelihood removal testing), the model ultimately contained only age at interview to predict the odds of not being admitted. For this variable, exp(B)=0.958 (p=0.069), i.e. an increase of 1 year in age might be associated with a very slightly decreased odds (i.e. multiplying by 0.958) of not being admitted to the programme, i.e. of being admitted. The model **(Table 43)** was approaching statistically significant reliability (Omnibus test; Hosmer and Lemeshow test), but barely accounted for any variance in 'not admitted' status (0.3%-0.5%; Cox & Snell R^2, Nagelkerke R^2, respectively), with 75.5% of students 'not admitted' being predicted successfully. Nevertheless, none of the admitted students was predicted, i.e. overall prediction success remained at 75.5% (and therefore did not improve upon 'Block 0' default prediction). The casewise list showed no outliers. Indicators such as tolerance showed no obvious multicollinearity.
- Adding Townsend score and whether at least one parent was medical made the model even less reliable (*data not shown*). On the 'entry' method none of the predictor variables or the overall model approached statistical significance.

Table 43: Predicting <u>failure</u> of interviewees subsequently <u>to enter Liverpool MBChB</u> programme (Study-element 4) in those with complete data on all predictor variables (n=968); backward stepwise logistic regression (least likelihood removal testing)

Failed to be admitted to the programme	Predictors retained	B	standard error	Wald	degrees of freedom (df)	p value	Exp(B)	95.0% confidence interval for Exp(B)
Step 5 of 5*	**age (years) at interview**	-0.043	0.024	3.296	1	0.069	0.958	0.915, 1.003
	Constant	1.946	0.462	17.707	1	0	6.998	

*Variables entered overall: deep, strategic, & surface learning *Short RASI*; sex; age at interview

Omnibus Test of Model Coefficient	$\chi^2=3.16, p=0.076$	*df=1*
Hosmer and Lemeshow Test	$\chi^2=7.09, p=0.527$	*df=8, H_0=no difference between observed and predicted*
−2 log likelihood (initial value): 1,076.646 (1,073.980)		*Cox & Snell R^2 and Nagelkerke R^2: 0.003 and 0.005*
		tolerance range for the 5 variables (derived from entry method) [must be ≥0.0001]: 0.78-0.99

Liverpool MBChB curriculum, medical school interviewees, Study (S)4

Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Summary

Across the three cohorts, similar proportions of responders had at least one medical parent (about 15%), and S4 England & Wales 'home' responders from the more deprived postcodes were statistically significantly less likely to be in this category. Regarding responders' views of their future career:

- Except for S2, responders 'ranked' 'compassionate, patient-centred carer' 1st, 'listening, informative communicator' 2nd, and 'efficient, organized self-manager' 9th. Even the proxy-ranks from S2 had 'listening…' 1st, 'compassionate…' 2nd, and 'efficient…' 8th. Overall, for 'efficient, organized self-manager', however, S4 England & Wales 'home' responders from the more deprived versus more affluent postcodes valued it more (albeit only slightly, r_s= -0.108, very highly statistically significant). Evidence was much less convincing of their possibly valuing 'well-balanced, insightful 'individual' less'.
- 'Hospital doctor (consultant)' was the commonest career intention in all but the 2001 cohort end-of-Year 1 responders. Only 17.7% (interviewees, 2001/02) down to 9.5% (end-of-Year 1, 1999 cohort) of responders reported 'GP'. Tracked in the 1999 and 2001 cohorts, most career intentions did not change (or did not become GP). 'Related data' showed a small (non-significant) increase in reporting a career intention (versus 'do not now') over time in the 1999 Cohort (but not the 2001 cohort). For S4, there were no statistically significant differences between interviewees who were admitted (versus the rest) in whether they reported 'do not know' (or a career intention), and similarly whether they reported intending to be a GP or otherwise. Those in S4 from the most deprived versus most affluent postcodes were very statistically significantly more likely to report a career intention, despite not favouring any specific category.

Regarding summative assessment outcomes in the 1999 and 2001 cohorts:

- Most students continuing in-cohort passed (under examination conditions), and their performance was associated with their learning approach.
- For the 1999 cohort, at each assessment level (1, 2, 3) and for the post-Level 3 cumulative outcome, despite few statistically significant differences, there was

a general pattern. This had higher mean (mid-Year 3) deep and strategic learning scores and lower surface learning scores in those who passed all elements first time (62.1% cumulatively). Whether male or whether a White 'home' student did not affect this significantly. In the 2001 cohort, learning approaches at the start of Year 1 were similarly related to Level 1 (end-of-Year 1) assessment outcome but (except for surface learning) not if measured close to those assessments.

In the 1999 and 2001 cohorts, regarding multiple logistic regression to predict 'ever-failing' an assessment (yet passing to progress with the cohort):

- Using eight variables (three learning approach subscales, two perceived good tutor components, age, sex, and whether home (EC)), both cohorts gave statistically significant models that were consistent.
- **In the 1999 cohort:** Only mid-Year 3 deep learning was predictive. An increase of 1 unit was associated with a slightly decreased odds (ExpB=0.902) of failing then passing at least one assessment by the end of Year 4. This model explained only minimal variance in 'fail' status, and its prediction success only slightly bettered the default.
- **In the 2001 cohort** using S3 predictors, only surface learning (positively; ExpB=1.107), whether home (EC) (negatively; ExpB=0.303), and, possibly, age at entry (negatively; ExpB=0.862) predicted the odds of failing (and passing retake) at least one end-of-Year 1 assessment. The model explained only minimal variance (8.7%-13.4%), but twice as much as for the other cohort but its prediction success only marginally bettered the default. Using S6 predictors instead, only whether home (EC) (negatively) and, possibly, age at entry (negatively), predicted the odds of having failed. This model explained less variance than with the S3 predictors, and its slightly higher prediction success did not improve on the default.

In the 1999 and 2001 cohorts, using multiple linear regression to predict satisfaction (still would do Medicine in this problem-based curriculum):

- With the eight variables above, plus whether set to be a GP, and how they ranked one or two good doctor themes, all the statistically significant models contained strategic learning, but effects were minimal.

- **In the 1999 cohort:** Strategic learning (positively, B= +0.115) and the good tutor component, 'tells me what to learn' (B= -0.254) were predictive, and explained 19.8% of the variance in 'satisfaction' status.
- **In the 2001 cohort, using S3 and S6 versions of predictors or using just S6 predictors:** Both statistically significant models contained only strategic learning (positively), undervaluing the good doctor theme 'efficient, organized self-manager' (negatively), surface learning (negatively), and undervaluing 'exemplary, responsible professional' (positively), plus, if only S6 predictors were used, the good tutor component, 'tells me what to learn' (negatively). All effects were small, and the models explained little variance (12.9% and 21.5%, respectively) in satisfaction.

In the S4 interviewee cohort, a logistic regression model of the three learning approach subscales, age, and sex did not predict non-admission to this curriculum, and became even less reliable if Townsend score and whether at least one parent was medical were added.

Chapter 6: Discussion

In **relation** to its research questions **(p17)**, this work found that:

- *Medical students in a problem-based curriculum perceived their learning and tutors* in interrelated ways. They generally appreciated the potential of PBL, valued tutors knowing when and how to intervene without dominating, but found over- or under-contribution in PBL sessions (from themselves, other students, or tutors) and other aspects of PBL implementation frustrating.
- *Their learning approaches, expectations, and experiences related to their curriculum stage, assessment performance, career ideas, and appreciation of a population health perspective* in various ways. They gave practical uses for *Population Perspective* learning, with surface learning being statistically significantly higher in those commenting negatively. All three cohorts ranked compassion and communication highest of nine themes characterizing the good doctor. Responders' career intentions, perceptions of good tutors and good doctors, and learning approaches were interrelated. Despite a community-orientated curriculum, only 9.5%-17.7% responders across the study-elements intended to be GPs. Students who passed without retakes: and who were still 'in-cohort 1999' (or still 'in-cohort 2001') after Y1 examinations scored significantly lower on surface learning; or who were still 'in-cohort 1999' after Y4 examinations scored significantly higher on deep learning. Curriculum satisfaction related significantly to learning approaches and good doctor ideas. The learning approaches of students admitted were similar to other interviewees, but were less informative when measured at that point compared with *medical students'* responses in the other cohorts.

This chapter reviews the work critically, namely the:

- literature search strategies underpinning the conceptual groundwork
- strengths and weaknesses of methods, related to: research questions, search strategies, research approach and overall design, questionnaire design and administration, and qualitative and quantitative analyses and their mixing
- synthesis of findings **(p326)** (recapping briefly on what was already known) about a: *good learning history; good doctor; good career; good learning and good tutoring in a problem-based curriculum; good curriculum; good assessment outcome;* what this work thus adds; further work indicated; and final reflections

[NB The caveats on the methods precede the synthesis of findings to set the interpretive context.]

It is timely to recall that educational research is variously viewed – very important; a noble pursuit; a very difficult challenge; even a waste of effort if built on untenable theories – and expectations of it must be realistic:

- *"...High-stakes educational decisions regarding admission, promotion and accreditation may not be as life-threatening as life-and-death clinical decisions, but some of the consequences of these decisions certainly are irreversible and can affect individuals' careers, quality (if not quantity) of life, job performance and productivity."* **(Wolf, 2000)**[473p251]
- *"Perhaps the highest level of professionalism in being a teacher is to contribute to the accumulation of evidence, to 'problematize' one's own educational situation, to start investigating and to engage in educational research"* **(van der Vleuten *et al*, 2000)**[468p249]
- *"It is very difficult to undertake meaningful research in education. The variables are too diffuse and difficult to identify. Very often they are not easy to measure. Other factors often contaminate the relationship between an educational event and its eventual outcome. Sometimes, particular outcomes are not easy to specify, nor are the timescales in which we might expect to see an effect or to see an effect last."* **(Harden *et al*, 1999)**[434p559]
- *"Cognitive science is often said to be the basic science of medical education, and cognitive theory is routinely cited as a justification for educational practice. ...a critical look at the theory [underpinning PBL] shows it is mostly metaphor, not rigorous, tested, confirmed scientific theory."* **(Colliver, 2002)**[248p1,217,p1,220]
- [In a critique of Colliver's review (above)[248]] "*Does this mean... that all efforts at educational research are fruitless? Not at all. But we must take a cue from the natural sciences and move away from blind allegiance to the canons of sound methodology (randomization and all that) to recognition and support for research programmes, whose intent is to create an environment where ideas are shepherded from the basic science laboratory to the application setting."* **(Norman & Schmidt, 2000)**[223p726]

The caveats discussed for this work are unsurprising for medical education research. As discussed earlier **(p113)**, medical education research is self-conscious about its allegedly impure study designs and probably unrealistic questions and expectations.

The RCT is problematic, but has its place. Norman and Schmidt were clear that there is no such thing as a blinded intervention, a pure outcome, or a uniform intervention in education; and that *"trials of curriculum level interventions... are... a waste of time and resources"*[223p725] (disputed by Colliver[239]). It is very unlikely that educational epidemiology or qualitative approaches are panaceas, despite exhortations otherwise:

- *"Longer-term outcomes, which would require collection of additional data and consideration of graduate medical education and continuing medical education events, might include patient satisfaction, quality of care, likelihood of being sued for medical malpractice, and experiences with medical errors...*
  ...Rigorous application of epidemiologic analysis across educational institutions should inform the choices about what could be deleted from the formal medical curriculum without compromising graduating students' clinical competence." **(Carney *et al*, 2004)**[480p1,045,p1,049]
- *"Against the grain of current trends, I would like to see the current hierarchy reversed and priority given to qualitative, interpretative research. On both ethical and epistemological grounds, the goals and assumptions of quantitative, positivist research need to be re-examined."* **(Buchanan, 1992)**[457p134]

This work was underpinned by notions of pragmatism, the great potential of mixed methods research, and the value of using robust questionnaire surveys as the vehicle for 'mixing'. To set the findings in context, first the methods will be reviewed.

Review of methods

Research questions

The research questions were not phrased exclusively for either a quantitative or qualitative approach:

- *How do medical students in a problem-based curriculum perceive their learning and tutors? How do their learning approaches and allied learning expectations and experiences relate to their stage in the curriculum, performance in assessments, vocational perspective, and appreciation of a population health perspective?* **(p18)**

Their relatively wide scope allowed iterative development of successive study-elements, but risked unproductive meandering through poor quality literature and data generation that was irrelevant beyond the local setting. Various presentations of the preliminary data at national/international research conferences[viii,ix,x,xi,xii,xiii,xiv,xv,xvii] reduced such risks. They prevented complacency, helped emphasize new issues while decreasing the emphasis on others, and helped consolidate the wording of the research questions. While the population health perspective element of the research questions was only a small part of the research, this was a distinct perspective from other elements and deserved articulation in the final formulation. The balance of work was much more towards the general aspects of learning and tutoring.

The complete research questions developed from preliminary versions, and were flexible from the outset unlike in some purely quantitative approaches to research. The experience of the more exploratory earlier study-elements helped to refine the phrasing. The notion of 'satisfaction' as an integral part of 'expectations and experiences' only emerged, for example, a few weeks before the S5 questionnaire was finalized. This seemed timely when a 'little local difficulty' had one clinical site claiming that the Year 3 students agreed with detractors amongst their clinical tutors that PBL 'did not work' and the year was unhappy as a whole. This illustrated how the study-elements could not ignore local faculty politics, prominent detractors, and unrepresentative but loud student voices, etc. along the way.

Literature search strategy

The search strategy was explicit and comprehensive, covered many years, and focused mainly on four electronic bibliographic databases (Web of Science, Ovid-Medline, PsychINFO, and ERIC). These four reflected those available for medical education research, i.e. from science/social science, medicine, psychology, and education, in the absence of similarly dedicated databases for medical education.

The primary focus on Web of Science was, however, questionable because it works by free-text literature searching, rather than by relatively robust standard thesauri. Indeed, Haigh and Dozier classified Web of Science under 'Other methods of searching' with handsearching, ancestry searching (i.e. from reference-lists of articles), experts, and grey literature[5]. They highlighted its strengths to be in its wide interdisciplinary coverage for researching across professions (used here for crossing various compartments in the literature, looking beyond tightly defined questions) and 'cited reference' searching (used here to track occasional misplaced or extra references). Using the other thesauri-driven databases as an electronic safety net, however, should have compensated partly for Web of Science's inadequacies[5]. Furthermore, medical education literature is generally poorly indexed anyway[459]. Web of Science has the advantage of having integrated links with Reference Manager software, making reference handling much easier (e.g. avoiding 'filters' that import incomplete details requiring 'repair' of the imported references), and also identifies grey (non-commercial) literature from conference proceedings and dissertations. It also has a reasonably intuitive user interface.

Using multiple databases was essential due to such patchy coverage of journals, partial indexing of journal content, and unhelpful subject headings. Each of the main four databases had slightly different coverage, e.g. PsychINFO was the only one indexing Teaching and Learning in Medicine. Embase, the second largest medical database to Medline, was unavailable on the University Library platform, yet this would have focused more on European than North American journals. Of the other 'core databases' listed by Haigh and Dozier[5], Medline, PsychINFO, and ERIC were used heavily, and CINAHL was not that productive. BEI access was terminated when the University Library subscription lapsed, preventing rerunning and extending that specific search (despite there being free WWW access to a limited version of the BEI, as this was inadequate). Neither of the main keyword databases (Research and Development Resource Base (RDRB) – Toronto; Topics in Medical Education (TIME) - Dundee)[5] was used, but three of Haigh and Dozier's six supplementary suggestions were, i.e. AMED, BNI, and Sociofile, yet these added little.

While the approach was systematic and relatively complete, it was also quite 'organic'. The results were not 'quantified' (as the research questions would have had to have been much narrower for this to have been meaningful), but the sensitivity and specificity may well have been modest. Numerous references were found by ancestry searching of the foundation sets of retrieved articles. Many references were obtained as 'interlibrary loans' as the journals were not part of The University of Liverpool Library's extensive paper or electronic holdings.

Grey literature searching did not extend beyond Web of Science and ERIC. Handsearching was mostly ad hoc (except for 2004/05 Medical Education and Medical Teacher), as the ancestry searching generated so many possible leads from authors' citations. The WWW provided vital details when references from ancestry searches were inaccurate and untraceable by bibliographic databases, and also for retrieving detail about institutions/curricula omitted from articles.

Even restricting the searches, to the parameters discussed, involved considerable time running and refining searches, managing references, obtaining articles personally and via interlibrary loans, and tracking down bogus leads from misleading citations. More time to widen the search terms was not justifiable, and restricting to English Language was pragmatic. Both main sets of search questions were well explored, even though quite ambitious, by the literature obtained:

- *What is known about medical students' conceptions, in problem-based curricula, of their learning, knowledge, and career (and how these relate to examination outcomes and learning about population health)?*
- *What is mixed methods research, and how does it relate to medical education research?*

Although preliminary searches informed the study-elements, the bulk of the searching post-dated data collection and analysis so that the qualitative data thematic analyses were not unduly influenced by current topics and preoccupations in the literature.

Research approach, overall study design, and sampling

Research approach and overall study design

The pragmatism paradigm encapsulated the research approach taken. The 'mixed methods with a quantitative predominance' used mixing at the level of the questionnaire and the analysis. The intent was mostly exploratory, but statistical significance testing was used to test likely (implicit) hypotheses. Notwithstanding likely criticisms of these labels as applied to design and approach, mixed methods contradict the idea of purism and make a virtue of versatility:

- *"Researchers who purport to subscribe to the philosophical underpinnings of only one research approach have lost sight of the fact that research methodologies are merely tools, instruments to be used to facilitate understanding. Smart researchers are versatile and have a balanced and extensive repertoire of methods at their disposal."* **(Morse, 1991)**[444p122]

Qualitative purists may well claim that the data collection in this work amounts to little more than adding in a few structured open questions to a quantitatively-orientated questionnaire. Indeed, the concept of a questionnaire does not even make it into the index of major texts about qualitative research, e.g. Miles and Huberman's sourcebook[499] and others[442,497,498].

Miles and Huberman summarized qualitative data analysis as an iterative process involving three concurrent activities: data reduction, data display, and conclusion drawing/verification, and that it focused on words based on observations, interviews, or documents (referring to Wolcott's *"watching, asking, and... reviewing [i.e.] experiencing... enquiring... examining"*[447p19])[499]. The implicit assumption was that 'asking' equated with the researcher as the instrument – the interview[500]. With this Researcher as an educator in various official roles with some or all the participants (PBL tutor, personal tutor, examiner, etc.), interviewing in person would have brought its own problems of power relations, let alone competing demands on students' time, and logistics. The decision was to try to get the most out of the paper version of 'asking', where responders could maintain some distance, yet engage at their leisure and not to use too much of their time.

The 'mixed methods' research spectrum conveniently accommodates broader interpretation of the 'rules' from either side of the quantitative-qualitative divide. Quantitative purists might well see questionnaire research as a 'soft option', and be unimpressed with the qualitative elements of the approach. In debunking the two positions, Onwuegbuzie explained that purists either side of the divide hold self-defeating assumptions[435]:

- Of qualitative purist's assumptions: 'All truth is relative' would be true only in the relative sense, and 'There are multiple realities' must mean that the quantitative paradigm is true in its own terms and is as good as any other version of reality.
- Of quantitative purist's assumptions: 'The verifiability principle' is neither empirical nor logical.

What technically defines quantitative versus qualitative research is disputed anyway. Punch, an educationalist, noted that it is *"not inevitable, or essential, that we organize our empirical data as numbers"*[436p58]. Indeed not, yet research approaches are usually classified broadly according to whether the data collected comprise numbers or text. It is noteworthy, therefore, that Newman highlighted the main distinction between the qualitative and quantitative approaches as being intent rather than data:

- *"...if your questions are to test differences, to generalize (to infer from the sample to a population), or to test theory, you are more likely to be doing quantitative research. ...If the intent is to describe, to uncover deep meaning, to explain, or to build theory, you are more likely to be interested in conducting qualitative research"* **(Newman, 2000)**[448p3-4]
- *"There is a frequently held misconception that quantitative research uses numbers and qualitative research is narrative. This is a misleading simplification. ...it is not the technique that makes something quantitative or qualitative, but it is the intent of its uses. Is it testing hypotheses or is it helping to develop hypotheses or describe the data"* **(Newman, 2000)**[448p4-5]
  - *theory→hypothesis→data collection→theory confirmation/revision*... or...
  - *data collection→hypothesis→theory development*

This work involved analysing substantial quantities of both numbers and words, and both testing differences and uncovering meaning. Other, 'epidemiological' descriptions of the study design included 'observational with analytical' elements, and mainly combining 'cross-sectional and longitudinal' design. It is unlikely that qualitative research purists would favour such descriptions. This Researcher's sympathy with mixed methods research and the pragmatism paradigm focused, however, on being systematic, explicit, and inductive for the qualitative elements, and heeding authors who did not reify their techniques within shrouds of mystique.

Sampling

The decision to include the whole of each cohort was ambitious and contestable. It led to responders being encouraged to give only brief answers to open questions. This restricted the scope of their responses mostly to the spaces provided (although those wanting to say more filled space elsewhere) and, sometimes, to specified numbers of points. Inevitably there was a mosaic effect to the pictures provided and such small glimpses, from so many perspectives, provided comprehensive clues to breadth of perceptions. This work, however, is less convincing as an example of 'in-depth' exploration. Nevertheless, the volume of qualitative data generated by the five medical student study-elements was considerable. The responses appeared quite honest and had a certain face validity, and the 'big picture' derived from them became clear standing back from the mosaics and squinting.

The sample sizes were more appropriate to the closed questions and quantitative approach. No sample size calculations were performed as the whole-cohort approach was used and no *one* question was crucial. While any of the cohorts were a sample of all cohorts over time, it made more sense practically and theoretically to keep to whole cohorts rather than sample repeatedly over different year-groups. For pure qualitative research, purposive sampling could have been used had the samples been much smaller, but other decisions rendered this less pertinent. Choosing Year 1 students provided a baseline from the start of Year 1 and, by revisiting them at the end of Year 1, there was then sufficient medical school experience for students to be taking their first of three sets of summative assessments (under examination conditions). The mid-Year 3 follow-up coincided with students having taken the second set of these summative assessments.

Questionnaire design and administration

The 'sins' of the questionnaire

The 'survey' is a much maligned data collection method, some of which is deserved in terms of many examples of sloppy aims, design, and analysis involving questionnaires:

- *Survey literature abounds with portentous conclusions based on faulty inferences from insufficient evidence misguidedly collected and wrongly assembled.* **(Oppenheim, 1992)**[456p7]

Well-designed questionnaire surveys are a challenge[501]. Indeed, the danger was in overstructuring the questionnaires to defend against such potential criticisms as summarized by Dauphinee in his scathing comment about *"the waste of time and effort that goes into some of the 'n of one school' or 'one-course questionnaire-type' surveys"*[461pS128]. He also agreed with a respected researcher's view that *"too many people encourage and tolerate 'hobby-style' medical educational research. And we are all the more diminished by that*[461pS128].

The 'survey', as conceptualized by Oppenheim from a social psychology perspective, comprises two categories, both of which this study encompassed[456]:

- descriptive, enumerative, census-type (describing commonness of particular factors and their associations with each other, asking 'how many' or 'how often' questions); and

- analytic, relational type (seeking explanations about causal relationships, asking 'why' and 'what goes with what' questions in order to predict).

In this work, there were other caveats about the questionnaires worth mentioning beyond their length and potential fragmentation:

- Piloting approach:
  - The minimalistic approach to piloting was a potentially high-risk strategy, but some of the items were not new, e.g. Entwistle's 18-item short RASI for learning approaches (Q1-18), the good PBL tutor open question, and any of the questions re-used in later study-elements. As it was, none of the items proved problematic, and all were analysed and presented.
- Breadth of coverage of questionnaire in each study-element:
  - While maximizing the number of items/questions risked confusing and demotivating responders, overcomplicating the analyses, and detracting from key lines of enquiry, this strategy worked in practice.
- Using the 18-item Entwistle inventory:
  - No relevant reports using the 18-item short 'RASI' were found in the literature, so no direct comparisons could be made with the evidence-base.
  - Nevertheless, Entwistle did provide it as a validated tool, and other Entwistle versions of the ASI have appeared frequently in the literature[502]. They are based on traditional test theory and measure a set of individual traits unlike, for example, the Kolb LSI. Stiernborg and Bandaranayake considered this to explain observed difficulties in how researchers try interpreting the Kolb LSI (e.g. Leiden *et al* 1990[358])[175].
- Questionnaire structure and the scope of open-ended questions:
  - Potential problems from overstructuring questionnaires and limiting the scope of open-ended questions risked obtaining decontextualized snapshots and trivial answers. In this work, there was a need to strike the right balance between questionnaire length and ease of answering, yet still generate rich data as context for the quantitative evidence produced.

  - The constrained approach of seeking, for example, 'two things only' or 'three things only' meant that analysis then had to take account of this, by not just quantifying number of concepts per number of responders, but also per total mentions. This is because the responder is indicating that (s)he sees these two/three things as separate and important, so if more than one ends up classified under the same overall theme this important emphasis would otherwise be lost.
- Stage of development of the 'good tutor items':
  - Reasonable progress was made in developing the 'good tutor items' to a good preliminary level, but further refinement would take several more rounds and considerable resources, including much more time beyond the remit of this work.

Administration of questionnaires

In much of the medical education research literature, questionnaire surveys involve in-class administration during lectures or other fixed sessions and little acknowledgement of the potential effect of the mode of administration. Some strengths in this work had downsides. The unique identifier, for example, allowed linking between study-elements and with assessment data. The emphasis on informed participation of responders in the research complied with expected ethical standards (i.e. clear messages about its not being compulsory to participate, and whether or not students responded was immaterial to their progress). Such features no doubt lost potential responders who chose to exercise their right not to respond, but added to the probity, credibility, and utility of the study.

This work was conducted within the permission frameworks of educational research in this Faculty at the time, which protected students' interests, e.g. preventing inappropriate or excessive research. The students received sufficient information about the nature and implications of their involvement, and were able to decide in their own time and place, without any implicit pressure from the official surroundings of the lecture-theatre, etc. or from staff present. The cautious approach to requesting students' participation hopefully countered any tendency to decline participation, or change their answers, according to the Researcher's status – most students may well not even have been aware of the various roles of the latter. Other students might have viewed *any* member of staff surveying them as having suspicious motives.

Of various recommended strategies to improve postal questionnaire response rates, the ones used here to good effect were[456]:

- *The first envelope:* was personally and professionally labelled, i.e. written to the students by name, and marked as confidential.
- *Advance warning* (...at least synchronous warning... via the year-group e-mail lists, as appropriate) was given.
- *Confidentiality* was assured in the integrated covering-letter and footer of questionnaire.
- *Semi-anonymity* was attempted via a unique identifying number, and omitting student names from the questionnaire/covering-letters.
- *Reminders* were used (facilitated by having a unique identifier to track replies), i.e. two reminder rounds, with comprehensive attempts to ensure that the students actually did receive their envelope, often by tracking alternative addresses.
- *The questionnaire:*
  - *appearance* was 'conservative', well presented, and professional
  - *content* was very specific to the students
  - *was short and relatively simple* to complete.
- *The external outbound and return envelopes* had commemorative/picture stamps.

For the interviewees (S4), the circumstances of questionnaire completion were not ideal (i.e. immediately before a high stakes interview), but steps were taken to reassure about confidentiality and that this was separate research unrelated to the selection process. Responders' anxiety and the potential for greater 'social desirability bias' cannot, however, be dismissed.

Analysing quantitative data

Likert perils; and comparing within and between study-elements

There were three main types of closed-question data, i.e. from: 5-point Likert scales (Entwistle items, good tutor items, satisfaction items); ranking the nine good doctor themes; and the '1-from-6' career intention. The approach to the Likert data deserves further comment.

Traditionally, attitude measurement methods (Bogardus, Thurstone, Likert, and Guttman scales) use the linear-scaling model of: uni-dimensionality or homogeneity; reliability, validity, linearity, and reproducibility[456]. Likert scales were used, consistent with the Entwistle items and cognisant of the inherent difficulties of doing so. Attitude statements (single sentences expressing *"a point of view, a belief, a preference, a judgement, an emotional feeling, a position **for or against** something"*[456p174]) should be meaningful to participants. In this work, it was therefore a strong feature that the participants or their predecessors had generated or informed the 'good tutor' statements in earlier study-elements. Design of these 38 items attempted to avoid (succeeding to varying degrees): ambiguity, double-barrelled items, jargon, value-laden terms, negative wording, and long items[503], yet tried to synthesize similar concepts and give sufficient detail for responders to be in an informed position to answer. Certain biases were also considered[503]:

- 'social desirability' or 'faking good' (unintentional or intentional, respectively): by subtle wording
- acquiescence ('yea-saying'): by having approximately equal numbers of items keyed in positive and negative directions (while trying to avoid negative wording)
- end-aversion (central tendency): by using the 5-point Likert scale with agree/disagree at the extremes rather than other scales' end-points that responders might avoid like 'always' or 'never'

Using the 5-point Likert scale with 'do not know' in the middle does mean that positive skew can be a problem where responders congregate towards one end of the scale. Then again, having a middle-point can encourage no decision to be made and not having one can force decisions inappropriately. Other biases such as, for example, 'illusory halo' (letting a global impression influence erroneously each of the composite scores)[503] would be less problematic in this work. Likert scales suffer from each responder's metric differing (not all using the same part of the scale) but, alternatives such as the Q-sort[504] were less applicable here where the decision was to survey such large numbers.

Strictly speaking, Likert scales provide ordinal data, as there is no guarantee that the 'intervals' between successive categories (1 and 2, 2 and 3, etc.) are equivalent. In this work, however, these data were mostly analysed as continuous data using parametric tests (consistent with the Entwistle dataset, which provides 'scores' on three subscales), except where categories were amalgamated in some analyses of learning approaches. This is a well recognized approach in psychological research, cognisant of the tensions between using non-parametric tests or parametric tests. Use of the latter needs acknowledgement of the assumptions made about the data. The literature features use of Pearson correlation coefficients to analyse learning approach scores (as continuous data) versus academic performance features, e.g. Stiernborg *et al* with nursing students[174]. Academic performance was not analysed as a score here, because the key outcome is 'competent or not' for that stage (i.e. categorical). Some authors feel particularly strongly against analysing Likert scales as continuous data, or at least without wearing a hair shirt of guilt[505]. Notwithstanding the previous caveats, Streiner and Norman's summary of the problem remains cogent[503]:

- *"Nevertheless, from a pragmatic viewpoint, it appears that under most circumstances, unless the distribution of scores is severely skewed, one can analyse data from rating scales as if they were interval without introducing severe bias."* **(Streiner & Norman, 1995)[503p38]**

The technique of expressing the number of points allocated over all three 30-point subscales out of a total of 90 was useful, particularly where there was potentially more reluctance to reveal surface learning tendencies, e.g. in the interviewees (S4). Others have used comparable techniques. Stiernborg and Bandaranayake, for example, reported the percentage of maximum scores on subscales of the ASI-32[175], and Mårtenson also reported percentage of total points[167].

The advantages of using Likert scales were that they tend to[456]:

- be good at placing people approximately in order for a particular attitude
- be good at giving information about the *degree* of agreement or disagreement
- allow inclusion of items not obviously related to the attitude to explore its more sophisticated connections

They also lend themselves to flexibility of analysis.

Analysing quantitative data both within and between study-elements strengthened the findings, as did other links. Indeed, in-cohort differences at two points were relevant when viewed as both unpaired and paired. The former tells you about overall differences and what to expect from whole cohorts (especially as different sets of students responded). Paired data tells you about differences for individuals:

- *"...so the actual movement or change in... preferences might be greater than the overall figures suggest. To overcome this problem we should not rely on before versus after overall distributions; we should calculate a change score for each individual. Although change measures are often unreliable and difficult to manage statistically, they will give us a better indication of the amount of change that has taken place."* **(Oppenheim, 1992)[456p32]**

Using measures that were between-participants (independent, separate) and within-participants (related, repeated), and units of analysis that were both individual and grouped gave breadth and depth to the evidence.

Using Cronbach's alpha to report the internal reliability of the Entwistle learning approach subscales (seeking alpha=0.7-0.9) is a standard approach to scale development, indicating the homogeneity of the scale[503]. While reliability is a prerequisite, it does not guarantee the validity of the scale. The test-retest reliability was not measured formally, and a suitable interval would have been debatable. The test-retest reliability of other versions of the ASI has been reasonable in published work. Clarke found the test-retest reliability of the Entwistle ASI-64, for example, to be 0.75 ('median correlation coefficient' across the four study orientations) at 1 month, and 0.73 at 3 months (but n=26 each only)[163]. Mårtenson 'test-retested' the ASI-30 (n=67) and found subscale correlation coefficients from +0.61 (reproducing) to +0.78 (achievement motivation), but 0.40 for comprehension learning[167].

There are 'regression to the mean'[506,507] perils in analysing data at only two rather than multiple time-points. This was noted, for example, by Arnold *et al* (citing Nesselroade *et al*[508]) about possible reasons for some *changes* in learning approach found in longitudinal studies with only two points[357]. Regression to the mean would, however, tend to *reduce* differences. This statistical phenomenon occurs whenever an 'extreme group' is selected on one variable, and then another variable is measured for the group and there is not perfect correlation between these variables[506,507]. If the tallest group of children were selected, the group's mean 'mid-parent height' would be shorter. Relating change in measurement to an initial value is a good example showing regression to the mean[507]. The 'very good' are likely to worsen and the 'very bad' tend to improve on retesting[503]. In this work, a difference was still found in S3-S6 comparisons of learning approaches, despite the dampening effect of regression towards the mean, and persisted when the means of *individual* differences were used.

Multiple significance testing

Many hypothesis tests were performed, but were inevitable given the amount of quantitative data. They tested *specific* questions related to the overall research questions. Formal correction procedures were not applied but, even if p values were not much less than 0.05, often the result would be confirmed in another study-element or at least the general patterns were in similar directions. Qualitative purists would criticize mixing inductively generated themes with hypothesis-testing, but the case for using a 'mixed methods' approach has already been made.

Regression

For logistic regression, arguably the forced entry method, i.e. all predictors enter as a block, is the mainstay of theory-testing[494]. In this work though, backward stepwise regression was also used. Field considered stepwise methods to be less reliable due to the effects of random variation, and defensible only where causality is not the focus and there is no previous research to guide hypothesis-testing[494]. The backward method is preferable (as the forward method is more prone to exclude predictors involved in 'suppressor effects' and thus to Type II errors); as is the likelihood-ratio for deciding what to exclude[494]. Choice of model involved checking various criteria:

- *"Sadly, social scientists, who have spent far too long being trained only to hunt out probability values below 0.05, often ignore the examination of residuals! ...running a regression without checking how well the model fits the data is like buying a new pair of trousers without trying them on – they might look fine on the hanger but get them home and you find you're Johnny-tight-pants. The trousers might do their job (they cover your legs and keep you warm) but they have no real-life value (because they cut off the blood circulation to your legs and other important appendages)."* **(Field, 2000)[494p171-172]**

Despite potential disadvantages of interpretation and inflated Type 1 error using a type of stepwise rather than hierarchical multiple regression[509], it was used for ease of administration.

No testing for interactions[510] was performed (and is usually discussed related to ANOVA). There were no clear grounds to pursue this. Multicollinearity was not a problem in the regression analyses.

Choosing and using principal components analysis

PCA was chosen over factor analysis (FA) to evaluate the utility of the good PBL tutor items in describing students' expectations, and to check how the Entwistle's 18-item short RASI for learning approaches fared in the three cohorts (four study-elements). This also facilitated exploring the relationship between the two sets of items.

Popularized in personality-testing and intelligence-testing, PCA/FA are 'interdependence' techniques[491] to reveal *"which variables in the set form coherent subsets that are relatively independent of one another"*[492p582]. Like ANOVA, they try to account for data variance, but they explore underlying associations while ANOVA tests for differences under different conditions[493]. PCA/FA seek 'parsimony' by extracting the fewest possible components/factors (linear classification axes for variables) that remain meaningful but account for much common variance in the correlation matrix[492,494,511]. Such techniques are either exploratory (in early research, e.g. developing instruments to investigate learning[512], developing theory), as in these study-elements, or confirmatory (in advanced research, testing theory, usually via structural equations modelling)[492]. Goals include to[492]:

- summarize patterns of correlation
- produce a smaller number of components/factors
- describe, with a regression equation, the underlying process
- test a theory about the underlying process

Both techniques therefore involve similar actions and purposes, respectively[491]:

- extracting components/factors from a correlation matrix of variables, deciding how many - initially from the unrotated factor-loading matrix, then confirming via the rotated factor-loading matrix (using rotation to aid interpretation)

- identifying: latent dimensions; subgroups of responders; or, for use in multiple regression, either a high loading variable as a surrogate for a component/factor (if it makes sense and data are reliable), or a smaller set of components/factors

PCA and FA extract the component/factor accounting for most variance first, then others in descending order of variance/importance[492,494]. The 'loading' of a variable on a component/factor **(Appendix 10, Appendix 11)** is the Pearson correlation coefficient between them (β), i.e. the coordinates on the linear axis of the factor/component[494]. Labelling components here was intuitive, and the highest loading variables and their direction (signs) informed this most[491,492,493,495].

PCA and FA differ mathematically and theoretically. PCA is *"...psychometrically sound... conceptually less complex..."*[494p434]. Mathematically, PCA analyses all the variance (common, unique, and error) while FA analyses only the shared (common) variance (i.e. covariance)[491,492,495]. Theoretically, PCA components are collections of correlated variables (an empirical summary), which possibly 'cause the components' while, in FA, possibly 'factors cause/influence the variables'[492,495]. In this work, crucial decisions, particularly for the good tutor datasets, were therefore between:

- PCA versus FA for extraction
- orthogonal versus oblique for rotation
- number of components/factors to extract

PCA was preferable for reducing many variables into a small number of components, selecting a solution (What components? What number?)[492], and for prediction, especially with orthogonal rotation, as used here[491]. Dancey and Reidy noted that research supports differences between PCA and FA being relatively unimportant with larger datasets and sample size[495]. Sample sizes here were ample but quite modest.

Varimax orthogonal rotation was chosen as components did not overlap substantially. All orthogonally rotated solutions give the same mathematical fit[492], and are preferred, according to Hair *et al*, when subsequent statistical analyses use the results[491]. Varimax rotation simplified the components by maximizing variance of loadings (high loadings become higher, low loadings become lower) and redistributing variance across components so that they approximated in importance[492].

In such orthogonal solutions, interpreting the signs of loadings should only refer to that component and not to others as, by definition, they are independent[491].

Choosing a solution involved judging various potential solutions, so: "*...when using [PCA/FA] the researcher should hold in abeyance well-learned proscriptions against data snooping*"[492p609]. In this work, various criteria were considered for factorability and utility **(Appendix 9).** For example, Field noted that data should be[494]:

- at least ordinal level, Normally distributed, with linear relationship between variables, n at least 100 (and probably even better 200); have more participants than extracted factors (at least 20:1), and at least 10 participants per variable (or is it 5-10 per variable but over n=300 is fine anyway?)

The datasets for learning approaches and expectations of the good PBL tutor generally fulfilled most of these (but were not uniformly Normally distributed across all data items). Different authors tend to set slightly different criteria anyway **(Appendix 9).**

Hair *et al* likened choosing the number of components to focusing a microscope to find a structure[491]. Preferably, at least 5-6 components are extracted to achieve a stable model[492], yet for the learning approaches data three components were chosen consistent with prior knowledge (including variables loading on them mostly as expected). Various criteria guide the choice of solution[491]:

- eigenvalues more than a certain value, e.g. 1, as components should account for at least as much variance as would a single variable
- being consistent with a prior hypothesis
- maximizing the percentage of variance for which the solution accounts
- above the scree-tail test's cut-off point (y-axis=eigenvalue; x-axis=number of factors), i.e. before unique variance dominates the common variance structure
- making sense

Across the datasets, the 5-component 'good tutor' solution chosen addressed these criteria and those of Tabachnick and Fidell[492], i.e. meaningfulness (made most sense), utility, replicability across the samples, construct validity (they made sense in analyses with other concepts), and appearing whatever the extraction technique[492]. The ideal technical requirements of a solution were considered, e.g.[492]:

- Each *variable* should have a *high 'communality'* (sum of squared loadings (SSLs) across components), i.e. its common variance across all components.

- Each *component* should comprise several variables and have a *high eigenvalue* - the amount of variance for which it accounts across all the variables.
- Each *component* should have a *'marker variable'* – highly correlated with it and not loading on other components:
  - Each variable should usually load highly on one component and not on others. 'Complex' variables confuse interpretation by being strong in several components ('multicollinearity'), 'catching each other' in a component due to similar complexity rather than truly correlating with it.
- The *squared loading of a variable* should be *relatively high* as it estimates its percentage of the component variance, and thus its importance.
  - This is the rationale for choosing a cut-off, e.g. 0.4 ---explaining 16% of the variance--- for judging what variables to include in (at least naming) a component. (The cut-off should really increase with fewer variables, fewer participants, or more factors/components, i.e. on later ones[491]).

In this work, some communalities were rather low, which is understandable in the preliminary stages of developing items. Developing them further would involve amending and/or omitting low communality items. Nevertheless, there may be good reasons for retaining components of marginal reliability[492]. The 'eigenvalues>1' rule was unhelpful here as it overestimated the number of components to extract. Indeed, the eigenvalue rule might *over*- or *under*-estimate, depending on number of variables and sample size[492]. Furthermore, the scree-test is more clear-cut the larger the sample size, the larger the communalities of the variables, and when each component has several high-loading variables[492]. Even in suboptimal conditions (arguably so with the *smallest* sample size dataset (S5)), however, it is usually accurate to within about two components[492]. Multicollinearity (which tends to be less problematic in PCA anyway[492]) was less in the learning approaches data than the newly developed good tutor datasets. For the squared loading cut-off, this work used 0.40 for all components when choosing solutions and naming components, but kept all variables for solutions and scoring. This simplified the approach but probably contributed to the instability of the 4th and 5th components in each of the 'good tutor' 5-component solutions in S3, S6, and S5. Nonetheless, subsequent analyses did not use these components anyway.

Analysing the datasets separately allowed recurring patterns to be sought. Pooling the data from the different cohorts or from the 2001 cohort at the two points would not have helped, and should be avoided, as components may change with people/setting/time[492]. *"When these methods [PCA/FA] are used conclusions are restricted to the sample collected and generalization of the results can be achieved only if analysis using different samples reveals the same factor structure"*[494p447]. Comparing solutions between samples thus requires the pattern and magnitude of correlations between variables and factors/components to be assessed[492].

In this work, responders' scores on each component were estimated by regression (mean=0; standard deviation =1[492]) for use in further analyses, but individual scores are not usually the focus[493], and there should be a spread of scores for a component to emerge at all. The scores should estimate what responders would have scored if that component (rather than the constituent variables) had been measured directly, and are usually more reliable than scores on the separate variables[492]. The weighted average method would have used each constituent variable's β as the weightings to derive the score, but restricts comparisons to only variables using the same scoring scale[494]. The regression method uses component score coefficients (i.e. β adjusted for the initial correlations between variables, and thus for inter-variable differences in scales and variance[494]). The component scores might be better (than surrogate variables) to use in subsequent analysis if the scale is well-constructed, valid, and reliable[491].

There are disadvantages of PCA/FCA against which the findings in this work need interpreting[492]:

- There is no criterion variable against which to test the solution.
- The potential number of rotations is infinite and choice of solution depends on pragmatic judgement of its coherence and utility, rather than objective criteria (despite major attempts here to be explicit about such criteria **(Appendix 9)**).
- Their strength at finding order in apparent chaos often gets misused in a vain effort to redeem bad research, undeservedly being labelled 'sloppy research' when 'sloppiness' is in its application not in the technique itself (which is robust).

In this work, PCA was particularly useful in reducing the good tutor data down to components whose scores could be used in subsequent analysis. While there was a bewildering array of 'rules of thumb' to guide the process (some more evidence-based than others), ultimately PCA involves pragmatic judgements about what solution makes most sense.

Qualitative analysis as part of mixed methods research

Mixing it

As discussed at length in **Chapter 3**, both qualitative and quantitative research approaches have strengths, and should complement rather than diminish each other[423]. Indeed complementarity and elaboration are key strengths. On elaboration, Rossman and Wilson noted: *"If we think of social phenomena as gems, elaboration designs are intended to illuminate different facets of the phenomenon of interest"*[449p2]. Barbour, for example, summarized the rationale for combining qualitative and quantitative methods as: for different stages in the project; to compensate for the shortcomings of individual methods; for 'triangulation'[453]. According to her, qualitative contributions within the quantitative paradigm include: providing insights into the process of data construction, identifying relevant variables to be studied, explaining unexpected or anomalous findings, and generating hypotheses or research questions for further investigation[453]. Quantitative contributions within the qualitative paradigm include in data analysis, sampling strategies, and amalgamation of data from separate studies[453]:

- *"Only rarely is multi-method research – or the individual researcher – likely to put equal emphasis on quantitative and qualitative methods"* **(Barbour, 1999)**[453p40]

Undertaking mixed methods research as an essentially 'lone researcher' requires diverse skills and different logical principles[513], is very time-consuming, and challenges entrenched purist philosophies. It is vulnerable to 'Jack of all trades, master of none' criticisms, yet the mixing 'trade' is in itself worth mastering.

Various aspects of the qualitative data analysis in this work require further comment such as attempting it at all against a background of quantitative research, mixing approaches generally, and the validity of the findings. Critics might undermine the worth of mixed methods research that involves qualitative-quantitative mixing, as if this transgresses some universal purity rule. Nevertheless, mixing different qualitative approaches, which might not attract much criticism, would not be without glitches given the diverse range of traditions that qualitative research covers:

- *"...variations in the language employed by qualitative researchers signal different ideas as to what constitutes data, whether we are engaged in collecting responses, answers, accounts, narratives, confessions, reminiscences, discourses, interactions, exchanges, or negotiations/decision making. Similarly, those being researched may be referred to as respondents, interviewees, group members, expert panels, or participants."* **(Barbour, 1998)**[452p354]

In qualitative research, theory is important to define the kind of knowledge generated, the nature of the data, and how to handle and interpret them[429]. Nevertheless, Chapple and Rogers warned against the 'sociological imperialism' of arguing that only social scientists can analyse the meaning that people attach to their behaviours, and that health services researchers cannot[429]. They warned against a form of occupational protectionism:

- *"Those working in medical specialties such as general practice may... come to the conclusion that they should not attempt qualitative research because they do not have the knowledge of social science and its theoretical frameworks or the practical skills necessary to follow the guidelines suggested for qualitative research. However, they should not be deterred by the proliferation of these criteria, guidelines and standards, and they should be aware that social scientists are not in agreement about the way in which qualitative research should be conducted and analysed."* **(Chapple & Rogers, 1998)**[429p557]

In this work, qualitative analysis was guided by the similarity and contrast principles to develop themes that were generally mutually exclusive[438], and then counted. The inductive analysis was iterative, involved discussion with supervisor-colleagues but no formal second verification of themes, and no formal second-coding of data under those themes. Barbour explained how the key issue about 'multiple coding' is not the degree of concordance, anyway, but the disputes and alternative interpretations emerging from discussions[446]. As an example of such activity, she included the notion of another person "*casting an eye*"[p1,116] over samples of the data or preliminary coding-frameworks (i.e. as key to supervision sessions for this work)[446].

- *"...thoroughness, both in interrogating the data at hand and in providing an account of how an analysis was developed. Whether this is carried out by a conscientious lone researcher, by a team, or by involving independent experts is immaterial: what matters is that a systematic process is followed and that this is rendered transparent in the written research project"* **(Barbour, 2001)**[446p1,116]

One of the more overtly 'systematic ways of tackling the data is to count categories of concepts.

Counting

While 'pure qualitative' approaches might shun any numerical perspective, Silverman (like others[453,514]) reasoned that simple counting of categories in qualitative data is useful in reinforcing the researcher's impressions and conveying an overview of the data[515]. Tashakkori and Teddlie referred to the transformation of qualitative data for quantitative analysis (QUAL→QUAN) as a 'quantitizing' technique and the transformation of quantitative data into narrative (QUAN→QUAL) as a 'qualitizing' technique[438]. Both techniques (plus 'triangulation') fall under the first of Tashakkori and Teddlie three mixed methods data analysis strategies **(p108)**: concurrent mixed analysis; sequential QUAL-QUAN analysis; and sequential QUAN-QUAL analysis.

In terms of 'quantitizing', Seale and Silverman considered counting in qualitative research to be one way of enhancing rigour[516]. Counting should, for example, counter anecdotalism. Furthermore, counting does not necessarily mean that second-coding follows naturally:

- *"...it is sometimes possible to summarise qualitative data into broad categories amenable to quantitative analysis – although this should probably only be attempted by the person who has collected the data."* **(Barbour, 1999)**[453p42]

Getting complex qualitative data into a format to count and crosstabulate with other data requires systematic manual or electronic methods.

Analysing inductively

This work did not use qualitative analysis software. The inductive analysis took much in-depth reading and deliberating over the pages of text. The earlier analyses involved coloured pens on paper, whereas the later analyses used a quicker version of the same process by using the copy/paste and colour-font functions in wordprocessing software to move text around and collect it under likely themes. For the large number of responses involved, this was achievable as the text involved was relatively short:

- *"When sample sizes are relatively small, interviews can be analysed using coloured pens and paper and pencil. If the sample size is bigger, a simple word-processing program such as Word for Windows may be helpful, but more sophisticated programs such as NUD*IST or ETHNOGRAPH are not essential for analysis of qualitative data."* **(Chapple & Rogers, 1998)**[429p559]

Being so close to the data in this way, it became clear that, for each answer under scrutiny, the final total of initial themes was reached some time before all responders' data were analysed:

- *"The rule of thumb applied most frequently is that when the same stories, themes, issues and topics are emerging from the study subjects, then a sufficient sample size has been reached."* **(Roche, 1991)**[423p136]

Ultimately, a key requirement is to be explicit about what could and could not be achieved in terms of rigour.

Ensuring 'validity', rigour

Different social scientists emphasize different standards and criteria for evaluating qualitative research. Key areas for consideration when reporting social science/educational research comprise: clarity of methods, trustworthiness, systematic data analysis, triangulation, reflexivity, and critique of methods[430]. Hoddinott and Pill's criteria for evaluating qualitative research involving interviews, for example, emphasized being explicit about detail of the researcher's role and relationship to responders, and how the responders were recruited, by whom, and using what information[425]. Barbour warned against formulaic use of the 'technical fixes' prescribed by checklists (e.g. *"purposive sampling, grounded theory, multiple coding, triangulation, and respondent validation"*[446p1,115]). She advised that such checklists have their place but do not in themselves assure rigour in qualitative research, i.e. the risk is in the 'tail' (checklist) wagging the 'dog' (qualitative research) rather than focusing on robust adherence to key principles[446].

The language of most qualitative research guidelines does not include 'questionnaire', but the messages remain the same about being explicit about the researcher's role, what was done, and why. There are various reasons why goals and standards of quantitative research do not translate well for critically appraising qualitative research. Buchanan remarked how, in physical science, gravity is not affected by the language used to describe it, but, for example, *"how we talk about our motivation influences how we experience it"*[457p130]. He noted that for qualitative research, the search for explicit standards receives two responses: that absolute criteria are untenable or that, notwithstanding the absence of equivalent checklists to quantitative research, provisional recommendations are possible[457]. Examples include prolonged engagement and triangulation, but they are neither preconditions nor guarantees of good research, which has more to do with providing new insights about self and others[457].

- *"Human beings are not like chemicals in a test tube. Unless or until the limitations of applying the model of the natural sciences to understanding human practices are addressed, the problem with quantitative research is that it too readily lends itself into treating them as if they were."* **(Buchanan, 1992)**[457p134]

Mays and Pope highlighted that comprehensiveness (i.e. allowing contradictions and exceptions to help refine interpretations) may well be more realistic than internal validity for qualitative research[428]. Concerning more specialized techniques such as responder validation (asking responders to check your interpretation of their accounts), Barbour considered that for one-off health services research (as opposed to action research), it may well not be worth the effort[446]. Mays and Pope questioned its appropriateness as researchers are trying to provide an overview while each responder has his/her own individual concerns, to which the mistake would be to pander in a spirit of cosiness and collusion[428]. In this work, a slightly related activity had the 'good doctor' themes from S1 replayed for S2 participants to score for importance.

As above, Seale and Silverman take a more pragmatic and less separatist perspective of enhancing rigour[516,517]. They considered counting in qualitative research to be a key technique, together with systematic coding schemes, searching for deviant cases, and being comprehensive and objective in recording data (e.g. conversation analysis transcription techniques)[516]. In this work, all four aspects were addressed, although deviant case analysis amounted mostly to noting the minimally represented themes and continuing to use these in further work or allowing these to inform further study-elements and comment. Despite qualitative research often valuing authenticity over validity and reliability, and attempting to transcend conventional standards, Seale and Silverman considered this to be *"methodological anarchy"*[516p380]. Others focus their search for authenticity on reflexivity, i.e.:

- *"the sustained attempt to understand ourselves, and to try to be explicit about the presuppositions and prejudices of our cultural milieux, and the ways in which these shape the phenomena we choose to look at and the way we interpret them"* **(Cribb & Bignold, 1999)**[48p204]

Tashakkori and Teddlie described the qualitative data analysis matrix in terms of two dimensions, irrespective of the knowledge claims/theoretical perspective, i.e.: simple versus complex schemes, and a priori (coding to pre-ordained) themes versus emergent themes[438]. In this work, most of the qualitative analyses involved emergent themes. Both manifest and latent content analysis were used[438]. On the few occasions where pre-ordained themes were used, these were the emergent themes from other study-elements, even from other cohorts, with the potential to create new themes, although very few emerged, e.g.:

- using end-of-Year 1 S2 emergent themes about the main advantage and main disadvantage of PBL as the basis for coding the same cohort's views when asked the same question in mid-Year3, S5

The emergent 'good tutor' themes from end-of Year 1 students (S2) provided a good basis for starting to develop distinct subscales to capture the essence of students' expectations of good PBL tutoring.

The effect of the Researcher

Despite attempts to reduce the Researcher's effects (as part of the social world studied) on what was found **(e.g. p309)**, these were unavoidable. The Researcher's presuppositions and prejudices[427] might have affected choice and interpretation of phenomena and techniques, and participants' reactions to the Researcher's other roles **(p121, p305)** might have affected whether students responded and what they said. The Researcher's self-awareness of the effect of prior knowledge (including early literature reviews) on deriving themes inductively from qualitative data was vital, but was balanced with being sufficiently informed about the issues and local curriculum context to facilitate timely and appropriate access to participants and efficient enquiry. Explicit attention to non-coercion was also vital (e.g. letter: **p124, p309)**, but some students might still resent staff exploring their personal vulnerabilities about learning.

Perceived and actual researcher-student differences in, for example, power, culture, and 'class'[443] cannot be ignored, and yet the breadth and depth of responses suggested these not to be problematic **(p309)**. Several students e-mailed or wrote notes showing interest in the work, and others sought a repeat questionnaire after mislaying it, or gave a current address on not receiving it. Others might have responded more readily if perceiving that staff would benefit from knowing students' perspectives, or specifically to help this researcher. For interviewee candidates, the social desirability bias evident in their learning approach answers **(p352)** possibly reflected, for example, distrust that this study was outwith the admissions process, or being deliberately positive on interview day, rather than knowing the Researcher.

Having reviewed many aspects of the methods, the focus now moves to the findings, synthesizing and interpreting them in the six main strands of the overall study objective: *a good learning history; a good doctor; a good career; a good learning experience with good tutoring; a good curriculum; and a good outcome* **(p17-18)**.

Review of results

How do medical students in a problem-based curriculum perceive their learning and tutors? How do their learning approaches and allied learning expectations and experiences relate to their stage in the curriculum, performance in assessments, vocational perspective, and appreciation of a population health perspective? **(p18)**

The response rates on all six study-elements were satisfactory **(Table 1a, p158; Table 1b, 1c, p159; Table 22, p219; Table 33, p265)**. Indeed, the response rates were particularly good for the five medical student questionnaires, given that they were posted rather than administered opportunistically to a captive audience in a timetabled session. Despite being very clear that participation was optional, research-related, and separate from official curriculum administration channels, many students felt able to give their time and effort. Contact during the summer-break was invaluable in increasing the end-of-Year 1 response rates.

Rees and Sheard advocated using an 'opt out' rather than 'opt in' approach to involving medical students in questionnaire surveys[518]. When their medical students received an information-sheet and signed a consent-form to 'opt in' to completing a communication skills questionnaire, only 24.8% responded. They invited non-responders to a briefing lecture, allowing them to 'opt out' of completing the questionnaire, thereby recruiting a further 44.2%. Repeating this with another year-group, the combined response rate reached 92.0%. Rees and Sheard admitted to trading off the more ethical approach to questionnaire surveys for an increased response. In the work of this thesis, however, the integrated letter was very clear that students could 'opt in' or 'opt out', without the implicit pressure of more direct/immediate requests for their participation.

Questionnaires are difficult instruments for meaningful qualitative data collection, but responders engaged well once 'captured' by the three rounds of questionnaires/ reminders. Rich data emerged, with enough diversity and exceptions to suggest that students were not just answering as they 'expected' that the Researcher wanted.

A good learning history: learning before entry to medical school

What was already known

From evidence and theory in the literature ***(Chapter 2 summary: p102)***:

- Besides the formal curriculum, there is a *complex* interplay of 'schooling', selection, and socialization characteristics influencing medical students' subsequent academic achievement, their generally coping, and curriculum satisfaction (such that the optimal selection procedure remains elusive).
- Relatively little is known about students' perceptions of prior education and expectations of medical school, especially in problem-based curricula.

Knowledge gaps include…

- …evidence from an established UK problem-based medical curriculum.

What this study adds

- Despite efforts to select suitable entrants, informed about problem-based education, the students' view of PBL in the Liverpool programme was rather naïve and, for many, school involved much teacher-directed learning.

- There was no evidence of unfair discrimination in favour of those entering this medical programme, but they were more likely to be from more affluent postcodes (reflecting the interviewee pool).

Comments on findings

Medical students are atypical of their population age-group by generally being high achieving, adept learners for the learning needed to enter medical school. Responders here were mostly female, reflecting the applicant pool to medical schools. From all three cohorts, 'home' England & Wales students were generally from the more affluent population groups. Affluent postcodes (or, for example, sex, whether a White 'home' student, or having at least one medical parent) did not, however, influence likelihood of entry to the programme (S4) in basic analyses. Across the three cohorts, similar proportions had at least one medical parent (about 15%). For reassurance of validity, it is notable that this individual measure of socioeconomic status was also statistically significantly higher amongst the more affluent postcodes (an ecological-level variable **(p124)** that allows a measure of material deprivation and population health inequalities[488,489,519]). Only Townsend scores (unemployment, no car, overcrowding, not owner-occupied) from the 1991 rather than 2001 Census were available though, so miscoding of newer postcodes might have marginally affected validity.

Reviewing medical students' socioeconomic status evokes the growing UK 'widening participation' agenda. For higher education generally, challenges from this agenda include encouraging males of lower socioeconomic groups to enter, and to address their perceptions of 'loss', e.g. of money and male identity[520]. Medical education has its own issues in the widening participation agenda, trying to recruit those most suitable for this career[521,522,523,524]. Literature searching on 'deprivation' and 'medical student*' tends to retrieve references about sleep deprivation rather than socioeconomic status. In the late 1980s, Yiango *et al* reported that only one-quarter of St Mary's medical students agreed that they had 'direct experience' of inner city living conditions (whatever that means) before medical school, mostly through voluntary community work[525]. Their questionnaire posed the statement, *"It is difficult for a doctor and a working class patient to understand one another because of the great social distance between them"*, and (setting aside the assumption that they are mutually exclusive) 30.3% of 216 Years 1, 3, and 4 students agreed! Better insights into this agenda are clearly needed. Recent data from the Scottish medical schools, for example, showed that the Australian Personal Qualities Assessment (psychometric tests of: cognitive ability, personality traits, moral/ethical reasoning) would not disadvantage candidates from more deprived postcodes (on Carstairs Index) if used for selecting medical students[526]. For 'non-disadvantaged' University of California (Los Angeles) medical students, MCAT scores and a *profile* of personality traits (of Comrey Personality Scales) predicted their academic and clinical performance[527].

In the S4 interviewee cohort here, logistic regression of the three learning approaches, age, and sex was unhelpful in predicting non-admission to this curriculum **(Table 43, p295)**, and adding Townsend score and medical parentage destabilized it. Analyses of the admissions process did not, therefore, show unfair discrimination but had not captured good predictors. This is unsurprising when most interviewees were applying pre-A-levels/Highers, and thus submitting up to four medical school choices on the 'UCAS' form and relying on predicted grades. Post-interview, the approximate ratio of candidates selected but choosing to go elsewhere, unselected candidates, and candidates selected but not then achieving the required academic standard is 3:2:1 (*Personal communication, Dr Gill Vince, July 2005*). This work did not have crucial information about whether interviewees received an offer or on academic performance for entry as measured by GCSEs and A-levels/Highers. (A-levels are a major determinant of whether successful interview candidates became entrants, and of medical undergraduate and postgraduate performance generally[528], but what they measure is debated[529,530,531]). The relationship between learning approaches and A-levels/Highers may well differ from that found in this work with competence-based, integrated, assessments designed for a problem-based curriculum **(p358)**. The analysis of 'admitted versus not admitted' was thus included for completeness, but the S4 interviewees' career intentions and views of a good doctor were more informative.

The large majority of S1 responders were 'home' students and, with a median age of 19.2 years, most also came from school/college (+/- 'gap years'). When over two-thirds described their learning at school in terms of its control and nature, with nearly three-quarters of these mentioning teacher-directed, very structured learning **(Table 5, p168)**, this was fairly recent history. 'Spoonfeeding' and receiving 'dictation' and prepared notes were surprisingly prominent given anecdotal and other[532] reports of more small-groupwork and project work in schools. (Indeed, Entwistle *et al* was mentioning 'spoonfeeding' explicitly in 1974 when exploring motivation to learn[147].) 'Widening participation' will have design implications for medical curricula as students enter with increasingly diverse strengths and weaknesses[533].

The vast majority (84.1%) of S1 responders expected a more active approach to learning, and some were aware of needing good time-management and priority-setting (25.8%) in the less authoritarian learning environment of a university **(Table 6, p171)**. Only one responder articulated anticipating more uncertainty in learning. Responders were generally looking forward to the practical/vocational aspects of learning Medicine and were generally positive about PBL's potential **(Box 11, p174)** (unlike Toronto medical students, for example, who had low expectations of PBL and significantly lower by the end of Year 1[534]). This anticipatory zest contrasted with the cohort's overall history of general dependence on the authoritarian, information-giving, and judging role of the 'teacher' **(Table 5, p168)**. Like the bravado emerging in descriptions of pre-registration house year, liberal use of the word 'active' did not necessarily convey insight about commitment to active learning. At this stage though, responders viewed learning to be a doctor mostly through its vocational perspective.

Students' expectations affect how they perceive their experience and cope[535,536,537]. Tiberius *et al* considered this to argue against relying on cross-sectional studies of student opinion to inform curriculum renewal, which assumed that such opinion was independent of initial expectations[534]. They found Toronto entrants to have specific expectations of their medical school experience, and that disappointment from unmet expectations underpinned downturns in student opinion. Their evidence did *not* therefore support the original notion for the study, i.e. the often quoted, supposed, *general* drop in morale, as articulated by a colleague of theirs: *"Our first-year students arrive fresh and eager, and then they turn sour over the year. What are we doing to them?"*[534p538]. Tiberius *et al* did find though that, on replaying the opinion changes to a small sub-sample of the students in late Year 2, they showed complete emotional indifference when recalling Year 1 disappointments and delights[534]:

- "*...if, in fact, students are more detached consumers than zealous reformers, their complaints will be muted, and, if the complaints go unheeded, they will* *fade away into silence – "It doesn't matter what I say, so why bother saying anything?"* **(Tiberius *et al*, 1989)**[534p542]

A good doctor: defining characteristics

What was already known

From evidence and theory in the literature ***(Chapter 2 summary: p102)***:

- There is relatively little empirical research depicting the 'good doctor' from the perspective of medical students or admission candidates, but there is more about what medical students seek in role models, e.g. personality, clinical competence, educational enthusiasm and competence, and compassion.
- There have been growing attempts to theorize, identify, and measure core components of professional development in medical school, and acknowledgement that role modelling alone is neither sufficient nor necessary.
- It is clear that the 'hidden curriculum' strongly conveys current professional behavioural norms, and therefore how to be a good doctor.

Knowledge gaps include…

- …the expected characteristics of 'good doctors' from the perspective of UK medical students in an established problem-based curriculum.

What this study adds

- The two most valued themes across five study-elements exploring good doctor characteristics (in three different ways) were consistently 'compassionate, patient-centred carer' and 'listening, informative communicator'.
- There was weak evidence that students' (and even interview candidates') perceptions of the 'good doctor' relate to their deep learning tendencies.

Comments on findings

There was striking consistency in all three cohorts' perceptions of good doctors, despite being constrained to the nine themes emerging from the 1999 cohort of medical students at entry **(Table 2, p161)**. As a core illustration of the qualitative data analysis overall, despite not having 'reliability' measures on the formation of (and coding to) the nine themes, recurring and complementary findings suggested promising reliability and validity. With only a brief descriptor for each theme, responders ranked the same two themes as most important: compassion and communication, with efficiency as the least important (or next to least for S2). Without comparators beyond medicine, it is difficult to know if these three cohorts' views reflected the general population, those seeking a medical career, or those specifically seeking the problem-based community-orientated medical education at Liverpool. The views tallied though with students seeking good 'doctors, educators, and people' in their future medical role models and active mentors[59], and with three big 'Cs' that patients seek: *communication* and *caring*, plus competence[538]. Indeed, Martin bemoaned the loss, to technological overload, of the *"ancient therapeutic art of listening"*[538p753] much needed by the 'good doctor'. Finally, how non-medical role models (e.g. parents, celebrities) affect such views cannot be underestimated[62].

Having translated open responses into a closed set of themes, this closed out further possible aspects of a 'good doctor' from the other cohorts, but the originating group showed consistency in confirming the relative importance of themes at the end of Year 1. The themes attempted to reflect 155 medical students' answers and appear quite comprehensive, although some key issues are not explicitly mentioned, e.g. involving patients in decisionmaking[539,540] (but 'patient-centred' *is* there); taking a societal view[378,541]; being altruistic (but 'caring' *is* there). The themes received 3-part descriptors in an attempt to cover multiple related issues. Potentially, this could have confused responders trying to rank them, and also risked combining attributes improperly. Does 'friendly' really combine with 'inclusive' and with 'teamplayer', for example? From these data they did, reflecting the 'good doctor's' need to relate well to others. Ultimately, forming and labelling such categories are pragmatic. Providing the extra detail in the 3-part descriptors attempted to cue responders to match them to own views of the 'good doctor'. No responders commented that the themes were inappropriate. Glitches with answers involved the small minority not following the instructions about using the ranks 1-9 once only (i.e. adding to 45).

It is unclear why 'exemplary, responsible professional' was most valued by S1 responders (ranked 3rd), but was otherwise relatively low ranking, or why only for S2 the importance of 'experienced, knowledgeable expert' dropped so low (9th) from otherwise mid-rankings **(Table 13a, p198; Table 37, p274)**. It is not as if, by then, those students had gained direct clinical experience that might have influenced their view, i.e. examples of 'good doctors' *without* this attribute. Their formal encounters with doctors had mostly been via those giving plenaries, tutoring PBL or, maybe less so, communication or clinical skills tutors and personal tutors.

It is intriguing that valuing highly the 'good doctor' as a 'thinking, flexible learner' was associated consistently with higher deep learning scores (albeit really weakly and not statistically significantly: S5 r_s= -0.07[xviii], S6 r_s= -0.11, and S4 r_s= -0.03: **Table 13b, p198; Table 29, p235; Table 35, p269**). This is unconvincing evidence, yet coherent in terms of the more holistic view of learning embedded in deep learning, and worthy of further exploration. Likewise, 'well-balanced, insightful individual' showed a similarly very weak relationship across all three cohorts, strongest and significant in S6 (r_s= -0.28), of being valued higher amongst those scoring higher on deep learning. If so, this would also fit with deep learning's wider world-view[542], as would the remaining significant but weak correlation, i.e. S6 responders scoring higher on deep learning valued 'experienced, knowledgeable expert' more (r_s= -0.21).

While there was a very slight tendency for deeper learning S4 interviewees to value 'listening, informative communicator' less (at a miniscule r_s= +0.06 just falling short of statistical significance at p=0.058), this again was unconvincing evidence. This could be a Type I error from multiple testing rather than an indication that those valuing deep learning are less enamoured with clinical communication skills. Nevertheless, amongst those subsequently admitted, this association was marginally stronger (r_s= +0.12) suggesting that, if anything, they valued 'listening, informative communicator' marginally less than the overall pool of interviewees. Despite the much smaller sample size (n=216), this value was still in the vicinity of statistical significance (p=0.089), but less than for the whole pool.

A more noteworthy finding for future exploration involved S4 England & Wales 'home' responders from the more deprived versus more affluent postcodes. The former valued 'efficient, organized self-manager' more, albeit only slightly, r_s= -0.11, and very highly statistically significantly (with much less convincing evidence of their possibly valuing 'well-balanced, insightful 'individual' less). Was this subgroup more focused on how to achieve their future occupational progress and security, and

xviii Remember that the sign appears counterintuitive here as the more that a responder values a characteristic the lower the number, i.e. the top rank is 1.

less exposed to examples of high occupational achievers who were not efficient, organized self-managers? Was 'well-balanced, insightful 'individual' a luxury that was alien to their very organized view of future socioeconomic advancement?

The hidden curriculum probably conveys a different 'good doctor'. Lempp and Seale summarized key features from the literature: losing idealism, assuming 'ritualized' professional identity, neutralizing emotions, changing ethical integrity, accepting hierarchy, and learning informal facets of 'good doctoring'[39]. From semistructured interviews with students from their curriculum, four main themes emerged[39]:

- Positive role models encouraged, motivated, and were committed educators.
- Some clinical staff showed poor commitment and a haphazard approach to their educational role.
- Learning about medical hierarchy meant humiliation, usually by male doctors.
- Students mostly competed rather than cooperated with each other.

Although a problem-based philosophy discouraged the last of these, it is unclear how exposure to such features in clinical placements affected mid-Year 3 students' vocational vision. Responders' rankings of a closed set of 'good doctor' themes do not preclude their harbouring dark views of the medical profession found by others[543] or confusion about equivocal judgements of professionalism by their clinical tutors[544].

A good career: their view of the future and their population perspective

What was already known

*From evidence and theory in the literature **(Chapter 2 summary: p102)**:*

- Low attraction to primary care and expanding medical student places have highlighted medical students' career perspectives and preferences, about which there is much North American literature (albeit for different medical career structures and health services) sharing similar struggles to the UK.
- Researching <u>what career</u> medical students choose is commoner than <u>how they choose</u> (with North American evidence not necessarily translating well to the UK, and associations with Entwistle learning approaches being unclear).
- Despite recurring world-wide pleas to match medical education with public needs and produce health promoting doctors, the public health component remains peripheral in the literature without much empirical study.

- Many key curricula generating PBL-based evidence have no clear population health education presence, and the medical educational research literature generally is flimsy (with, for example, North American literature focusing more on individual-level prevention) and compartmentalized about public health.

Knowledge gaps include…

- …how career expectations and intentions relate to medical students' learning in a problem-based curriculum, and how wider aspects like public health education fare.

What this study adds

- At entry to medical school, students' insight into pre-registration house year was fairly basic and harboured sizeable misconceptions and probable naivety.
- After entry to medical school, only 40.3% of medical students reported altruistic reasons for having chosen to pursue Medicine.
- 'Hospital doctor (consultant)' was the commonest career intention in Liverpool interview candidates and medical students up to mid-programme.
- Only one-tenth (end-of-Year 1) to one-twentieth (interviewees) of medical students/candidates reported GP intentions (despite a community-orientated programme), non-significant trends were generally away from GP, and most career intentions remained fairly stable.
- Interview candidates from less affluent postcodes were more likely to report a specific career intention rather than 'do not know'.
- Between Years 1 and 3, medical students with GP intentions showed slightly more surface learning (and equivocal links with expectations of PBL tutors).
- Medical students in a problem-based curriculum that integrates public health education as a core theme generally appreciated its vocational utility, and those viewing it negatively tended to score higher on surface learning.

Comments on findings

How a problem-based curriculum should best bridge between 'spoonfeeding' at school and the responsible house officer, let alone the 'good doctor' as an *"exemplary, responsible 'professional' "*, is challenging. Beyond such generic notions of a 'good doctor' lie more specific ideas about entry-level medical posts and subsequent careers. Start-of-Year 1 (S1) responders' insight into pre-registration house year was fairly basic: working long hard hours, performing basic clinical duties on medical and surgical rotations, and learning and gaining experience under supervision **(Table 4, p165)**. About one-third apparently recognized transition to greater responsibility.

Some of the 'long hours, hard work, poor pay' descriptions hinted of bravado and 'martyrdom chic', and hinted at little insight about that first year as a doctor[545], careers 'worked close to the limits' by generations of predecessors[546], and difficulties keeping motivated for lifelong learning[547]. Some of the misconceptions about that first year of a medical career were striking, e.g. that it did not involve being a '*doctor*' yet, or taking *any* responsibility, and was not a *job*.

Despite reasonable awareness in the cohort overall, naive conceptions, misconceptions, and motivations question how much entrants *should* understand, how this should inform selection, and how much is tolerable and aptly tackled at medical school. Indeed, maybe lack of critical awareness of future career does not bear on the capacity to be a 'good doctor' but there is face validity in candidates for any job having realistic expectations. Many students will have 'ticked the boxes' of having gained 'health care experience' (in hospital or community), e.g. school work experience, and many will have attended conferences about gaining access to medical school. This is neither necessary nor sufficient though to show a strong aptitude and vocation, and the essence of the right 'raw material' and its selection remain elusive.

When the 2001 cohort at the start of Year 1 (S3) explained why they chose Medicine, the breadth and types of answers eclipsed the sanitized view from formal admissions interviews and personal statements on 'UCAS' application forms, and complemented tick-box approaches in the literature[548]. This was despite the 'brief question, small space' approach of encouraging practical pithiness rather than denotative and connotative depth. Most common, from just over one-half, was that Medicine would give them something worthwhile, meaningful, interesting, or rewarding as a career, but only 19.4% combined needing scientific interest/application with altruism **(Table 24, p224)**. Finding responders admitting just doing what was expected of them (*"I let myself be dissuaded from doing Chemistry/Physics"*) added authenticity. Another responder did likewise in referring to a formulaic approach to admissions interviews, i.e. claiming to have chosen Medicine because *"Of all the usual "interview" reasons"*.

Overall, the 15.2% expressing a longstanding or unflinching dedication to this career showed slightly more curriculum satisfaction. This group could, however, still include students with minimal critical insight and minimal suitability, those merely seeking the social cache of the 'Dr' label[549], or those whose longer-term view of Medicine will wither on youthful aspirations. Medical school selection procedures are thus such a challenge[550], let alone for problem-based curricula[551]. Only 40.3% disclosed an altruistic motive (i.e. similar to the 39.8% claiming interest in science/human biology). This was not necessarily low, just *realistic*, and resulted from a value-neutral question in a research project and not a high-stakes question in an admissions interview. McGaghie reported a model for measuring altruism[552], if it exists[553]. Maybe this will help relate altruism to other aspects of a 'good doctor'.

For specific career intentions **(Table 38a, p275)**, it is concerning that 'hospital doctor (consultant)' was commonest in all but the 2001 cohort end-of-Year 1 responders, for whom it was still a close 2nd to 'do not know'. Career intentions may continue forming well after graduation. Indeed, the positive predictive value of career intentions expressed at the end of house year are lower for females, those choosing hospital mainstream careers, and those with a less definite choice[554]. Nevertheless, these three cohorts, including the interviewees, had only 17.7% (interviewees, 2001/02) down to 9.5% (end-of-Year 1, 1999 cohort) choosing GP. This reflected medical schools elsewhere in the world struggling to increase the attraction[555], e.g. 14% of mid-Year 2 Queensland medical students wanted to be GPs in 1999-2000[556], and 14% of McGill (Montreal) students just before their 1995 graduation reported wanting family medicine residency training[63]. When tracked in the 1999 and 2001 cohorts, most intentions stayed fairly stable, and even the non-significant trends were away from general practice **(Table 38b, p276; Table 38c, p277)**. Community-orientated curricula should at least reinforce students' early interest in general practice, but might not do so, e.g. if early attitudes are negative[557], which is worth pursuing. 'Graduate-entry' is also not a panacea for this. Lambert *et al* showed that changing entry profiles to older students would not substantially increase GP entrants[558].

The work here gave some evidence of less career doubt over time in the 1999 cohort, but not translating into greater GP career intentions. Is it that, for example[365,366,372]:

- In " *'trying on' possible selves*"[372p540] **(p94)**, insufficient students are meeting exceptional role models to overcome negative specialty stereotypes (or more are meeting excellent hospital clinician role models[559]).
- Students are seeking urgency and immediate impact[372p540] **(p94)**, etc. in their career to match personality, etc. (thus with selection implications).
- Changes away from GP careers are following the *elimination*-type decision-making highlighted by Burack **(p94)**[372], as most changes might be for negative reasons as found by Katz **(p94)**[366].

Indeed, two-thirds of interview candidates specified a career intention (compared with the 40% of Katz's Buffalo, New York State, medical students who, asked at graduation, reported having decided *pre*-admission[366]). Career advice interventions[560] must start early. As yet, the Liverpool curriculum has no programmed careers advice.

Finding that S4 interviewees from less affluent postcodes were very statistically significantly more likely to report a career intention (versus 'do not know') merits further attention. This might reflect a cultural focus on job security over the uncertainty of keeping options open, which might be viewed as a luxury.

Associations between reported career intentions and learning approaches deserve comment. There was no association in any study-element between which of the three learning approaches predominated and reporting a career intention (versus 'do not know') **(Table 15, p200; Table 30a, p237; Table 30b, p238; Table 36, p270)**. When students *had* formulated a career intention, however, a pattern emerged, albeit of marginal differences giving rather weak evidence. Statistically significantly fewer mid-Year 3 responders (S5) with GP intentions (versus not GP/do not know) tended towards deep/strategic learning (73.9% versus 92.6%) rather than surface learning **(Table 15, p200)**. This modest difference emerged, despite using rather unsophisticated groupings (the highest scoring subscale) and pragmatic rules about which subscale took precedence when two subscales tied for 1st place. These findings held when comparing between GP and hospital consultant intentions. Whether such differences are important is arguable, yet the pattern appeared in the 2001 cohort (S3, S6) at the start and end of Year 1 **(Table 30a, p237; Table 30b, p238)** (even more attenuated and non-significant), but not for interviewee responders **(Table 36, p270)**.

The Years 1 and 3 medical student responders (S3, S6; S5) showed a pattern of differences in mean learning approaches scores (albeit very small, and only statistically significant for Year 1 (2001 cohort)) for GP versus hospital consultant intentions. This comprised slightly lower mean scores on deep and strategic, and slightly higher for surface learning in the GP group **(Table 15, p200; Table 30a, p237; Table 30b, p238)**. The interviewees showed a significant surface learning difference in this same direction (GP: 13.69 versus hospital consultant: 12.89; 95% confidence interval on 0.80 difference 0.04 to 1.55) but the non-significant strategic learning difference opposed the overall pattern **(Table 36, p270)**. This gave more evidence that measuring learning approaches on interview day was less reliable, and less predictable in the more diverse pool of interview candidates.

Viewed as a 'longitudinal' proxy, the cross-sectional evidence above would suggest that, with progression, students tending towards deep or strategic learning might match their learning approach (and possibly future learning needs) with the career of a hospital consultant. This explanation would seem more intuitive than students with particular career intentions then aligning their learning approaches to these. An iterative feedback loop of reinforcement is feasible though, depending on students' views of such careers, but that information was not available here.

Associations between reported career intentions and expectations of good PBL tutors also deserve comment from both cohorts (S3, S6; S5), but were generally unimpressive, as for learning approaches above. Maybe this reflected that other factors not measured, e.g. personal qualities and preferences, had more bearing on students' choices and perceptions in this area. Compared with responders intending to be a 'hospital doctor (consultant)', the 'GP' group scored statistically significant negatively on 'focuses on content' at the end of Year 1 (S6) and positively on 'helps me with how to learn', mid-Year 3 in the other cohort (S5) **(Table 31c, p247)**.

This S6 finding about the 'GP' group appreciating process-orientation from a PBL tutor was unsupported by the pattern of non-significant differences in other study-elements and involved one of the less stable/weaker components anyway. It would have been consistent though with Prislin *et al*'s evidence that medical students perceive primary care placements to involve very process-orientated learning[561].

The S5 finding about the 'GP' group appreciating 'helps me with how to learn' is probably more robust, given a more stable component and the pattern of non-significant differences in the other two study-elements. Its highest loading items were *"Q47 guide us subtly back on the right track and depth if going off at a tangent or into too much detail"* and *"Q58 know how and when to interrupt the discussion without taking over"*. The 'GP' group apparently needed more of a non-authoritarian tutor presence. This conflicted, however, with the only other clear pattern, shared by all three study-elements, in the non-significant tendency for 'tells me what to learn' to score positively (versus very marginally negatively in the 'hospital consultant' group). This would indicate tension, although on weak evidence, between the 'GP' group wanting tutors to facilitate, yet for example: *"tell me exactly what syllabus I need to cover for each scenario, avoiding uncertainty"*, and *"take responsibility for complicated discussions by telling us the answers to difficult objectives"*.

Describing how a wider view of Medicine might relate to their careers, end-of-Year 1 and mid-Year 3 responders from the 2001 **(Table 20a, p212)** and 1999 **(Table 20b, p213)** cohorts, respectively, had convergent views about *Population Perspective* learning. Both groups highlighted the same three themes most, despite so many career views being likely from so many individuals. The overall view of using *this* learning to: appreciate the broader context on individual patients; be aware of the population distribution, causes, and impact of diseases; and appraise evidence critically showed that *integrating* it into core curricula is feasible to good effect. (Labelling it other than Public Health & Epidemiology may help[393].) This is encouraging as waning interest in preventive issues over undergraduate medical years[99] and making 'data handling' clinically relevant[562] are world-wide concerns.

Finding that negative views about public health education were associated with students' learning approaches makes sense, as the subscales refer to motivations, whether connections are made, and breadth of learning. *Population Perspective* might generate antipathy through its: long-termism; lack of glamour; reliance on critical thinking; glossary of different terms; and many transferable concepts (versus context-specific 'facts'). Less reliance on surface learning should help such learning. (Although Kolb assimilators have been found to perform better in public health examinations, the relevance is unclear[563].) In both cohorts, negative or doubting comments about its vocational utility were associated with lower deep and strategic learning scores (both very statistically significantly mid-Year 3) and higher surface learning scores **(Table 21, p216)**.

Many problem-based curricula do not include public health education[564] in a meaningful way. Psychosocial issues suffer similarly, e.g. Wear and Castellani bemoaned PBL often using psychosocial issues as an add-on after the 'real learning'[72]. Nearly three decades ago, Canada tried tackling this, for example, by raising the profile of the epidemiological approach in undergraduate medical education above 'add-on' status:

- *"...not just an armchair scientific method or a fireman's approach to medical emergencies in groups of people.*

  Perhaps we are evolving towards teaching epidemiology at the undergraduate level as an objective and scientific method of analysis, intervention, surveillance and prediction of major health-related phenomena, applicable to a broad array of health-related topics." **(Jenicek & Fletcher, 1977)**[391p69]

Why 'perhaps' is unclear! Konefal *et al* found that Miami medical students' interest in learning about quantitative data handling waned between start and end of Year 1 to Year 4, illustrating the challenges (i.e. *"To learn mathematics"*: deemed 'not necessary' by 45%→49%→68%)[191].

Population health issues suffer from the 'it is all commonsense' perception (despite one person's common sense being another person's undoing). In the Queensland problem-based curriculum, with *Population and Preventive Health* as one of four curriculum domains, Régo and Dick found that 48.1% and 53.4% of mid-Year 2 medical students ascribed knowledge and application of public health and of health promotion principles, respectively, to commonsense[556].

Only 41.3% of Régo and Dick's students perceived positive faculty attitudes to population and psychosocial issues[556], such that the 'not-so-hidden curriculum' undervalued the relevance of public health education. Poor role modelling about population health issues reinforces students' views that time spent on it detracts from learning how to practise safe acute medical care[556]. Indeed, in consecutive years (1999, 2000), 47.9% and 60.4% of Queensland students considered that PBL tutors were not good role models for the public health domain. Liverpool students' collective view of the utility of population health learning was apparently more positive. Of Queensland students, 42.5% acknowledged difficulty identifying how they could practise population health on graduation[556], and only 70.0% felt that they understood what the domain represented. Of Liverpool's original PBL tutors telephone-interviewed about PBL (with 100% response from n=34), only 41% (including both public health doctors) described the *Population Perspective* theme adequately without disclosing confusion, antagonism/indifference, or difficulties/ uncertainty[314,318]. *Structure & Function* was the main comfort zone of the large majority. While collective insight has probably improved since, an ongoing challenge for Liverpool PBL tutor development is for tutors to be good attitudinal role models for the relevance of population health concepts. Régo and Dick considered the need:

- *"to enlighten the faculty as a whole so that it has a fuller appreciation of the significance of population and preventive health issues to the practice of medicine (thus providing better role models – if only attitudinally!"* **(Régo and Dick, 2005)**[556p210].

A good learning experience and good tutoring in a problem-based curriculum

What was already known

From evidence and theory in the literature ***(Chapter 2 summary: p102)***:

- North American evidence about learning *style* mostly focuses on the Kolb LSI (giving interesting but inconsistent associations, e.g. with career choices), while that from elsewhere features Entwistle learning *approaches* more.
- Keeping track of the various versions of the Entwistle instruments is challenging, as research reports often omit crucial details, but undergraduate medical education research has yet to feature the 18-item short RASI.
- Much of the key literature about problem-based undergraduate medical education is North American, Dutch, Scandinavian, or Australian.
- The PBL literature suffers from conflicting definitions and implementations of PBL, but there is increasing evidence of benefits to enjoyment/satisfaction and cognition, and probably sufficient basic science learning.
- Overall, research about PBL tutors has mostly explored how their content- versus process-expertise affects student learning; how the tutoring process affects learning; and how various factors influence tutors' behaviour.

- There is some non-UK evidence of 'PBL' promoting more desirable (deep) learning approaches, but this is limited and from pioneering curricula.

Knowledge gaps include...

- ...more qualitative insights about how students perceive their role and the tutor's role in making PBL work, more longitudinal evidence about learning approaches in problem-based curricula, and a UK perspective.

What this study adds

- A substantial proportion of medical students in a problem-based curriculum remained surprised or dismayed at the extent to which such a philosophy placed such responsibility on learners from the outset.
- Despite such misgivings, medical students mostly conceptualized PBL as being process-orientated, focusing on small-groupwork/dynamics and testing understanding through discussion (consistent with Liverpool PBL).
- Medical students mostly conceptualized the good PBL tutor as knowing when and how to intervene without 'taking over', and transgressing this (mainly overcontributing) was mostly to blame when tutors made a session ineffective.
- Medical students appreciated many PBL benefits, e.g. to: cognition; cooperative learning; and personal responsibility/control; with self-motivation viewed as both an advantageous result and a disadvantageous requirement.
- Medical students in a problem-based curriculum were broadly still satisfied with this choice after 1 and 2.5 years, but a substantial minority still held contradictory stances about PBL or about its implementation.
- Medical students ascribed ineffective PBL sessions mostly to their own lack of work/preparation, and other students' (or a tutor's) under-/over- contribution.
- By the end of Year 1 in a problem-based curriculum, medical students' mean strategic score had increased (also reflected in mean individual differences), and, overall, most movement was apparently away from surface learning.
- By Year 3, medical students' deep learning appeared to be the strongest of the three components of learning approaches appearing on PCA.
- Medical students' expectations of their PBL tutors were related to their preferred learning approaches.

It was only in 1991 that experts in the field highlighted gaps in understanding of medical students' learning approaches:

- *"...we believe the research in this area has barely scratched the surface of the highly complex relationships between the personal characteristics of the student which influence their learning and the educational environment in which they work."* **(Newble & Hejka, 1991)**[160p341-342]

Comments on findings

By the end of Year 1, of all factors that students could have cited as helping overall learning, almost one-third of S2 responders mentioned the problem-based environment and PBL sessions (36.1% if including other issues integral to that environment) **(Table 7, p178; Table 8, p181)**. Conversely, about two-thirds did not mention explicitly this main theme, and it came fourth under main hindrances (22.4%). Difficulties with the library and computer resources frustrated students as their researching learning objectives between PBL sessions depended on these. Plenaries received a mixed reception. Indeed, curriculum design was against 'lectures' being the mainstay as if they were *the* source for 'being told *the* truth'. Camp noted that 'lectures as the truth' is a logical positivist approach to education[240], whereas allowing students to *find* knowledge, *compare* with what others know, and *refine* prior with new knowledge, as in PBL, uses constructivist principles[240]. Some Liverpool students struggled with some core PBL features, as described by Camp, i.e. the interaction with the learning environment, cognitive conflict, and the social negotiation and assessment required to build their knowledge and understanding[240].

Despite much pre-entry curriculum information and an admission interview for PBL suitability, and S1 responders generally claiming to appreciate more adult-type learning, PBL shockwaves continued to ripple through the 1999 cohort's experience. (The 2001 cohort was similarly surprised, i.e. that self-directed learning placed so much responsibility on learners from the start.) S2 responders also reported PBL's main disadvantage to be lack of a 'syllabus'/uncertainty about what and how much to learn (43.4%) **(Table 17, p205)**, e.g. *"Unsure about what & in what depth you need to know things"* **(p206)**. This remained similar when followed up in mid-Year 3 (S5): *"With little direction, one inevitably covers too much (poorly) or too little of the 'wrong' or inappropriate stuff. It is very confusing & I feel as if we are very much on* *our own"* **(p206)**. Students remained surprised at the extent to which the curriculum pursued these goals. For some, their 'socialization to the goals of PBL' (described by Caplow[316]) appeared incomplete. A self-directed workload exceeding their expectations will have frustrated some. Bloomfield *et al* found that, generally, staff overestimate medical students' personal study effort[587]. Moreover, 'self-directed learning' has various meanings and goals in the literature[565], let alone to learners.

De Grave *et al* viewed PBL as a strategy to effect conceptual change via cognitive conflict and deep processing, supported by evidence from a Maastricht PBL group of medical students explaining what they had been thinking at various points in a videotape of their session[566]. Such cognitive conflict may well be uncomfortable, but there may be selection implications if students continue rejecting 'adult learning':

- *"Since PBL is designed to develop skills and habits of problem-solving and life-long learning, perhaps students who have difficulty with the method might be those who lack the competence teachers desire in medical graduates"* **(Moore, 1991)[301p143]**

PBL involves self-regulation[567]. The more successful PBL students are those who adopt a progressive, interactive-transactive stance that promotes their group participation and development of professional identity and who do not retreat to tactics that worked in school but are inappropriate to PBL[567].

Focusing on S2 responders' appreciation of key features of PBL, after two semesters' experience, their descriptions were mostly process-orientated, focused on small-groupwork/dynamics (57.4%) and testing understanding through discussion (55.1%), consistent with Liverpool PBL **(Table 9, p183)**. The minimal mention of the tutor's role (i.e. intervening appropriately), by 13.2%, revealed some ambivalence in expectations of a tutor and also probably reflected a *self*-referential stance to a broad question. When asked the same question, but via telephone interview, over three times more (41.2%) of the Liverpool foundation PBL tutors (n=34 besides the interviewer) mentioned the tutor's role as a key to PBL, but *they were* the tutors[318].

When specifically asked about the good PBL tutor, most S2 responders valued those who knew when and how to intervene without 'taking over' (51.1%) **(Table 10, p187)**. When asked by telephone-interview a closely related question (*"What makes a good PBL tutor? It might help to focus on your 'main 3 elements'."*), 41.2% of

Liverpool foundation PBL tutors triggered a 'knowing when and how to intervene theme'[318]. S2 responders' other themes were tutors being the 'non-telling *guide*' to 'what' and 'how much' to learn (40.0%), being an approachable good communicator (29.6%), and motivating and maintaining participation/momentum (29.6%). These overlap with the foundation tutors' other conceptions of a good tutor's characteristics: empathy with students (29.4%); enthusiasm (23.5%); understanding of and commitment to PBL (20.6%); and facilitating a safe environment (17.6%). They also overlap with McLean's Year 2 medical students in the Natal (Durban) problem-based undergraduate curriculum, who valued 'good communicator' well above all other attributes of a 'good educator'[568]. Being 'approachable', 'understanding and relating to students', and 'willing to help/helpful' came next, but 'good listener' and 'understanding the role of teacher', for example, barely registered with them.

Even for short subject-based PBL courses, similar good PBL tutor functions emerge:

- In a 12-week PBL surgery clerkship, Kentucky medical students' ratings (on 5-point scales) of four of twelve items distinguished 'good' from 'bad' tutors best, according to students' perceptions of group effectivness[225]. These were: increases awareness of group function, promotes in-group feedback, helps students set learning issues, and promotes integration of learning issues[225]. Tutors' goals related to imagination, creativity, personality, and temperament[569].
- In a 6-week 'PBL' 'Basics of Drug Therapy' course **(p86)**, Year 3 Dresden medical students most valued four of twelve items (on 6-point scales): allowing enough discussion time, having a good partnership with students, refraining from interfering, and having content-expertise[339].

Tutor variability and its measurement are problematic[334,570] and knowledge required of tutors remains contentious[571,572,573,574,575]. Fu-Gen medical students (Taiwan) **(p86)** wanted PBL tutors with both clinical and basic science knowledge, besides good facilitation skills and positive personality traits[340]. Many features of PBL groups will affect how participants view their experience: group-size, group membership, process features, context, the tutor, the 'problem', and individual characteristics of students like age and ethnic group. This work only explored some of these. Not pursued was whether 'fixed' aspects affected students' perceptions of the good tutor, e.g. a tutor's age, sex[575], and whether medical[575]. In this work, nearly one-quarter of Liverpool medical students wanted the good PBL tutor to have sufficient grasp of the knowledge-base (yet students may not know a tutor's qualifications and expertise). In the previous Liverpool tutor study, five foundation tutors (14.7%) thought that 'good tutors' needed to be medical and another two that they needed a good biomedical science background)[318]. Such comparisons are complicated by that study having been in the first-ever semester and the two research approaches having been different (with about 3.5 years between them and PBL requirements made more explicit over time).

The validity of heeding students' views of the 'best' and 'worst' PBL activities is contestable, e.g. their possible misunderstanding of how a tutor can participate/intervene without adding content or taking over proceedings. (Ullian *et al*'s work showed though that *"comments written by residents about their teachers have validity, at least when considered over a large number of residents and teachers"*[306p837].) Staff and students may differ in their emphasis on various desirable attributes of educators and their role. Compared with medical students, for example, United Arab Emirates faculty generally rated professional qualities and personal qualities significantly lower as important for the 'teacher' in the classroom setting[338].

Liverpool students, here, mostly gave a reasonable view of PBL as it was 'supposed to be', while sometimes recognizing that, in practice, implementation might go awry. A core role of Liverpool PBL tutors includes *challenging* students to clarify and justify assertions and to explain how assertions fit together (not in a Socratic tutor process, but by highlighting superficial explanations and unsubstantiated assertions). Students *and* tutors can misunderstand this role leading to the frustration uncovered here. Non-speaking 'cardboard cut-out' tutors will not keep the PBL process on track and students on side, and PBL without a well functioning tutor is not really PBL[22]. Steele *et al* showed how peer-tutored groups shortcircuited discussion of triggers in the case, and focused on Faculty learning objectives in the peer-tutor's possession[576].

For end-of-Year 1 responders (S2), advantages of PBL were diverse. While the commonest focus was on its encouraging independent, active learning, only about one-fifth cited this. The cohort collectively appreciated many other benefits, e.g. to: cognition; cooperative learning; and personal responsibility/control, but self-motivation appeared as both an advantageous result **(Table 16, p205)** and a disadvantageous requirement **(Table 17, p205)** (a paradox also noted by Kelson, i.e.

self-directed learning as a PBL requirement *and* outcome[577]). This resurfaced in mid-Year 3 overall comments about their PBL experience **(Table 18 & Table 19, p207)**.

By mid-Year 3 (S5), the most commonly cited main advantage only came from one-fifth of responders again, but had changed to the responsibility/control given to the students, with PBL's motivational role, cognitive benefits, and its encouraging independent, active learning as the main supplementary themes. While student responsibility/control relates to independent, active learning, Year 3 students' increased appreciation of the former might mark intellectual progress, allowing them to cope with the increasing workload and the need to juggle work commitments.

By mid-Year 3 (S5), responders' two comments about their PBL experience so far were broadly consistent with their curriculum satisfaction level, but various examples of contradictory positions showed the strength of mixing approaches to questions to illustrate the complexity of students' views. An example would be agreeing that *"If I had my time again, I would still do Medicine in this Liverpool problem-based curriculum"*, while commenting that PBL experience was *"inconsistent, depending on good/not so good tutor"* and *"Frustrating at times when limited time to study scenarios, at times only 1/52"* **(Box 12a, p193; Box12b, p194)**. Perceived deficiencies in academic support or basic science knowledge, or via inconsistencies between tutors or within the curriculum design/implementation, were understandable and balanced overall with positive comments echoing the advantages cited. PBL should allow Biggs' 'constructive alignment' between curriculum goals, design, and assessment[159], but responders perceived glitches in that alignment. PBL tutors can be crucial in fuelling such negative or positive perceptions. Tipping's study videotaping Toronto PBL groups **(p84)**, for example, showed that observed and self-reported tutor practice differed, and tutors lacked awareness of group dynamics:

- *"The observers noted patterns of interaction and involvement, such as some students not participating at all for the full two hours, communication directed mostly toward the tutor and not among the group, one member sleeping during the tutorial, and a group in which the sole female member was relegated to a secretarial role. No cohesion was evident in the groups. Several aspects of productivity were not addressed. Goals were not articulated, methods for achieving goals were unclear, measurement of* *achievement was nonexistent, and no time was spent in planning for future sessions. There was no evidence of reflection on any aspect of group behaviour."* **(Tipping *et al*, 1995)**[315p1,052]

What damaged productivity in the Liverpool PBL groups? Very early in their PBL experience, nearly one-fifth of start-of-Year 1 responders (S3) were understandably reluctant to note any critical incidents **(Table 23, p224)**. They were presumably still adjusting to university, medical school, other students, and PBL with a tutor who was not 'teacher'. They were still gaining confidence about interpreting and coping with difficulties[229,578] (e.g. was it just them or a good/bad feature of the system?). With a diverse array of suggestions, consistent with evidence from elsewhere[579,580], about four-fifths of responders noted something affecting PBL group productivity.

Their two commonest themes (13.6%, 12.3%, respectively) had students participating poorly and self-centred students dominating sessions, resonating with the literature. The supplementary themes also resonated, i.e. students skimping explanations of key concepts; students not formulating appropriately specific learning objectives; and students wasting session-time on the wrong things (e.g. too much detail). Although very uncommon in this work, students who undermined others (by being offensive or overcompetitive); who were late/absent; or who relied heavily on notes in-session had each created critical incidents for others at this early stage. They were, however, surpassed by the absent or problematic tutors (6.2% of responders). In other answers, inter-tutor inconsistency only came through as exceptions, e.g. one mention only amongst S2 responders' 'main disadvantage' of PBL: *"Too much variability in tutors"* **(Table 17, p205)**, and two from S5 responders **(Table 19, p207)**. Later in the curriculum, maybe responders focused more on their own and their colleagues' transgressions rather than the tutor (and were giving only *one* disadvantage anyway).

De Grave *et al* undertook critical incident analysis **(p80)**, using 5-point Likert scales for students to rank statements about six barriers to effectiveness of unproductive PBL sessions emerging from their research[94]. Unequal participation; lack of elaboration, lack of interaction, lack of cohesion, lack of motivation; and difficult personalities were all confirmed to be relevant but the first three were the most frequent[94]. Other students' lack of motivation was less frequent, but was the greatest barrier for learning, and students expected tutors to sort this[94]. This was complemented by work with United Arab Emirates medical students **(p81)**, in whom self-reported PBL group productivity was greater with greater self-reported motivation, cohesion, interaction, and elaboration, and less with withdrawing (all statistically significant)[298].

When asked to focus specifically on how a *PBL tutor* might cause a PBL session not to work well, end-of-Year 1 (S6) answers emerged as transgressions of the 'good tutor' picture described by the other (1999) cohort (S2). The recurring requirement for tutors to know when and how to intervene without 'taking over' was the main expectation transgressed (42.6%), mostly showing as *over*contribution **(Table 32b, p260)**. Now after a year of PBL with a different tutor each semester, only one responder denied tutor transgressions as a problem. An insightful exception from a few responders (2.7%) revealed how tutors not grasping and keeping to PBL 'rules' could lead to ineffective sessions. Restricted to only one concept each (versus three concepts sought from the originating cohort (S2) at the same stage), a similar group still labelled tutoring actions as transgressions when they were not. In this problem-based philosophy, for example, tutors who: avoided discussing content directly, did not judge accuracy of assertions, and did not tell students what to learn were tutoring appropriately, compared with those who did not *"hold on to the philosophy"*[581].

Focused on the arguably easier topic of *themselves or colleagues*, and specifically on how they might cause less effective PBL sessions, end-of-Year 1 responders (S6) reflected earlier notions of critical incidents from the start of Year 1 (S3). Nevertheless, emphasis on these transgressions differed **(Table 32a, p254)**:

- *Their own role:* Their own inadequate work/preparation (cited by 54.8%) predominated. PBL might emphasize personal work deficiencies as sessions involve students 'theory-building'[582], and reflecting on prior knowledge, what they need to know, and what others know. Both main ancillary themes (although each only from one-tenth) were also consistent with this, i.e. their own poor participation and own inability to explain concepts without notes meant getting less out of sessions.
- *Other students' role:* There was more consensus about how other students disrupted sessions, as students might view their colleagues' transgressions in more clear-cut and less forgiving ways. By far the strongest themes (each from about one-third) were: other students participating poorly (presumably

irritating those who prepare and contribute well and who resent having to 'carry' the group), and other students dominating/being self-centred. The latter could cause conflict, undermine confidence, frustrate those who are more aware of others' needs, and undermine the collaborative philosophy that students have been led to expect of PBL. This overall focus on the balance of colleagues' contributions (from almost two-thirds of responders) ---either too much or too little--- complemented their overall concern about how tutors can undermine PBL sessions, i.e. by not knowing when/how to intervene.

Responders commented little about PBL scenarios, e.g. as to authenticity of triggers. Self-directed study effort does not map *completely* to group learning objectives anyway as prior knowledge, other resources, tutoring, and discussion, etc. influence the individual[583]. Slotnick queried whether PBL allowed students to develop through self-directed learning stages that practising clinicians revealed by interview[262]. These were: *Stage 0: scanning for problems, 1: deciding whether to tackle that problem as a learning task; 2: learning new knowledge and skill; 3: gaining experience*. (These 'stages' fulfilled social psychology criteria for a 'stage theory' i.e. were qualitatively different and invariably in that sequence, and the move between them was *abrupt*[262]). Slotnick noted that PBL would prevent stage 1 decisions as the cases were 'givens'[262].

The Entwistle 18-item short RASI gave various notable results. Reliability is not a property solely of an instrument, and appeared adequate in this setting and with this population **(Table 12, p196; Table 25a&25b, p230 Table 34a, p267)**:

- *"There is literally no such thing as the reliability of a test, unqualified; the coefficient has meaning only when applied to specific populations. Reliability is relative, just as Einstein said about time."* **(Streiner & Norman, 1995)[503p108]**

Both medical student cohorts had similar learning approach distributions (for Year 1 and mid-Year 3) with strategic marginally outweighing deep learning (S3, S6; S5). Just over half the responders in each scored most on strategic learning, but nearly one-fifth in each (S3, S6; S5), worryingly, had either deep or strategic (not surface) learning as *least* evident. Maybe this was the academically 'at-risk' quintile.

The interview pool (S4) showed the same pattern for predominant learning approach, with strategic far outweighing deep learning (whether assessed by the median or by the percentage for whom it was the predominant score (68.1%)). The tendency for so few responders (1.0%) to admit to surface learning tendencies **(Table 34a, p267)**, however, shows the instrument's vulnerability to social desirability bias and to the overactive mind of a candidate about to enter the 'high-stakes' interview-room for a medical school place. Nevertheless, this is where (given three subscales) exploring the 'least evident' approach helped particularly, as 4.3% of responders still had *other than surface learning* as the weakest tendency **(Table 34b, p267)**.

Differences between those admitted/registered and those not admitted/registered from the interviewee pool were minimal, with no statistically significant differences in learning approach scores. Those admitted did, however, have a non-significant pattern of higher deep and strategic and lower surface learning that could be worth future study. It is unsurprising, however, that no clear differences emerged:

- There is much to dilute and confound the influence of learning approaches in the complex web of pre-admission factors.
- Timing of measurement had already induced likely 'social desirability bias'.
- The shortlisting for interview from the 'UCAS' form and the subsequent admissions interview only explored such issues very indirectly.
- The 'pre-A-level results' selection system further confuses the issue.

The particularly weak (and not statistically significant) evidence that entrants deferring might have given relatively fewer points (than the 2002/03 entrants) to strategic learning might still be worth considering in further work. If it were a real effect, maybe students widening their horizons in a 'gap year' were less focused on the competitive thrust between their peers for immediate medical school places.

Looking for a 'real' change in learning approach was problematic as test-retest reliability was not measured. The literature is unclear what changes to expect with ageing and curriculum progression, let alone from a *problem-based* curriculum. Such caveats aside, by the end of Year 1 (2001 cohort), the mean strategic score had increased statistically significantly from 22.42 to 23.21 (out of 30) and the mean individual increase was +0.79 **(p229)**. This was a clear (albeit unimpressive) change. Why should this be so? Did the timing of the second measurement-point clash with the students' peak for needing strategic learning, namely the end-of-Year 1 summative assessments (even if these were designed with deep learning in mind). As it was, many responders did not reply until after the assessments (but the assessments were probably the part of the Year 1 curriculum uppermost in their consciousness at that time). In the paired observations, most change appeared to be away from surface learning, as shown by whether the same learning approach predominated at the end versus the start of the year, i.e. only one-third of the responders stayed in the surface learning category **(Table 26, p230)**.

The 18-item datasets of learning approaches in the three cohorts had good indicators of factorability for PCA. It was reassuring that, despite occasional glitches, the 3-component solution (deep, strategic, and surface learning) emerged for each study-element with reasonable reliability and the expected loading patterns **(Table 31bii, p245)**. Of note, the strategic component was strongest in all except S5, for which deep was strongest and that, if the four elements are viewed chronologically, surface learning weakened by the end of Year 1 and mid-Year 3 (S3, S5). While this is only tangential and weak evidence, the suggestion of movement away from surface learning would be welcome whether it were a function of ageing, a medical education, or specifically the problem-based aspects of this curriculum. The stronger longitudinal evidence in the 2001 cohort had shown the (S3-S6) move towards strategic learning. A move to deep learning by mid-Year 3 would be more desirable.

The 38 'good tutor' items generated from end-of-Year 1 ideas were a good first attempt at typifying the 'good PBL tutor' from the student perspective **(Table 31a, p240)**. The generally positive correlation of key 'good actions' with deep and/or strategic learning and of 'bad actions' with surface learning, in both medical student cohorts, thus linked expectations of PBL tutors with learning approaches **(Table 14, p200; Table 28, p234)**. The 18-item short RASI does not include expectations of tutors, only referring to tutors in the item least congruent with students' response-sets in this setting, i.e. *"I look carefully at tutors' comments on course work to see how to get higher marks next time"*. (This reduced strategic subscale reliability, as it was less relevant in this curriculum, except maybe for special study modules.)

The S3, S6, and S5 'good tutor' datasets had good indicators of factorability for PCA, and the 5-component solutions each explained sufficient variance (about two-fifths) **(Table 31bi, p245)**. The strongest and most stable components made sense, with 'tells me what to learn' and 'helps me with how to learn' being unacceptable and acceptable actions of Liverpool PBL tutors, respectively. Associations with learning approaches were marginal but coherent. Compared with the group with 'deep or strategic' predominating, the 'surface' group scored positively on 'tells me what to learn' (S3, very highly significant; S6 significant), and more negatively on 'engages with me/us' (S3, significant) in Year 1 students **(Table 31c, p247)**. (The non-significant difference in mid-Year 3 of the other cohort (S5) took the same direction.) This reliance on tutor as didactic 'teacher' fits with the surface learning description of: syllabus-boundness, routine memorizing, missing connections between content, and motivation by fear of failure rather than understanding[28,43,157]. In all three study-elements, responders who tended towards surface learning favoured tutors allowing students to skip explanations, justifications, and synthesis (i.e. 'not facilitating active learning'), although this was a much weaker 'good tutor' component. Despite comprising small non-significant differences, the consistent pattern made sense.

A good curriculum: factors in problem-based curriculum 'satisfaction'

What was already known

From evidence and theory in the literature ***(Chapter 2 summary: p102)***:

- The PBL evidence-base shows benefits in enjoyment/satisfaction, but student anxiety about self-directed learning and perceived gaps cannot be ignored.
- Attempts to explore curriculum satisfaction beyond routine programme evaluation have explored multiple organizational and educational aspects of medical school 'learning environments'; personality (e.g. mismatched with learning strategy); and learning approach (e.g. deep bringing more satisfaction).

Knowledge gaps include…

- …exploration of the determinants of problem-based curriculum satisfaction.

What this study adds

- Medical students' satisfaction with a problem-based curriculum was quite high despite rumbling misgivings in both cohorts, and showed weak-modest correlations with learning approaches, e.g. positively with deep learning by Year 3, and with strategic learning generally, and particularly strongly inversely with surface learning by the end of Year 1.
- Medical students' satisfaction with a problem-based curriculum showed weak correlations with their expectations of good doctors.

- Taking account of some key variables, higher scoring on strategic learning was still associated with higher satisfaction in this problem-based curriculum.

Comments on findings

- *"...[**curriculum**]...the most over-used, under-interpreted, vague, ambiguous, misleading and misunderstood term in the whole of education discourse"* **(Genn, 2001)[211p338]**

In both cohorts, irrespective of their various misgivings, the vast majority of responders were still satisfied overall ('agreed'/'agreed somewhat') with their 'choice' of the Liverpool problem-based curriculum. This amounted to four-fifths by the end of year 1 (S6) **(Table 27, p232)** and somewhat fewer in the possibly more 'battle-weary' mid-Year 3 S5 responders (just over three-fifths) of the other cohort **(Table 11, p196)**. The proportions still favouring their choice of Medicine itself (95.9% S6; 92.4% S5) resonated with US evidence. Matorin *et al* reported that 94% of 95 Texas junior medical students (representing 70% response from the 135/206 randomly sampled) would *"still select medicine if starting all over again"*[365p503]. (Of the remainder, 1% said Probably and 5% said No.) This was an uncommon example of a similar approach to exploring medical students' satisfaction with their choice.

The work here tackled the notion of 'satisfaction' rather simplistically (*"If I had my time again, I would still do Medicine in this Liverpool problem-based curriculum"*), but many more factors are likely to be involved than a single study would capture. Indeed, the 'learning environment' literature[584,585,586] highlights the complexity:

- *"The medical school is a habitat... this habitat is a big buzzing confusion, a complex, chaotic kind of situation, with countless components, myriad dynamics and interactions of inputs and processes, inevitable conflicts, and constantly in a state of flux."* **(Genn, 2001)[211p340]**

Despite such deafening background noise, in both cohorts satisfaction scores showed statistically significant, weak-modest correlations (r_p= +/- 0.2-0.4) with learning approaches:

- Responders with higher strategic learning scores, lower surface scores and, for S5 only, higher deep scores tended to have greater curriculum satisfaction.

- The strongest correlations were with surface learning, inversely, at the end of Year 1 (S6 r_p= -0.33), possibly because such students were still suffering the PBL shockwaves **(p344)**; and, positively, with strategic learning by mid-Year 3 (S5 r_p= +0.41) of the other cohort. The latter might be because curriculum flexibility can satisfy students who are willing and able to organize themselves to best advantage in study terms, despite competing demands on their time.

Indeed, conflict between clinical work, PBL, and personal study can be problematic. It is a challenge in many undergraduate medical curricula to protect personal study time versus non-educational compulsory clinical observational activity[587]. Some mid-Year 3 students' negativity about PBL might have been a projection on to it from this.

For S6 responders (as for S5), some expectations of the 'good doctor', from the nine good doctor themes, correlated with their comfort with the Liverpool curriculum. This could have reflected, for example, the image of the 'good doctor' (or skills/attributes) promoted in Liverpool's hidden and overt curriculum; doctors whom they had met; or curriculum malleability to fit responders' views of their future role.

The two most valued themes across the five relevant study-elements, i.e. 'compassionate, patient-centred carer' and 'listening, informative communicator', were also those that S6 and S5 responders highlighted more if they were more satisfied with the curriculum. Furthermore, in S5, these two were the only statistically significant correlation coefficients (r_s= -0.20 and r_s= -0.19, respectively **(Table 13b, p198)** amongst all the themes and, despite being weak, exceeded those of S6 (r_s= -0.09 and r_s= -0.11, respectively **(Table 29, p235)**). Maybe this association follows from so much curriculum emphasis on learning and demonstrating competence in clinical communication skills, and that this appreciation increases with progression.

Conversely, S6 responders showed four statistically significant associations, all with correlation coefficients of approximately +/-0.2, which gave weak evidence of those who were *more satisfied* at the end of Year 1 *valuing*:

- 'efficient, organized self-manager' *more so*; and
- 'exemplary, responsible professional', 'experienced, knowledgeable expert', and 'decisive, competent diagnostician' *less so*

The remaining three 'good doctor' themes did not show convincing evidence of any association. S5 responders showing no association for the highly significant one of these S6 associations (i.e. with 'efficient, organized self-manager') might suggest that clinical dilution of PBL experience could have been demoting this while still promoting the idea of being 'compassionate…' and 'listening…'. Overall, such associations did not conflict with other findings and gave some credence to the notion of 'curriculum satisfaction' embedded in the "*If I had my time again…*" question.

A multivariate approach gave further insight for these complex findings. In the 1999 cohort, only strategic learning (positively) and the good tutor component, 'tells me what to learn' (negatively) predicted 'satisfaction' **(Table 41a, p286)**. This was using three learning approach subscales, the two strongest good tutor components, age, sex, whether a home (EC) students, plus whether set to be a GP, and the one or two good doctor themes associated with satisfaction in simple analysis. In the 2001 cohort, both S3 and S3---S6 models **(Table 41b, p286; Table 41c, p286)** were statistically significant and contained only strategic learning (positively); *valuing* the good doctor theme 'efficient, organized self-manager'; surface learning (negatively); and *undervaluing* 'exemplary, responsible professional'. Using only S6 predictors, the good tutor component, 'tells me what to learn' (negatively) was also included. The effects in both cohorts were only small yet coherent. Such consistent associations are still worth further study, but the links will not necessarily be 'causal'[588]. Prosser and Trigwell reported evidence of greater satisfaction accompanying deep learning in students from seven different university faculties in Sydney[276]. Found here on bivariate analyses, that link disappeared on multivariate analyses.

Examples of similar predictive attempts in the literature are uncommon. Robins *et al*, for example, found that Michigan medical students' satisfaction with the overall learning environment was predicted by curriculum structure (timely feedback and promoting critical thinking), perceiving medical school as comfortable for both sexes and all ethnic groups, and, particularly, how faculty valued their education[589]. This 5-predictor model accounted for 39% of the variance and exceeded the 19.8% and 12.9% of variance explained by the S3 and S5 models above, respectively.

A good outcome: assessment in a problem-based curriculum

What was already known

From evidence and theory in the literature ***(Chapter 2 summary: p102)***:

- Some evidence shows at least a modest effect of *medical* students' learning approach on academic or clinical performance, but other evidence is less striking or unsupportive.

Knowledge gaps include…

- …convincing demonstration of better assessment outcomes in problem-based undergraduate medical curricula being related to deep learning.

What this study adds

- Medical students still in-cohort and scoring higher on deep learning were more likely to have *never failed* any element along the way by the end of Year 4 in this problem-based curriculum, and those higher on surface learning were more likely to have failed at least one element of end-of-Year 1 assessments.
- The association of better cumulative assessment outcomes with higher deep learning score was retained after accounting for other variables.

Comments on findings

This work ultimately focused on assessment outcomes (measured as 'competent or not'), but the literature warns that learning approaches remain an important measure:

- *"Indeed, it may be argued, that the quality of teaching and courses has a more direct influence on approaches than on outcomes and that approaches may be a better criterion."* **(Prosser & Trigwell, 1990)**[276p136]

Assessment does drive learning, but other drivers are required (e.g. a curriculum to match), as expressed in another 'dog and tail' metaphor **(p323)**: *"…the examination tail is only partly responsible for wagging the dog"*[42p216]. Assessment is so dominant, however, that students' pre-assessment behaviours can be misinterpreted. Of Miller and Parlett's notions of cue-deafness, cue-consciousness, and cue-seeking **(p61)**, they thought cue-seeking to align most closely with Perry's final stage of intellectual development **(p60)**, i.e. 'relativistic with personal commitment'[201]. They considered that most cue-seekers were probably reacting appropriately to what they perceived as the artificial set-up of assessments, standing back to take an overview, and focusing on how best to present themselves. Miller and Parlett warned against considering such students to be game-playing or taking staff 'for a ride', but rather that they were using an *"intelligent, adaptive, and realistic strategy"*[201p69]. Maybe this relates to the delicate balance **(p77)** between mixing overall picture *and* detail[149] and seeking success with least effort[244]. Indeed, in the work here, analyses mainly split learning approaches between the less desirable surface learning and the other two approaches.

Assessment loomed large, however, in the collective view from S1 responders' descriptions of how a successful first year at medical school would look. Performing well in assessments (55.2%) was the second commonest concept below a positive learning experience (66.9%) **(Table 3, p165)**. Nevertheless, the requirements for social acceptance and friendship (45.5%) and generally enjoying themselves socially (40.3%) showed that, at the start of Year 1, with assessments well in the future, other concepts in medical students' hierarchy of 'needs for success' were able to emerge.

In the 1999 and 2001 cohorts, most students continuing in-cohort passed their summative assessments under examination conditions **(Table 39a, p280; Table 40a, p283)**. This amounted to 75% and 72% respectively, for the end-of Year 1 assessments and, for the 1999 cohort, 62.1% cumulatively by the end-of-Year 4 assessments. Cleary, by focusing on only students still in-cohort while weaker students had departed by failing assessments twice (whether leaving medical school or falling behind a year), overall performance will probably have been stronger further on in the curriculum. Furthermore, other departures were not categorized and some of these will have involved suspension of studies for students struggling academically, who then rejoined a more recent cohort.

Mindful of such caveats and that learning approaches were measured mid-Year 3, they were still associated with prior or subsequent assessment performance in the 1999 cohort. Each assessment level (1, 2, 3) had the same pattern **(Table 39b, p280)**:

- higher mean deep and strategic learning scores
- lower surface learning scores

in those who passed all elements at first attempt. The only statistically significant difference was for responders scoring higher on surface learning being more likely to have failed at least one element of the end-of-Year 1 assessment, but other differences did approach statistical significance. The pattern recurred for the post-Level 3 cumulative outcome (where sex, age, and whether a home 'White' student did not affect whether students had ever failed anything). Now, however, the deep learning association with better outcome was the statistically significant finding **(Table 39c, p281)**. This suggested that, with progression, the consistency involved in passing all assessments required students to learn for understanding, make connections, and justify assertions. The 2001 cohort added further evidence of learning approaches (this time measured at the start of Year 1) being similarly related to Level 1 (end-of-Year 1) assessment outcome, and highly statistically significantly for surface learning **(Table 40b, p283)** . Substituting end-of-Year 1 (S6) for S3 learning approaches gave all non-significant findings and lost the pattern of association, possibly because proximity to the assessments had decreased the reliability of the measures. Surface learning did retain (non-significantly) the inverse relationship with performance though. The consistent evidence of this association across the two cohorts ---- students most likely to fail end-of Year 1 assessments were scoring higher on surface learning--- suggests that rote learning and skimming is a high-risk tendency.

A multivariate approach gave extra insight. In the 1999 cohort, of three learning approach subscales, the two strongest good tutor components, age, sex, and whether a home (EC) students, only mid-Year 3 deep learning was predictive (negatively) of *ever*-failing then passing an assessment under examination conditions by the end of Year 4. Despite very small effects, this confirmed that these assessments did apparently explore learning for understanding, **(Table 41a, p286)**. There was insufficient time to follow the 2001 cohort to end-of-Year 4 retakes, and the focus in the analysis was, therefore, end of Year 1 **(Table 41b, Table 41c, p286)**. (The mid-Year 3 assessment point might have been less stable a standard in a *relatively* new assessment system compared with prior notions of what students might achieve by the end of Years 1 and 4.) Using similar S3 predictors as for the other cohort, only surface learning (positively), whether home (EC) (negatively), and, possibly, age at entry (negatively) predicted the odds of failing (and passing retake) at least one end-of-Year 1 assessment. Substituting S6 predictors instead was less helpful.

Duckwall *et al* considered that, where assessment outcomes are consistently associated with learning approach, students' self-awareness about such tendencies should be raised so that they can *adapt*[165]. (This would not just be 'adjust', i.e. meet situational requirements, but 'adapt', i.e. meet situational requirements plus students actively modify themselves to meet their responsibilities[109].) For traditional curricula and assessments, the associations tend to be with surface learning (negatively) rather than positive with deep learning[170] (a flaw in higher education generally[355]). McManus *et al* found, however, that intercalated degrees could increase SPQ[44] deep and strategic learning and decrease surface learning scores compared with medical students' admission scores[590]. Tooth *et al* (including McManus) found that end-of-year summative examination performance in St Mary's conventional curriculum was positively correlated with strategic learning, negatively with surface learning, and not correlated with deep learning[81]. Associations vary, however, with students, curriculum, assessment, context, etc. Wigen *et al* found that medical students' 'achieving' score (ASI-30[114]) correlated very statistically significantly positively with examination marks in Trondheim problem-based curriculum, with those from high school outperforming older students[297]. Likewise, Wyller and Wyller reported older age (≥24 years) predicting failing a mid-Year 1 examination in applied knowledge/ reasoning in Oslo hybrid PBL curriculum[275]. Strategic learning (measured by one item, and thus of doubtful validity) was commoner in males and predicted poor satisfaction and examination failure (which personal study hours did not).

The Liverpool students had far less assessment than in the traditional curriculum, and it was coordinated, integrated, and competence-based. At least one full set of formative assessments of all elements preceded all summative assessments, to provide practice and an idea of progress. Medical students value formative assessment feedback[591], and feedback should increase curriculum satisfaction generally[592]. There are possible sex-specific differences in its effect[593] and in students' PBL self-ratings[594]. Of note, Nendaz and Tekian's review of assessment literature revealed little about structured formative assessment in problem-based curricula[251]. This work here did not explore perceived fairness of Liverpool assessments, nor the semi-formal ongoing assessments in clinical placements. Some evidence shows medical students tending to view such performance assessments in clinical rotations as less fair[591].

Arnold *et al* found inconsistent associations between learning approaches and clinical performance in two cohorts of Missouri-Kansas medical students[357]. Students' baseline ASI-30[114] scores and their selection of learning approaches to match particular curriculum elements affected the effectiveness of the approaches subsequently used (n=100, n=102; 90%-100% response including attrition)[357]. Arnold *et al* thus adapted Newble and Entwistle's model of[43]:

educational context→→→learning approaches→→→performance

to[357]

students' baseline scores on learning approaches →→→ perceptions of educational context →→→ selection of learning approaches →→→ performance

Students scoring high on 'achievement motivation' but low on reproducing orientation and globetrotting scored statistically significantly higher average marks in Years 1, 2, and 4 of the cohorts in the six academic years studied.

Weak correlation coefficients recur in the above sections (supported albeit by clear and coherent patterns), meriting some closing quotations that capture the stance taken:

- *"Let us be prepared to measure what is needed for policy guidance, even if it can only be measured poorly...*

  ...To refuse to measure something because there is no good frame can easily be hubris, the kind of pride that leads to a fall." **(Tukey, 1979)**[595p786, p793]
- *"In some quarters, such as physiology and some epidemiology, any correlation below 0.7 is sneered at. In other domains, a correlation of 0.15, which is statistically significant with a sample size of about 400, is viewed with delight."* **(Norman & Streiner, 1994)**[596p104]

Answering criticism of a correlation coefficient of 0.26[597] for deep learning versus clinical experience[178], McManus *et al* summarized the counterarguments:

- *"Of course our r^2 values are not terribly high. If they were then statistical analysis would be unnecessary as mere observation would be sufficient. Scientific studies are interesting for multifactorial human conditions influenced by 10 or 20 factors, and mathematical necessity means that none alone can determine more than 5-10% of accountable variance, and r is rarely more than 0.3"* **(McManus *et al*, 1998)**[598p1,984]

So what?

This study extends what was already known about medical students' expectations and experience as learners in a problem-based curriculum. Better understanding of such matters should help to improve admissions, curricula, assessment, and student experience, while producing the 'good doctor'. Some findings will be of more local interest, e.g. about admissions. Others findings are relevant beyond this curriculum, e.g. about relating views of good tutors, good doctors, and learning to students' satisfaction and academic achievement. Likely sources of bias (selection, information, confounding) and other threats to rigour have been noted, but overall the evidence is consistent, coherent, authentic, and robust, even if the links found may not be directly causal.

Further work indicated

There are facets of this research that need pursuing in further work, e.g.:

- *A good learning history: learning before entry to medical school:*
  - To what extent do expectations of medical school affect subsequent curriculum satisfaction and academic performance, and how should 'widening participation' agendas take account of this?
- *A good doctor: defining characteristics:*
  - How might the 'good doctor' themes be developed to explore 'widening participation', formation of career intentions, and curriculum satisfaction?
- *A good career: their view of the future and their population perspective:*
  - Why does a community-orientated curriculum not translate into more community-orientated career intentions; how does socioeconomic status affect this; and how might attitudes to population health learning be developed further as a facet of learning approaches?
- *A good learning experience and good tutoring in a problem-based curriculum:*
  - How might the 'good tutor' themes be developed further to explore improving the PBL experience and its effectiveness; and how should learning approaches best be shaped (and addressed in admissions)?
- *A good curriculum: factors in problem-based curriculum 'satisfaction':*
  - What determines satisfaction in a problem-based curriculum?
- *A good outcome: assessment in a problem-based curriculum:*
  - Do students who pass all assessments first time make better use of PBL sessions?

Chapter 7: Comment

Reflections

This multifaceted work explored medical students' learning expectations and experience, for which the concept of measuring 'learning approaches' was crucial. (The concept keeps being refined, e.g. another 18-item Entwistle inventory has since emerged[599].) Learning approaches are good for group comparisons or for relating scores to learning context, for example, to promote deep learning or make students aware of the evidence and their scores so that they can reflect and adapt[175]. Generally, questionnaires might illuminate only part of the 'big picture', but there were 'mixed methods' opportunities here to revisit and illuminate some concepts several times (mindful to retain the context of the narrative 'chunks' studied[514]). Even with limited space, responders provided rich qualitative data, analysis of which is usually complicated and always time-consuming[513], whether the data be *"voluminous, unstructured and wieldy"*[514p216] or somewhat more manageable as here.

Comparing findings with the evidence-base was not straightforward. Many research reports had relevant detail missing (e.g. key features of study design or setting). There is much national[600] and international improvement needed on the 'QUESTS' dimensions of medical education evidence (quality, utility, extent, strength, target, setting)[434]. Even with recent advances in an evidence-based approach, and a renewed interest in aligning with health services research[601], it is revealing that the first BEME systematic review tackled high-fidelity medical simulations leading to effective learning[602]. Arguably, this is the more mechanistic end of the spectrum of priority research questions in undergraduate medical education research.

The generalizability of research in a 'PBL' setting can be problematic as there is so much scope for PBL implementation and the educational setting to differ from elsewhere[603,604] (e.g. the added value beyond *integrating* basic and clinical science[605]). Indeed, the PBL label can be almost meaningless in some renditions. World-wide, the 'PBL' advance continues though, with numerous explanations to different audiences as to its advantages and disadvantages[312,606,607,608], and much positivity from students[609] and faculty[610]. Camp's answer to 'Why did PBL catch on?' in this way was[240]:

– It was there at the right time to answer questions about forgetful medical students, who failed to apply and integrate, or refused learning opportunities.

- It was successfully implemented in the first few schools attempting it, probably through close communication and mentoring.
- Applicants started seeking it.
- It was consistent with:
  - 'adult learning theory'; and learning principles about motivation, relevance, active learning, and contextual learning
  - constructivist notions of knowledge (not fixed, but constructed by learner)
  - cognitive psychology theory (showing cognitive and motivational benefits)
- Medical schools did not wish to 'miss the boat'.

Arguably, staff are also more positive about PBL once they have been a PBL tutor[611], and it promotes both good student and good doctor[612]. In all this educational euphoria though, there must be research beyond early pioneering curricula and about students' expectations and experience in ecologically valid 'normal' situations, to complement the essential cognitive science insights[27,259,613,614,615] from more artificial examples:

- *"Pulling the plant up by its roots to examine it more carefully, or asking the student to carry out artificial learning tasks in a laboratory experiment, alters the whole nature of what is being examined."* **(Entwistle *et al*, 1979)**[146p101]

Exploring medical students' perceptions of the learning process is crucial:

- *"It is interesting that the process of PBL allows for the social correction of students' scientific misconceptions about content through the group dialectic. However, it is not as successful in dispelling erroneous conceptualizations of the learning process in spite of its self-reflective component."* **(Evensen *et al*, 2001)**[567p674]

As with other examples around the world, Liverpool managed a major transformation from a traditional to a problem-based curriculum (with reported improvement in student satisfaction[616]), despite warnings to the contrary in the literature:

- *"...it is unlikely that an established school will ever be able to introduce the degree if innovation which was possible for the problem-based schools [Newcastle and Maastricht], all of which were new institutions."* **(Newble & Clarke, 1986)**[272p272]

The challenge is to maintain momentum. Liverpool students described a generally positive PBL experience that still harboured frustrations. Some of these were attributable to students' inapt expectations clashing with PBL implementation[578] (appropriate or otherwise), with some uncertainty probably causing distress[617]. Recalling e-mail correspondence with Barrows, Wilkerson, and Ravitch, Camp noted a consensus about what constituted 'pure' PBL: *"active, adult-oriented, problem-centered, student-centered [sic], collaborative, integrated, interdisciplinary, utilizes small groups and operates in a clinical context"*[240p5]. This resonated with the PBL (or at least the rhetoric) to which these Liverpool students were generally exposed:

- *"By our definition, then, any program which does not place students in tutorial groups of, say, 5-10 students is not 'pure' PBL, nor are programs which operate in a single discipline, such as pathology, or pharmacology, or physiology, or neurology. In addition, if the program is 'teacher-centered', rather than 'student-centered', the heart of 'pure' PBL has been lost."* **(Camp, 1996)**[240p4]

Camp warned how the early pioneers of 'innovations' (e.g. lecture, slide, or MCQ) would be 'horrified' at their misuse over original intentions, and hoped that PBL would not befall a similar fate[240]. Student pressure to 'tell us what to learn', 'tell us the answers', and 'give us the learning objectives' should be viewed as an intellectual development stage and not a consumer demand to be met. To work, PBL needs better understanding of educational rationale and evidence and better implementation:

- *"...I hope it is a paradigm shift. The part of me that sees the glass as half-full believes that this is the future for medical education. The other side or [sic] me, though, the half-empty side, remembers all those other educational 'fads' and sighs."* **(Camp, 1996)**[240p5]

The research challenge is to focus on how and why each of the core concepts of PBL works or not, and under what conditions[603,618]. For example, what 'scaffolding' (cognitive or otherwise)[619] is needed for success in PBL *and* good career preparation; and to whom is PBL most suited (as dissatisfaction can be major in some settings or professional groups[620])? Where does measuring 'learning approaches' fit[621]? Being strategic about medical education research[622] should embrace such challenges and fuel debates of *crucial* concern to governments, funders, health services, and communities[622], i.e. what are the workforce, career, and service outcomes and implications of problem-based education and its selection processes?

- *"I feel I have developed appropriate thinking & management skills [I have enjoyed this way of learning.]*
- *I feel have an all-round knowledge of working in medicine thro' SF, PVPD, IGS & PP. (*but would I have gained these anyway?)"* *[S5-711] mid-Year 3, Q22*

THE UNIVERSITY of LIVERPOOL

...artment of Public Health, Whelan Building, Quadrangle
The University of Liverpool, Liverpool L69 3GB
Correspondent: telephone no: 0151 794 5592
e-mail: gillmau@liverpool.ac.uk

Thursday 23rd September 1999

...ear Year 1 Medical Student,

...should be grateful if you would contribute to ...ur understanding of how best to support ...edical students in their studies by completing ...his questionnaire **as best you can. (Even the ...riefest of comments/observations will be ...ppreciated.)** This study forms part of my MD ...esearch project on the development of medical ...udents' learning. Initially, I am trying to ...dentify your baseline expectations.

...ease **return** this questionnaire in the attached ...nvelope to Faculty Office (box labelled ...*earning to be a Doctor' Research Project* on ...eception desk) **by Monday 27.9.99** ahead of ...our first sessions. Your responses will be ...eated *in strict confidence and will not affect ...our academic progress. The unique identifying ...umber on the questionnaire merely allows me ...o link to your responses and other relevant ...formation in my future educational research.

...hope that medical school and your medical ...areer live up to your expectations. If you have ...ny queries about this study, *please* ask: I am on ...xtension 5592 (Department of Public Health).

...ours faithfully,

...r Gillian Maudsley
...enior Lecturer in Public Health Medicine
...B ChB, FRCPath, MPH (dist), MFPHM, MEd (dist)

...rstly, please provide a few details about ...ourself, ticking 3 or writing in... the boxes:

...nt ...er: ☐☐☐☐☐☐☐☐☐

...e of birth: ...onth/year ☐☐/☐☐/☐☐ **Age:** ☐☐ years

...postcode (...ents only): ☐☐☐☐☐☐☐ **Sex:** male ☐ female ☐

...ther's occupation:

...ther's occupation:

...ering as: 'school'-leaver ☐ graduate ☐
...chool'-leaver ...er gap year ☐ other, please specify ☐..................

...r ethnic origin (UK students only): White ☐
...ck-Caribbean ☐ Black-African ☐ Black-other** ☐
...dian ☐ Pakistani ☐ Bangladeshi ☐ Asian-other** ☐
...hinese ☐ Other** ☐
***Please also describe in own words: ....*

Now proceed to Q1-6 ...continued...

...strict confidence:* These data are for my research purposes only and completely separate from official curriculum administration channels

Appendix 1: Questionnaire: Study-element 1

...continued...

1) Describe what, for *you*, makes a good doctor:

2) Outline **three** things that would make this first undergraduate year a success for *you*:

   ➢

   ➢

   ➢

Please think for a little while about this next question – even if it seems quite difficult, please jot some thoughts down anyway...

3) Describe your experience as **'a learner' at school/college**:

4) Describe how you think that the following *might* differ from *your* experience as a learner at school/college:

(**Graduates**: please compare with your *actual* university experience in 4a); then, in 4b) & c) compare with school/college and previous degree)

a) **learning at university**:

b) **learning to be a doctor**:

c) **learning using problem-based learning (PBL)**:

In this country, doctors work as preregistration house officers ('PRHOs', 'internship') for their first year after graduating.

5) At the outset of your medical career, describe what *you* know about 'preregistration house year':

6) At the outset of your medical career, what is your intended career destination?

	Please tick one box only	
general practitioner (GP)	☐	
hospital doctor (consultant), please specify specialty	☐	....
community doctor (consultant), please specify specialty	☐	....
public health doctor (consultant)	☐	
other, please specify	☐	....
do not know	☐	

Appendix 2: Questionnaire: Study-element 2

THE UNIVERSITY of LIVERPOOL

...ment of Public Health, Whelan Building, Quadrangle
University of Liverpool, Liverpool L69 3GB
...y queries at all? telephone no: 0151 794 5592
e-mail: gillmau@liverpool.ac.uk

Friday 5th May 2000

...ar Year 1 Medical Student,

...questionnaire follows up on the one that I ...to you at the start of Year 1. Please try and ...pond, even if you did not do so last time. This ...y is part of my MD research project on how ...ical students' learning develops.

...ponses in the attached envelope (internal post) ...Friday 19.5.00, ahead of your assessments, ...uld be greatly appreciated. Whether or how ...respond will not compromise your academic ...d, and will be treated in strict confidence ...ase help if you can...

...s faithfully,

...illian Maudsley
...nior Lecturer in Public Health Medicine
...BChB, FRCPath, MPH (dist), MFPHM, MEd (dist)

...t you... *please tick 3 or write in the boxes:*

☐☐☐☐☐☐☐☐☐☐ **Sex:** male☐ female☐

...f birth: *day month year* — **Home postcode at entry:** *(UK 'home students' only)*

☐☐/☐☐/☐☐ — ☐☐☐☐☐☐☐

...r's occupation:

...er's occupation:

...ed year as: 'school'-leaver ☐ + *'A-level/Highers' resit year(s)* ☐
...-leaver, ...after ...(s) ☐ graduate ☐ other, please specify *(e.g. resit/restart Year 1, 'ACCESS', other 'mature')* ☐

...as:
...student' ☐ 'overseas student'* ☐
...other European ...country* *Please specify*:*

...ethnic origin: White ☐
...Caribbean ☐ Black-African ☐ Black-other* ☐
... Pakistani ☐ Bangladeshi ☐ Asian-other* ☐
... ☐ Other* ☐ *Please specify*:*

...your learning...

1) ...utline **three** things that have ...rticularly *helped your* learning in ...is academic year:

...continued...

...continued...

2) Outline **three** things that have particularly *hindered your* learning in this academic year:

-
-
-

About PBL...

3) Describe what, for *you personally*, are the essential characteristics of problem-based learning (PBL):

4) For PBL, what do *you* see as its **main** advantage and disadvantage?

- **advantage**
- **disadvantage**

5) Outline **three** characteristics of a good PBL tutor:

-
-
-

About what makes a good doctor...

6) For each row ('aspect'), please circle a score, **1** *disagree* to **4** *agree*, for the extent to which you agree that: [...this is important] [...the curriculum promotes this]

...a good doctor is...	...this is important: disagree			agree	...the curriculum promotes this: disagree			agree
well-balanced, insightful 'individual'	1	2	3	4	1	2	3	4
thinking, flexible learner	1	2	3	4	1	2	3	4
listening, informative communicator	1	2	3	4	1	2	3	4
friendly, inclusive team-player	1	2	3	4	1	2	3	4
experienced, knowledgeable expert	1	2	3	4	1	2	3	4
exemplary, responsible 'professional'	1	2	3	4	1	2	3	4
efficient, organized self-manager	1	2	3	4	1	2	3	4
decisive, competent diagnostician	1	2	3	4	1	2	3	4
compassionate, patient-centred carer	1	2	3	4	1	2	3	4

Further comments? (Overleaf)

these nine aspects were developed from your year group's answers to the previous questionnaire

About your career plans...

7) At this stage in your medical career, what is your intended career destination? *Please tick one box only*

- general practitioner (GP) ☐
- hospital doctor (consultant), please specify specialty* ☐ *
- community doctor (consultant), please specify specialty* ☐ *
- public health doctor (consultant) ☐
- other, please specify* ☐ *
- do not know ☐

In strict confidence: These data are for my research purposes only and completely separate from official curriculum administration channels.

Please write overleaf if necessary. *I very much appreciate you taking time to share your thoughts... Thank you*

Appendix 3: Questionnaire: Study-element 3 and coding-key for the 18-item Short RASI

Extracted from electronic notes provided by Entwistle for scoring the 18-item Short RASI (Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST))

"Scoring procedure

Students respond to items on a 1 - 5 scale (5 high). Sub-scale scores are formed by adding together the responses on the items in that sub-scale. Scoring can be carried out by computer, using a program such as SPSS. Each item is set as a variable (e.g. D04 = Deep item 4), and then a scale total is produced by creating a new variable by summing the items. For example, Deep approach = D02 + D06 +D10 + D12 +D15 + D17. The other two scale scores can then be formed in the same way."

"Deep Approach

D02 When I'm reading an article or book, I try to find out for myself exactly what the author means.
D06 Regularly I find myself thinking about ideas from lectures when I'm doing other things.
D10 When I'm working on a new topic, I try to see in my own mind how all the ideas fit together.
D12 Often I find myself questioning things I hear in lectures or read in books.
D15 Ideas in course books or articles often set me off on long chains of thought of my own.
D17 When I read, I examine the details carefully to see how they fit in with what's being said.

Strategic Approach

T03. I organise my study time carefully to make the best use of it.
T05. I look carefully at tutors' comments on course work to see how to get higher marks next time.
T07. I'm pretty good at getting down to work whenever I need to.
T09. I put a lot of effort into studying because I'm determined to do well.
T11. I don't find it at all difficult to motivate myself.
T13. I manage to find conditions for studying which allow me to get on with my work easily.

Surface Apathetic Approach

S01. Often I find myself wondering whether the work I am doing here is really worthwhile.
S04. I concentrate on learning just those bits of information I have to know to pass.
S08. Much of what I'm studying makes little sense: it's like unrelated bits and pieces.
S14. Often I feel I'm drowning in the sheer amount of material we're having to cope with.
S16. I often worry about whether I'll ever be able to cope with the work properly.
S18. I often have trouble in making sense of the things I have to remember."

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Appendix 3: Questionnaire: Study-element 3

Department of Public Health, Whelan Building, Quadrangle
The University of Liverpool, Liverpool L69 3GB
Queries? Tel: 0151-794-5592 e-mail: gillmau@liverpool.ac.uk

Confidential

Monday 22nd October 2001

Dear Year 1 Medical Student,

I should be grateful if you would spare some time to complete this short research questionnaire about your learning in a problem-based curriculum.

Please be assured that whether or how you respond will not affect your academic progress or compromise your academic record. Your responses will be treated **in strict confidence**. The unique identifying number merely allows me to link to your responses and other relevant information in my future educational research.

Please **reply** using the attached orange envelope **by Monday 12.11.01** (internal post, e.g. from halls or into the in-tray on Faculty Office counter).

This study underpins my MD research work: ***Please help if you can!***

Yours faithfully,

Dr Gillian Maudsley
Senior Lecturer in Public Health Medicine
MBChB, FRCPath, MPH (dist), MFPHM, MEd (dist)

1 About you... please tick or write in boxes:

...: ☐☐☐☐☐☐☐☐☐☐ Sex: male☐ female☐

☐☐

...birth: day month year ☐☐/☐☐/☐☐

Home postcode at entry: (UK 'home students' only) ☐☐☐☐☐☐☐☐

Problem-based learning group no.: ☐☐

...y:

...r's occupation:

...er's occupation:

...d year as: 'school'-leaver ☐ + 'A-level/Highers' resit year(s) ☐

...-leaver, ...d, after ...year(s) ☐ graduate☐ other, please specify☐ (e.g. resit/restart Year 1, 'ACCESS', other 'mature')

...ed as:

...udent' ☐ 'overseas student'* ☐

...ther European ...country* Please specify*:

...ic origin: White ☐

...Caribbean ☐ Black-African ☐ Black-other* ☐

...n ☐ Pakistani ☐ Bangladeshi ☐ Asian-other* ☐

...e ☐ Other* ☐ Please specify*:

2 About your approaches to studying... please complete this standard 'Approaches and Study Skills Inventory for Students' (Q1-18):

Approaches and Study Skills Inventory for Students (A S S I S T) (short version)

...se work through the following comments, giving your **immediate** response. In deciding your answers, think in terms ...his **MBChB programme.** It is also very important that you answer **all** the questions: check that you have done so.

5 = agree (✔)   4 = agree somewhat (✔?)   2 = disagree somewhat (x?)   1 = disagree (x).
Try not to use 3 = unsure (??), unless you really have to, or if it cannot apply to you or your course.

Circle one response only per statement	✔	✔?	??	x?	x
Often I find myself wondering whether the work I am doing here is really worthwhile.	5	4	3	2	1
When I'm reading an article or book, I try to find out for myself exactly what the author means.	5	4	3	2	1
I organise my study time carefully to make the best use of it.	5	4	3	2	1
I concentrate on learning just those bits of information I have to know to pass.	5	4	3	2	1
I look carefully at tutors' comments on course work to see how to get higher marks next time.	5	4	3	2	1
Regularly I find myself thinking about ideas from lectures when I'm doing other things.	5	4	3	2	1
I'm pretty good at getting down to work whenever I need to.	5	4	3	2	1
Much of what I'm studying makes little sense: it's like unrelated bits and pieces.	5	4	3	2	1
I put a lot of effort into studying because I'm determined to do well.	5	4	3	2	1
When I'm working on a new topic, I try to see in my own mind how all the ideas fit together.	5	4	3	2	1
I don't find it at all difficult to motivate myself.	5	4	3	2	1
Often I find myself questioning things I hear in lectures or read in books.	5	4	3	2	1
I manage to find conditions for studying which allow me to get on with my work easily.	5	4	3	2	1
Often I feel I'm drowning in the sheer amount of material we're having to cope with.	5	4	3	2	1
Ideas in course books or articles often set me off on long chains of thought of my own.	5	4	3	2	1
I often worry about whether I'll ever be able to cope with the work properly.	5	4	3	2	1
When I read, I examine the details carefully to see how they fit in with what's being said.	5	4	3	2	1
I often have trouble in making sense of the things I have to remember.	5	4	3	2	1

→...continued...↗

Part 3 About learning medicine using problem-based learning (PBL)... *please circle your immediate response to these statements:*

5 = agree (✔) *4 = agree somewhat (✔?)* *2 = disagree somewhat (x?)* *1 = disagree (x).*
Try not to use 3 = unsure (??), unless absolutely necessary *Circle one response only per statement*

	Ideally, my problem-based learning (PBL) tutor should...	✔	✔?	??	x?	x
19.	always look to involve everyone in keeping the session moving	5	4	3	2	1
20.	help us by discussing his/her own personal experiences of science and medicine	5	4	3	2	1
21.	look interested enough in what we have to say to want to be there	5	4	3	2	1
22.	act like another member of the group by contributing to the debate	5	4	3	2	1
23.	keep things non-competitive and relaxed so we can make mistakes when trying out explanations	5	4	3	2	1
24.	help get us moving again if we are well and truly stuck and missing things right under our noses	5	4	3	2	1
25.	recognize and understand various students' discomforts and difficulties during the session	5	4	3	2	1
26.	make sure that the group takes time to evaluate how things are going at the end of each session	5	4	3	2	1
27.	allow you to drift for now if you want to – it's only you that misses out if you don't participate!	5	4	3	2	1
28.	provide extra input to sessions from his/her particular discipline so as not to waste this expertise	5	4	3	2	1
29.	know the detailed content and answers of each objective we set	5	4	3	2	1
30.	avoid asking questions that worry us into having to go away and recheck our work all the time	5	4	3	2	1
31.	come right out and regularly judge our group and individual performance	5	4	3	2	1
32.	understand and stick to the rules of PBL	5	4	3	2	1
33.	be enthusiastic even if it is not his/her subject-area	5	4	3	2	1
34.	avoid the messy process of getting us to link various types of knowledge with the scenario	5	4	3	2	1
35.	save time by letting us skip explanations if we say that we've done it before	5	4	3	2	1
36.	be able to recognize what is important for a doctor to know	5	4	3	2	1
37.	remain detached in the background so as not to put us off our discussion	5	4	3	2	1
38.	contribute to the group dynamics and process rather than the content of the discussions	5	4	3	2	1
39.	ensure we focus on one theme or type of topic for most of a session so we work in neat blocks	5	4	3	2	1
40.	keep feedback mostly indirect and descriptive about how individuals and the group do things	5	4	3	2	1
41.	allow us to report back from notes when we've done the work but not had time to learn it yet	5	4	3	2	1
42.	guide us subtly back on the right track and depth if going off at a tangent or into too much detail	5	4	3	2	1
43.	avoid wasting precious time getting us to reflect back on every session	5	4	3	2	1
44.	indicate if we've said something silly so I don't waste time on other people's wrong answers	5	4	3	2	1
45.	avoid wasting session-time on students with personal problems	5	4	3	2	1
46.	communicate with students in a formal way	5	4	3	2	1
47.	help us to formulate specific learning objectives to sort out relevant gaps in group knowledge	5	4	3	2	1
48.	use our time to seek and respond to student feedback about his/her effect on the group	5	4	3	2	1
49.	encourage us to talk through and use what we already know about things, even simple stuff	5	4	3	2	1
50.	be a friendly character who puts the group at ease	5	4	3	2	1
51.	ask questions that challenge us to think whether we really understand what we're talking about	5	4	3	2	1
52.	tell me exactly what syllabus I need to cover for each scenario, avoiding uncertainty	5	4	3	2	1
53.	know how and when to interrupt the discussion without taking over	5	4	3	2	1
54.	ensure that students avoid commenting on his/her tutoring performance	5	4	3	2	1
55.	give us the faculty learning objectives	5	4	3	2	1
56.	take responsibility for complicated discussions by telling us the answers to difficult objectives	5	4	3	2	1

Moving on now... please think carefully about critical incidents sticking in your mind from PBL sessions so far, e.g. things you or others said/did:

57. Outline (anonymously) one specific incident with student(s) in your PBL group that contributed to an **unproductive** session.

Part 4 About your career... *Please tick one box only for Q58*

58. At this stage in your medical career, what is your intended career destination?

- general practitioner (GP) ☐
- hospital doctor (consultant), please specify specialty* ☐ *
- community doctor (consultant), please specify specialty* ☐ *
- public health doctor (consultant) ☐
- other, please specify* ☐ *
- do not know ☐

...and finally...

59. I chose Medicine because...

Thank you

In strict confidence: These data are for my research purposes only and completely separate from official curriculum administration channels.

'UCAS' number: □□□□□□□□□ Interview date:

THE UNIVERSITY *of* LIVERPOOL

'Learning to be a Doctor' Research Project

Appendix 4: Questionnaire: Study-element 4

Department of Public Health, Whelan Building, Quadrangle
The University of Liverpool, Liverpool L69 3GB
Queries? Ask in the Admissions Office

Confidential

Monday 5th November 2001

Dear Medical School Applicant (during academic year 2001/02),

I should be grateful if you would spare a few minutes to complete this short research questionnaire about your approach to learning and medical careers.

Please be assured that whether you respond or how you respond will not affect the outcome of your application Your responses will be treated **in strict confidence**. The unique identifying number merely allows me to link to your responses and other relevant information in my future educational research.

Please **fold** this questionnaire and **place it** (completed or otherwise) in the special box, for me to collect from the Admissions Office.

This study contributes to educational research related to learning at medical school: ***Please help if you can!***

Yours faithfully,

Dr Gillian Maudsley
Senior Lecturer in Public Health Medicine
MBChB, FRCPath, MPH (dist), MFPHM, MEd (dist)

1 About you… *please tick or write in boxes:*

male□ female□

birth: *day/month/year* □/□□/□□

Home postcode at entry: *(UK 'home students' only)* □□□□□□□

's occupation:

's occupation:

ing as: 'school'-leaver □ + *'A-level/Highers' resit year(s)* □
'-leaver,
erring for □ graduate□ other, please specify □
ap year(s) *(e.g. 'ACCESS', other 'mature')*

and as:

student' □ 'overseas student' * □
& other European *Please specify**:
on country*

ethnic origin: White □
-Caribbean □ Black-African □ Black-other* □
ian □ Pakistani □ Bangladeshi □ Asian-other* □
ese □ Other* □ *Please specify**:

2 About your approaches to studying… *please complete this standard 'Approaches and Study Skills Inventory for Students' (Q1-18):*

Approaches and Study Skills Inventory for Students (A S S I S T) (short version)

ase work through the following comments, giving your **immediate** response. In deciding your answers, think in terms of **your** rrent or **most recent learning**. It is also very important that you answer **all** the questions: check that you have done so.

5 = agree (✔) 4 = agree somewhat (✔?) 2 = disagree somewhat (x?) 1 = disagree (x).
Try not to use 3 = unsure (??), unless you really have to, or if it cannot apply to you or your situation.

Circle one response only per statement	✔	✔?	??	x?	x
1. Often I find myself wondering whether the work I am doing here is really worthwhile.	5	4	3	2	1
2. When I'm reading an article or book, I try to find out for myself exactly what the author means.	5	4	3	2	1
3. I organise my study time carefully to make the best use of it.	5	4	3	2	1
4. I concentrate on learning just those bits of information I have to know to pass.	5	4	3	2	1
5. I look carefully at tutors' comments on course work to see how to get higher marks next time.	5	4	3	2	1
6. Regularly I find myself thinking about ideas from lectures when I'm doing other things.	5	4	3	2	1
7. I'm pretty good at getting down to work whenever I need to.	5	4	3	2	1
8. Much of what I'm studying makes little sense: it's like unrelated bits and pieces.	5	4	3	2	1
9. I put a lot of effort into studying because I'm determined to do well.	5	4	3	2	1
10. When I'm working on a new topic, I try to see in my own mind how all the ideas fit together.	5	4	3	2	1
11. I don't find it at all difficult to motivate myself.	5	4	3	2	1
12. Often I find myself questioning things I hear in lectures or read in books.	5	4	3	2	1
13. I manage to find conditions for studying which allow me to get on with my work easily.	5	4	3	2	1
14. Often I feel I'm drowning in the sheer amount of material we're having to cope with.	5	4	3	2	1
15. Ideas in course books or articles often set me off on long chains of thought of my own.	5	4	3	2	1
16. I often worry about whether I'll ever be able to cope with the work properly.	5	4	3	2	1
17. When I read, I examine the details carefully to see how they fit in with what's being said.	5	4	3	2	1
18. I often have trouble in making sense of the things I have to remember.	5	4	3	2	1

3 About your career… *Please tick one box only for Q19*

19. At this stage, what is your intended medical career destination?
- eral practitioner (GP) □
- spital doctor (consultant), please specify specialty* □ *
- mmunity doctor (consultant), please specify specialty* □ *
- lic health doctor (consultant) □
- er, please specify* □ *
- n't know □

…and finally… *In Q20 please **rank** the descriptions using each number 1 to 9, as **1 most important** to **9 least important**, so that the ranks add up to **45***

20. A good doctor is…
- well-balanced, insightful 'individual' □
- thinking, flexible learner □
- listening, informative communicator □
- friendly, inclusive team-player □
- experienced, knowledgeable expert □
- exemplary, responsible 'professional' □
- efficient, organized self-manager □
- decisive, competent diagnostician □
- compassionate, patient-centred carer □ total=45

strict confidence: These data are for my research purposes **only** and completely separate from official curriculum administration

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Appendix 5: Questionnaire: Study-element 5

'Learning to be a Doctor' Research Project

Department of Public Health, Whelan Building, Quadrangle
The University of Liverpool, Liverpool L69 3GB
Queries? Tel: 0151-794-5592 e-mail: gillmau@liverpool.ac.uk

Confidential

Tuesday 11th December 2001

Dear Year 3 Medical Student (1999 entrant),

I do hope that you can spare a few minutes to complete this research questionnaire, which is part my MD. *(If I have used your address, this was only to save you a journey to collect this post.)* This study follows on from that of you and your colleagues in your first year here. Indeed, Q24-61 and Q64 build on your year's views about problem-based learning (PBL) tutoring and good doctors.

As stated previously, please be assured that whether or how you respond will not affect your academic progress or compromise your academic record. Your responses will be treated **in strict confidence**. Results will be presented in non-identifiable format only. The unique identifying number merely allows me to link to your responses and other relevant information as this educational research develops. Please **reply** with the enclosed stamped envelope, preferably **by Friday 21st December**. Please help if you can!

Yours faithfully,

Dr Gillian Maudsley
Senior Lecturer in Public Health Medicine
MBChB, FRCPath, MPH (dist), MFPHM, MEd (dist)

1 About you... *please tick or write in boxes:*

☐☐☐☐☐☐☐☐☐ Sex: male☐ female☐

☐☐

...birth: day/month/year ☐☐/☐☐/☐☐

Home postcode at entry: *(UK 'home students' only)* ☐☐☐☐☐☐☐

...year as: 'school'-leaver ☐ *'A-level/Highers' resit year(s)* ☐
...leaver, ...ed. after ...year(s) ☐ graduate☐ other. *please specify* * ☐ *(e.g. resit/restart Year 1, 'ACCESS', other 'mature')*

...and as:
...udent' ☐ 'overseas student' * ☐
...other European ...country* *Please specify*:

...thnic origin: White ☐
...-Caribbean ☐ Black-African ☐ Black-other* ☐
...n ☐ Pakistani ☐ Bangladeshi ☐ Asian-other* ☐
...e ☐ Other* ☐ *Please specify*:

2 About your approaches to studying... *please complete this standard 'Approaches and Study Skills Inventory for Students' (Q1-18):*

Approaches and Study Skills Inventory for Students (A S S I S T) (short version)

...se work through the following comments, giving your **immediate** response. In deciding your answers, think in terms ...this **MBChB programme.** It is also very important that you answer **all** the questions: check that you have done so.

5 = agree (✔) *4 = agree somewhat (✔?)* *2 = disagree somewhat (x?)* *1 = disagree (x).*
Try not to use 3 = unsure (??), unless you really have to, or if it cannot apply to you or your course.

Circle one response only per statement	✔	✔?	??	x?	x
Often I find myself wondering whether the work I am doing here is really worthwhile.	5	4	3	2	1
When I'm reading an article or book, I try to find out for myself exactly what the author means.	5	4	3	2	1
I organise my study time carefully to make the best use of it.	5	4	3	2	1
I concentrate on learning just those bits of information I have to know to pass.	5	4	3	2	1
I look carefully at tutors' comments on course work to see how to get higher marks next time.	5	4	3	2	1
Regularly I find myself thinking about ideas from lectures when I'm doing other things.	5	4	3	2	1
I'm pretty good at getting down to work whenever I need to.	5	4	3	2	1
Much of what I'm studying makes little sense: it's like unrelated bits and pieces.	5	4	3	2	1
I put a lot of effort into studying because I'm determined to do well.	5	4	3	2	1
When I'm working on a new topic, I try to see in my own mind how all the ideas fit together.	5	4	3	2	1
I don't find it at all difficult to motivate myself.	5	4	3	2	1
Often I find myself questioning things I hear in lectures or read in books.	5	4	3	2	1
I manage to find conditions for studying which allow me to get on with my work easily.	5	4	3	2	1
Often I feel I'm drowning in the sheer amount of material we're having to cope with.	5	4	3	2	1
Ideas in course books or articles often set me off on long chains of thought of my own.	5	4	3	2	1
I often worry about whether I'll ever be able to cope with the work properly.	5	4	3	2	1
When I read, I examine the details carefully to see how they fit in with what's being said.	5	4	3	2	1
I often have trouble in making sense of the things I have to remember.	5	4	3	2	1

3 About learning Medicine using problem-based learning (PBL)... *circle one response only per statement*

	✔	✔?	??	x?	x
If I had my time again, I would still do Medicine.	5	4	3	2	1
If I had my time again, I would still do Medicine in a problem-based curriculum.	5	4	3	2	1
If I had my time again, I would still do Medicine in this Liverpool problem-based curriculum.	5	4	3	2	1

Looking back, provide your **two** main comments on *your* experience of learning for a medical career via PBL:

23. For PBL, what do *you* see as its **main** advantage and disadvantage?

- **advantage**
- **disadvantage**

→...continued...↗

For Q24-61 (which build on your year-group's descriptions from 1st Year), please circle your immediate response to these statements:

5 = agree (✓) 4 = agree somewhat (✓?) 2 = disagree somewhat (x?) 1 = disagree (x).

Try not to use 3 = unsure (??), unless absolutely necessary

Circle one response only per statement

Ideally, my problem-based learning (PBL) tutor should…

No.	Statement	✓	✓?	??	x?	x
24.	always look to involve everyone in keeping the session moving	5	4	3	2	1
25.	help us by discussing his/her own personal experiences of science and medicine	5	4	3	2	1
26.	look interested enough in what we have to say to want to be there	5	4	3	2	1
27.	act like another member of the group by contributing to the debate	5	4	3	2	1
28.	keep things non-competitive and relaxed so we can make mistakes when trying out explanations	5	4	3	2	1
29.	help get us moving again if we are well and truly stuck and missing things right under our noses	5	4	3	2	1
30.	recognize and understand various students' discomforts and difficulties during the session	5	4	3	2	1
31.	make sure that the group takes time to evaluate how things are going at the end of each session	5	4	3	2	1
32.	allow you to drift for now if you want to – it's only you that misses out if you don't participate!	5	4	3	2	1
33.	provide extra input to sessions from his/her particular discipline so as not to waste this expertise	5	4	3	2	1
34.	know the detailed content and answers of each objective we set	5	4	3	2	1
35.	avoid asking questions that worry us into having to go away and recheck our work all the time	5	4	3	2	1
36.	come right out and regularly judge our group and individual performance	5	4	3	2	1
37.	understand and stick to the rules of PBL	5	4	3	2	1
38.	be enthusiastic even if it is not his/her subject-area	5	4	3	2	1
39.	avoid the messy process of getting us to link various types of knowledge with the scenario	5	4	3	2	1
40.	save time by letting us skip explanations if we say that we've done it before	5	4	3	2	1
41.	be able to recognize what is important for a doctor to know	5	4	3	2	1
42.	remain detached in the background so as not to put us off our discussion	5	4	3	2	1
43.	contribute to the group dynamics and process rather than the content of the discussions	5	4	3	2	1
44.	ensure we focus on one theme or type of topic for most of a session so we work in neat blocks	5	4	3	2	1
45.	keep feedback mostly indirect and descriptive about how individuals and the group do things	5	4	3	2	1
46.	allow us to report back from notes when we've done the work but not had time to learn it yet	5	4	3	2	1
47.	guide us subtly back on the right track and depth if going off at a tangent or into too much detail	5	4	3	2	1
48.	avoid wasting precious time getting us to reflect back on every session	5	4	3	2	1
49.	indicate if we've said something silly so I don't waste time on other people's wrong answers	5	4	3	2	1
50.	avoid wasting session-time on students with personal problems	5	4	3	2	1
51.	communicate with students in a formal way	5	4	3	2	1
52.	help us to formulate specific learning objectives to sort out relevant gaps in group knowledge	5	4	3	2	1
53.	use our time to seek and respond to student feedback about his/her effect on the group	5	4	3	2	1
54.	encourage us to talk through and use what we already know about things, even simple stuff	5	4	3	2	1
55.	be a friendly character who puts the group at ease	5	4	3	2	1
56.	ask questions that challenge us to think whether we really understand what we're talking about	5	4	3	2	1
57.	tell me exactly what syllabus I need to cover for each scenario, avoiding uncertainty	5	4	3	2	1
58.	know how and when to interrupt the discussion without taking over	5	4	3	2	1
59.	ensure that students avoid commenting on his/her tutoring performance	5	4	3	2	1
60.	give us the faculty learning objectives	5	4	3	2	
61.	take responsibility for complicated discussions by telling us the answers to difficult objectives	5	4	3		

Part 4 About your career… *In brief for Q62…*

62. Looking forward, provide your **two** main comments about how learning *Population Perspective* relates to *your* future work as a doc

-
-

…and finally… In Q64 please rank the descriptions (from your cohort's 1st Year answers) using each number 1 to 9, as **1 most important** *to* **9 least important**, *so the ranks add to*

63. At this stage in your medical career, what is your intended career destination?

- general practitioner (GP) ☐
- hospital doctor (consultant), please specify specialty* ☐ *
- community doctor (consultant), please specify specialty* ☐ *
- public health doctor (consultant) ☐
- other, please specify* ☐ *
- do not know ☐

Please tick one box only in Q63

64. A good doctor is…

- well-balanced, insightful 'individual' ☐
- thinking, flexible learner ☐
- listening, informative communicator ☐
- friendly, inclusive team-player ☐
- experienced, knowledgeable expert ☐
- exemplary, responsible 'professional' ☐
- efficient, organized self-manager ☐
- decisive, competent diagnostician ☐
- compassionate, patient-centred carer ☐

Thank you

In strict confidence: These data are for my research purposes **only** and completely separate from official curriculum administration channels

THE UNIVERSITY *of* LIVERPOOL

Problem-based learning group no.:

Appendix 6: Questionnaire: Study-element 6

Department of Public Health, Whelan Building, Quadrangle
The University of Liverpool, Liverpool L69 3GB
Queries? Tel: 0151-794-5592 e-mail: gillmau@liverpool.ac.uk

Confidential

Tuesday 14th May 2002

Dear Year 1 Medical Student,

This research questionnaire about your learning in a problem-based curriculum **revisits** some questions from my survey of you and your colleagues last semester, *and* asks some new questions. I should be grateful if you would have a go at completing this form (even if you did not respond in the previous round).

As stated previously, please be assured that whether or how you respond will not affect your academic progress or compromise your academic record. Your responses will be treated **in strict confidence**. Results will be presented in non-identifiable format only. The unique identifying number merely allows me to link to your responses and other relevant information as this educational research develops. Please **reply** in the orange internal-envelope, preferably **by Thursday 23rd May** (e.g. internal post from halls or the in-tray on Faculty Office counter).

This study underpins my MD research work: **Please help if you can!**

Yours faithfully,

Dr Gillian Maudsley, Senior Lecturer in Public Health Medicine
MBChB, FRCPath, MPH (dist), MFPHM, MEd (dist)

1 About you... *please tick or write in boxes:*

...: ☐☐☐☐☐☐☐☐☐ Sex: male☐ female☐

...of birth: *day/month/year* ☐☐/☐☐/☐☐

Home postcode at entry: *(UK 'home students' only)* ☐☐☐☐☐☐☐

...ed as: 'school'-leaver ☐ *'A-level/Highers' resit year(s)* ☐

...-leaver, ...ed, after ... years) ☐ graduate☐ other* ☐ Please specify*: *(e.g. resit/restart Year 1, 'ACCESS', other 'mature')*

...and as: ...student' ☐ 'overseas student'* ☐

...-other European ... country* Please specify*:

...thnic origin: White ☐

...-Caribbean ☐ Black-African ☐ Black-other* ☐

...☐ Pakistani ☐ Bangladeshi ☐ Asian-other* ☐

...☐ Other* ☐ Please specify*:

2 About your approaches to studying... *please complete this standard 'Approaches and Study Skills Inventory for Students' (Q1-18):*

Approaches and Study Skills Inventory for Students (A S S I S T) (short version)

...se work through the following comments, giving your **immediate** response. In deciding your answers, think in terms ...this **MBChB programme.** It is also very important that you answer **all** the questions: check that you have done so.

5 = agree (✔) 4 = agree somewhat (✔?) 2 = disagree somewhat (x?) 1 = disagree (x).
Try not to use 3 = unsure (??), unless you really have to, or if it cannot apply to you or your course.

Circle one response only per statement	✔	✔?	??	x?	x
Often I find myself wondering whether the work I am doing here is really worthwhile.	5	4	3	2	1
When I'm reading an article or book, I try to find out for myself exactly what the author means.	5	4	3	2	1
I organise my study time carefully to make the best use of it.	5	4	3	2	1
I concentrate on learning just those bits of information I have to know to pass.	5	4	3	2	1
I look carefully at tutors' comments on course work to see how to get higher marks next time.	5	4	3	2	1
Regularly I find myself thinking about ideas from lectures when I'm doing other things.	5	4	3	2	1
I'm pretty good at getting down to work whenever I need to.	5	4	3	2	1
Much of what I'm studying makes little sense: it's like unrelated bits and pieces.	5	4	3	2	1
I put a lot of effort into studying because I'm determined to do well.	5	4	3	2	1
When I'm working on a new topic, I try to see in my own mind how all the ideas fit together.	5	4	3	2	1
I don't find it at all difficult to motivate myself.	5	4	3	2	1
Often I find myself questioning things I hear in lectures or read in books.	5	4	3	2	1
I manage to find conditions for studying which allow me to get on with my work easily.	5	4	3	2	1
Often I feel I'm drowning in the sheer amount of material we're having to cope with.	5	4	3	2	1
Ideas in course books or articles often set me off on long chains of thought of my own.	5	4	3	2	1
I often worry about whether I'll ever be able to cope with the work properly.	5	4	3	2	1
When I read, I examine the details carefully to see how they fit in with what's being said.	5	4	3	2	1
I often have trouble in making sense of the things I have to remember.	5	4	3	2	1

3 About learning Medicine using problem-based learning (PBL)... *circle one response only per statement*

	✔	✔?	??	x?	x
If I had my time again, I would still do Medicine.	5	4	3	2	1
If I had my time again, I would still do Medicine in a problem-based curriculum.	5	4	3	2	1
If I had my time again, I would still do Medicine in this Liverpool problem-based curriculum.	5	4	3	2	1

Q22-24 *(Complete each sentence with one main thing that sticks in your mind as adversely affecting PBL session(s) for YOU)*

...PBL sessions do not work so well for *me* **if I**...

23. PBL sessions do not work so well for *me* **if (an)other student(s)**...

24. PBL sessions do not work so well for *me* **if the tutor**...

→...continued...↗

For Q25-62 (which build on the descriptions from 1st Year in 1999/00), please circle your immediate response to these statements:

5 = agree (✔) *4 = agree somewhat (✔?)* *2 = disagree somewhat (x?)* *1 = disagree (x).*
Try not to use 3 = unsure (??), unless absolutely necessary *Circle one response only per statem*

Ideally, my problem-based learning (PBL) tutor should...

		✔	✔?	??	x?	x
25.	always look to involve everyone in keeping the session moving	5	4	3	2	1
26.	help us by discussing his/her own personal experiences of science and medicine	5	4	3	2	1
27.	look interested enough in what we have to say to want to be there	5	4	3	2	1
28.	act like another member of the group by contributing to the debate	5	4	3	2	1
29.	keep things non-competitive and relaxed so we can make mistakes when trying out explanations	5	4	3	2	1
30.	help get us moving again if we are well and truly stuck and missing things right under our noses	5	4	3	2	1
31.	recognize and understand various students' discomforts and difficulties during the session	5	4	3	2	1
32.	make sure that the group takes time to evaluate how things are going at the end of each session	5	4	3	2	1
33.	allow you to drift for now if you want to – it's only you that misses out if you don't participate!	5	4	3	2	1
34.	provide extra input to sessions from his/her particular discipline so as not to waste this expertise	5	4	3	2	1
35.	know the detailed content and answers of each objective we set	5	4	3	2	1
36.	avoid asking questions that worry us into having to go away and recheck our work all the time	5	4	3	2	1
37.	come right out and regularly judge our group and individual performance	5	4	3	2	1
38.	understand and stick to the rules of PBL	5	4	3	2	1
39.	be enthusiastic even if it is not his/her subject-area	5	4	3	2	1
40.	avoid the messy process of getting us to link various types of knowledge with the scenario	5	4	3	2	1
41.	save time by letting us skip explanations if we say that we've done it before	5	4	3	2	1
42.	be able to recognize what is important for a doctor to know	5	4	3	2	1
43.	remain detached in the background so as not to put us off our discussion	5	4	3	2	1
44.	contribute to the group dynamics and process rather than the content of the discussions	5	4	3	2	1
45.	ensure we focus on one theme or type of topic for most of a session so we work in neat blocks	5	4	3	2	1
46.	keep feedback mostly indirect and descriptive about how individuals and the group do things	5	4	3	2	1
47.	allow us to report back from notes when we've done the work but not had time to learn it yet	5	4	3	2	1
48.	guide us subtly back on the right track and depth if going off at a tangent or into too much detail	5	4	3	2	1
49.	avoid wasting precious time getting us to reflect back on every session	5	4	3	2	1
50.	indicate if we've said something silly so I don't waste time on other people's wrong answers	5	4	3	2	1
51.	avoid wasting session-time on students with personal problems	5	4	3	2	1
52.	communicate with students in a formal way	5	4	3	2	1
53.	help us to formulate specific learning objectives to sort out relevant gaps in group knowledge	5	4	3	2	1
54.	use our time to seek and respond to student feedback about his/her effect on the group	5	4	3	2	1
55.	encourage us to talk through and use what we already know about things, even simple stuff	5	4	3	2	1
56.	be a friendly character who puts the group at ease	5	4	3	2	1
57.	ask questions that challenge us to think whether we really understand what we're talking about	5	4	3	2	1
58.	tell me exactly what syllabus I need to cover for each scenario, avoiding uncertainty	5	4	3	2	1
59.	know how and when to interrupt the discussion without taking over	5	4	3	2	1
60.	ensure that students avoid commenting on his/her tutoring performance	5	4	3	2	1
61.	give us the faculty learning objectives	5	4	3	2	1
62.	take responsibility for complicated discussions by telling us the answers to difficult objectives	5	4	3	2	

Part 4 About your career... *In brief for Q63...*

63. Looking forward, provide your **two** main comments about how learning *Population Perspective* relates to *your* future work as a doc

▪

▪

...and finally... In Q65 please rank the descriptions (deriv from 1st Year's answers in 1999/00) using each number 1 t as 1 most important to 9 least important, so the ranks add t

64. At this stage in your medical career, what is your intended career destination?

- general practitioner (GP) ☐
- hospital doctor (consultant), please specify specialty* ☐ *
- community doctor (consultant), please specify specialty* ☐ *
- public health doctor (consultant) ☐
- other, please specify* ☐ *
- do not know ☐

Please tick one box only in Q64

65. A good doctor is...

- well-balanced, insightful 'individual' ☐
- thinking, flexible learner ☐
- listening, informative communicator ☐
- friendly, inclusive team-player ☐
- experienced, knowledgeable expert ☐
- exemplary, responsible 'professional' ☐
- efficient, organized self-manager ☐
- decisive, competent diagnostician ☐
- compassionate, patient-centred carer ☐

Thank you!

In strict confidence: These data are for my research purposes **only** and completely separate from official curriculum administration channels

Appendix 7: Good tutor item development

	Ideally, my problem-based learning (PBL) tutor should...		code	
1	know how and when to interrupt the discussion without taking over	Y	3	
2	take responsibility for complicated discussions by telling us the answers to difficult objectives	N	3	
3	guide us subtly back on the right track and depth if going off at a tangent or into too much detail	Y	1	
4	tell me exactly what syllabus I need to cover for each scenario, avoiding uncertainty	N	1	
5	be a friendly character who puts the group at ease	Y	2	
6	communicate with students in a formal way	N	2	
7	always look to involve everyone in keeping the session moving	Y	4	
8	allow you to drift for now if you want to – it's only you that misses out if you don't participate!	N	4	
9	be able to recognize what is important for a doctor to know	Y	6	
10	know the detailed content and answers of each objective we set	N	6	
11	look interested enough in what we have to say to want to be there	Y	10	
12	remain detached in the background so as not to put us off our discussion	N	10	
13	help get us moving again if we are well and truly stuck and missing things right under our noses	Y	11	
14	help us by discussing his/her own personal experiences of science and medicine	N	11	
15	Ask questions that challenge us to think whether we really understand what we're talking about	Y	8	
16	avoid asking questions that worry us into having to go away and recheck our work all the time	N	8	
17	contribute to the group dynamics and process rather than the content of the discussions	Y	7	13
18	Act like another member of the group by contributing to the debate	N	7	13
19	keep things non-competitive and relaxed so we can make mistakes when trying out explanations	Y	5	
20	indicate if we've said something silly so I don't waste time on other people's wrong answers	N	5	
21	help us to formulate specific learning objectives to sort out relevant gaps in group knowledge	Y	9	
22	give us the faculty learning objectives	N	9	
23	keep feedback mostly indirect and descriptive about how individuals and the group do things	Y	5	14
24	come right out and regularly judge our group and individual performance	N	5	14
25	understand and stick to the rules of PBL	Y	12	
26	allow us to report back from notes when we've done the work but not had time to learn it yet	N	12	
27	recognize and understand various students' discomforts and difficulties during the session	Y	15	
28	avoid wasting session-time on students with personal problems	N	15	
29	be enthusiastic even if it is not his/her subject-area	Y	16	
30	provide extra input to sessions from his/her particular discipline so as not to waste this expertise	N	16	
31	Use our time to seek and respond to student feedback about his/her effect on the group	Y	17	
32	ensure that students avoid commenting on his/her tutoring performance	N	17	
33	make sure that the group takes time to evaluate how things are going at the end of each session	Y	18	
34	avoid wasting precious time getting us to reflect back on every session	N	18	
35	encourage us to talk through and use what we already know about things, even simple stuff	Y	extra	
36	save time by letting us skip explanations if we say that we've done it before	N	extra	
37	avoid the messy process of getting us to link various types of knowledge with the scenario	$\boxed{\text{N}}$	extra	
38	ensure we focus on one theme or type of topic for most of a session so we work in neat blocks	$\boxed{\text{N}}$	extra	

Paired statements:

Y=Yes, this is recommended

N=No, this is not recommended

NB: □ = the paired statements that were mistakenly designed in the same direction

Appendix 8: Permissions (examples) for 'Learning to be a Doctor' research

From: Sam Leinster <[redacted]@liverpool.ac.uk> Director of Medical Studies **Example: e-mail correspondence about Study-element (S)1**
To: Gillian Maudsley <[redacted]@liverpool.ac.uk>
Subject: OK to proceed? 'Learning to be Doctors' Research Project: MBChB curriculum
In-Reply-To: SIMEON.9909211925.G@pc012020.liverpool.ac.uk Message-ID: <SIMEON.9909220819.C@pc027113.liverpool.ac.uk>
Date: Wed, 22 Sep 1999 08:24:19 +0100 (GMT Daylight Time)

Dear Gillian,
There should be no problems with sending out this questionnaire. Should the covering letter be more explicit that this has nothing to do with the course administration and will be kept confidential from the official channels?
Best of luck with the project.
Sam
On Tue, 21 Sep 1999 19:16:25 +0100 (GMT Daylight Time)
Gillian Maudsley <[redacted]@liverpool.ac.uk> wrote:

> CONFIDENTIAL
> Re: 'Learning to be Doctors' Research Project: MBChB > curriculum
>
> Sam,
> I am just checking with you that I will not be creating any problems by issuing a short 2-page self-completion questionnaire to
> the new intake of medical students at registration. I have discussed the registration process for Thursday pm and Friday am this
> week with David Williams, to minimize any disruption. I will be providing the questionnaires in named envelopes (according
> to David's latest list). The questionnaire includes a unique identifying number (that would facilitate follow-up), a short letter
> asking for their participation, a request for a few personal details, and several open-ended questions about their expectations of
> learning: at university; to be doctors; with problem-based learning, etc. The short letter goes something like this **DRAFT**-
> --
> Dear Year 1 Medical Student,
> I should be grateful if you would contribute to our understanding of how best to support medical students in their studies by
> completing this questionnaire as best you can (even the briefest of comments/ observations will be appreciated). This study
> forms part of my MD research project on the development of medical students' learning. Initially, I am trying to identify your
> baseline expectations.
> Please return this questionnaire in the attached envelope to Faculty Office (postbox labelled 'Learning to be a Doctor' Research
> Project on Reception desk) by Monday 27.9.99 ahead of your first sessions. Your responses will be treated in confidence and
> will not affect your academic progress. The unique identifying number on the questionnaire merely allows me to link this with
> your responses and other relevant information in future educational research.
> I hope that medical school and your medical career lives up to your expectations. If you have any queries, please let me know
> on extension 5592 in the Department of Public Health.
> Yours faithfully,
> Dr Gillian Maudsley
> Senior Lecturer in Public Health Medicine
> MB ChB, MRCPath, MPH (dist), MFPHM, MEd (dist)
> --
> This is part of my MD research project about medical students' learning development (with John Bligh and Lyn Williams, who
> have both commented on the questionnaire design already). I am away tomorrow, but will send you a copy of the
> questionnaire on Thursday. I have informed Peter Dangerfield, and have copied this to him as well.
> I assume that it is safe to proceed...
> Gillian
> ----------------------
> Dr Gillian Maudsley,
> Senior Lecturer in Public Health Medicine,
> Department of Public Health, Whelan Building, Quadrangle, The University of Liverpool, Liverpool. L69 3GB
> Tel: [redacted], Fax: [redacted]

[redacted]@liverpool.ac.uk
Professor Sam Leinster, Director of Medical Studies, University of Liverpool

From: Gillian Maudsley [redacted]@liverpool.ac.uk **Example: e-mail correspondence about S1**
To: Sam Leinster <[redacted]@liverpool.ac.uk> Cc: EMI Williams <[redacted]@liverpool.ac.uk>, John Bligh <[redacted]@liverpool.ac.uk>,
[redacted]@liverpool.ac.uk
Subject: OK to proceed? 'Learning to be Doctors' Research Project: MBChB curriculum
In-Reply-To: SIMEON.9909220819.C@pc027113.liverpool.ac.uk Message-ID: <SIMEON.9909231746.A@pc012020.liverpool.ac.uk>
Date: Thu, 23 Sep 1999 17:56:46 +0100 (GMT Daylight Time)

CONFIDENTIAL
Re: Just to keep you informed...
Sam,
>
> There should be no problems with sending out this questionnaire. Should the covering letter be more explicit that this has
> nothing to do with the course administration and will be kept confidential from the official channels?
>
Yes, thankyou for that. I have changed the footer from 'In confidence' to 'In strict confidence:*These data are for my [[continued overleaf]]

[[continued research purposes only and completely separate from official curriculum administration channels.' This cross-references to the relevant bit of the short covering letter, which I have adjusted accordingly...
>
> Best of luck with the project.
>
As previously indicated, I have left a copy of the questionnaire for you in Faculty Office for information (a copy is winging its way to Peter Dangerfield, and I am letting David Taylor know too in case of queries to tutors),
Gillian
PS ((A secretary from over here, [redacted], has been over there helping to give the letters out at the same time as the packs/student cards, to minimize any perceived disruptions to the registration process.))

Dr Gillian Maudsley,
Senior Lecturer in Public Health Medicine.
Department of Public Health, Whelan Building, Quadrangle, The University of Liverpool, Liverpool. L69 3GB
Tel: [redacted]. Fax: [redacted]

From: Gillian Maudsley gillmau@liverpool.ac.uk **Example: e-mail correspondence about S4 and referring to S3 & S5**
To: Anne S Garden <[redacted]@liverpool.ac.uk> [[Director of Medical Studies]]
Cc: Clive Richards <[redacted]@liverpool.ac.uk>, David Taylor <[redacted]@liverpool.ac.uk>, EMI Williams <[redacted]@liverpool.ac.uk>
Subject: Supplementary note: Approval for MD research Message-ID: <SIMEON.10111022121.A@uni-liv-dialup-user.liverpool.ac.uk>
Date: Fri, 2 Nov 2001 21:53:21 +0000 (GMT Standard Time)

CONFIDENTIAL
Re: Supplementary note about approval: following e-mail of 12.10.01 about continuation of 'Learning to a Doctor' Research project during 2001/02, MBChB curriculum To Director of Medical Studies

Anne (copied to Clive),
Further to my previous e-mail of 12.10.01 and our brief meeting of 18.10.01, the Year 1 questionnaire survey related to my MD educational research is in progress. Further to my conversation with you about extending the learning approaches survey to the medical school applicants during 2001/02, I discussed this with Clive Richards yesterday. We discussed my draft questionnaire and ways of minimizing disruption to the office, and [redacted] has kindly agreed to hand out the 1-page closed questionnaire to those candidates attending for interview (starting 5.11.01). As noted previously, the plan is to compare the responses (linking via the 'UCAS' number of those that we ultimately admit with other groups in the overall candidate-'pool'). Besides linking with my other research, this element should also provide some helpful evidence for the admissions process.
It will be made clear to the candidates that it is up to them whether or how they respond and that their responses will not affect their application in any way. I have copied the note on the questionnaire below, for your information. The Admissions Office will complete the 'UCAS' number and date of interview. The questionnaire requests from the responders similar demographic information to that featuring in my previous questionnaires. There are then 20 closed questions (18 for the standard learning styles inventory, the 19th being the career intentions question used in the previous questionnaires, and the 20th about ranking nine descriptions of a 'good doctor' derived from the 1999 cohort's answers at entry to medical school. I have left a special post-box in the Admissions Office for the responders to use. I will copy a version of this questionnaire to you.
Gillian
PS As per our recent conversation, I will defer the second follow-up questionnaire to the 1999 cohort (now in Year 3) until after their impending Level 2 assessment (this month), maybe during their subsequent special study module period.

Copied to MD joint supervisors EMIW/DCMT
###

[[Copy of note on questionnaire to applicants also INCLUDED with this e-mail]]

###

Dr Gillian Maudsley,
Senior Lecturer in Public Health Medicine.
Department of Public Health, Whelan Building, Quadrangle, The University of Liverpool, Liverpool. L69 3GB
Tel: [redacted]. Fax: [redacted]

Appendix 9: Principal components analysis: Questionnaire survey of medical students: Year 1 at start and end of year, 2001/02 (Study-element (S)3 & S6) and Year 3, mid-2001/02 (S5): Perceptions of a good tutor: Choosing an appropriate model using factorability, stability, and utility criteria

Criteria	S3 (n=201), Q19-56		S6 (n=198), Q25-62		S5 (n=158), Q24-61	
Factorability related to sample size						
Correlation matrix						
• **$r_p \geq 0.3$**[493p283] preferable. If none >0.3, probably nothing to factor-analyse[492p589]. If variables not correlating with others or correlating >0.9 (look for most pairings p>0.05), ?remove[494p444, p446]	One at r_p=0.7, one at 0.6, three at 0.5, twelve at 0.4, etc.		One at r_p=0.7, two at 0.6, several at 0.5, several at 0.4		Several at r_p=0.5 and more at 0.4	
Anti-image matrix						
• **KMO values >0.5 on diagonal** (the Kaiser-Meyer-Olkin value) for each variable in the anti-image correlation (lower) section, or → ?remove variables and rerun to note difference[493p295,494p456]	✓ nil less than 0.5		✓ despite Q37: 0.484; Q46: 0.466		X/✓ despite Q32: 0.491; Q40: 0.490; Q46: 0.446; Q50: 0.491; Q54: 0.386	
• **Small negative partial correlations (off-diagonal)** in the anti-image correlation (lower) section[492p589,493p283]	✓ reasonable		✓ reasonable		✓ reasonable	
Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (mean of KMOs for variables)						
• **≥0.6 →good factorability**[492p589]; 0.6 is acceptable[493p294], should be >0.5 (0.5-0.7 mediocre, 0.7-0.8 good, 0.8-0.9 great, >0.9 superb)[494p455]	✓ 0.731		✓ 0.797		✓ 0.616	
Bartlett's Test of Sphericity (use only if <5 participants per variable as very sensitive)[492p589]	*[201/38=5.29 participants per variable]*		*[198/38=5.21 participants per variable]*		*[158/38=4.16 participants per variable]*	
• **p<0.05**[493p294] **and >0.00001**; if less & r_p>0.8, ?remove variables[494p444]	7.03E-118, but no r_p>0.8		3.10E-187, but no r_p>0.8		1.52E-72, but no r_p>0.8	
Factorability related to best individual solutions	5 factors	6 factors	4 factors	5 factors	5 factors	6 factors
Reproduced correlations matrix						
• **Small residuals, small %>0.05,** in the residual (lower) section[493p285] [→good solution] [several moderate residuals 0.05-0.10 or a few large ones >0.1 suggest presence of another factor[492p622]]; if >50% are >0.05, there are grounds for concern	42.0%, 7 iterations	38.0%, 9 iterations	38.0%, 12 iterations	37.0%, 15 iterations	45.0%, 10 iterations	43.0%, 21 iterations
Communalities						
• **Large extraction communalities** otherwise consider dropping variables[493p296]; if all communalities >0.6 in samples <100 fine, but if in 0.5 range need 100-200, but if well below 0.5 need >500[494p443]	0.099-0.597 mean=0.39	0.132-0.646 mean=0.43	0.139-0.676 mean=0.40	0.139-0.678 mean=0.43	0.098-0.578 mean=0.38	0.199-0.601 mean=0.42
Scree-plot						
• **No. of factors**[493,494p436,492p621]; reliable for selecting number of factors for >200 participants[494p436]	6 or perhaps just 5 (??7); gap larger between 6 & 7		4 or 5 (???6); big gap between 4 & 5		5 or perhaps 6 (???even 7); big gap between 5 & 6	
Number of factors						
• **Need at least 5-6 factors** for a stable solution[492p587]	✓		X/✓		✓	
• **'Eigenvalues > 1.0' rule:** should give maximum no. of factors, i.e. usually between no. of variables/3 and /5[492p620]; but the '>1.0 rule' better if<30 variables, >250 participants, and average communalities ≥0.6 (otherwise use scree-plot if participants >200)[494p437]	12 eigenvalues >1.0, and anyway 38 variables (?should give 7.6-12.7 factors) and n=201, so 'rule' not very helpful		10 eigenvalues >1.0, and anyway 38 variables (?should give 7.6-12.7 factors) and n=198 so 'rule' not very helpful		12 eigenvalues >1.0, and anyway 38 variables (?should give 7.6-12.7 factors) and n=158 so 'rule' not very helpful	
Number of participants						
• **Sample size:** 50 very poor, 100 poor, 200 fair, 300, good, 500 very good, 1,00 excellent; but 150 sufficient if several high loading variables, e.g. >0.8[492p588]	fair (but 3 variables load at 0.7)	fair (but 5 variables load at 0.7)	fair (but 2 variables load at >0.7 & 6 at 0.7)	fair (but 2 variables load at >0.7 & 5 at 0.7)	poor to fair, (but 5 variables load at 0.7)	poor to fair (but 6 variables load at 0.7)
Stability of solution						
• **Solution appears whatever extraction**[492p609] **or rotation**[492p614,494]; with 30 or more variables and communalities >0.7 for all variables, different solutions unlikely but with <20 and any low communalities <0.4, differences can occur[494p434]	differences expected	differences expected	differences expected	differences expected	differences expected	differences expected
• **If a factor has ≥4 loadings >0.6→reliable** regardless of n; but if a factor has only a few loadings→do not be use unless n≥300[494p443]	2 components with 6 & 4 loadings ≥0.6	1 component with 4 loadings ≥0.6	2 components with 8 & 6 loadings ≥0.6	2 components with 8t & 4 loadings ≥0.6	2 components with 4 loadings ≥0.6	2 components with 4 loadings ≥0.6
All variables useful?						
Outlier variables						
• **If low squared multiple correlation** with all other variables and low correlations with all important factors	—	—	—	—	—	—
Adequacy of rotation						
• **Check correlation matrix patterns** reflected in rotated solution[492p623]	—	—	—	—	—	—
Loading matrix						
• **Variables loading at ≥0.32**[492p625] (in excess of 0.71, excellent: 0.63 very good; 0.55 good; 0.45 fair; 0.32 poor) [typically take >0.3, but: allowing for alpha=0.01 and multiple tests: n=50 loading of 0.722 significant, n=100 >0.512; n=200, >0.364; n=300, >0.298; n=600, >0.21; n=1,000, >0.162[494p440]]	one variable, Q27 does not load; highest on component 1 (0.286)	all variables load on ≥1 factors	one variable, Q33 does not load; highest on component 1 (-0.274)	two variables, Q44 & Q46, do not load; but highest on components 2 (-0.286) & 4 (0.310)	one variable, Q53 does not load; highest on component 4 (0.238)	all variables load on ≥1 factors
Solution explains... (% of variance explained)	**38.6%**	**42.8%**	**39.6%**	**43.1%**	**38.4%**	**42.4%**

■ denotes the best solutions

Liverpool MBChB curriculum, Year 1 medical students, Study (S)3 & S6, and Year 3, S5

Appendix 10: Principal components analysis: Questionnaire survey of Year 1 medical students at start and end of year, 2001/02 (Study-element (S)3 & S6) and Year 3 medical students mid-2001/02 (S5): Perceptions of a good tutor: Loadings on components in each of three 5-component models

S3 Component 1 tells me what to learn	S6 Component 1 helps me with how to learn	S5 Component 1 tells me what to learn	S3 Component 2 helps me with how to learn	S6 Component 2 tells me what to learn	S5 Component 2 helps me with how to learn	S3 Component 3 engages with me us	S6 Component 3 does not facilitate active learning	S5 Component 3 facilitates active learning	S3 Component 4 focuses on content	S6 Component 4 focuses on content	S5 Component 4 engages with me/us	S3 Component 5 does not facilitate active learning	S6 Component 5 engages with me/us	S5 Component 5 focuses on process
Q52 tell me exactly what syllabus I need to cover for each scenario, avoiding uncertainty ♦ ➔ 0.662	Q30 help get us moving again if we are well and truly stuck and missing things right under our noses ♦ ➔ 0.792	Q6 I take responsibility for complicated discussions by telling us the answers to difficult objectives ♦ ➔ 0.737	Q50 be a friendly character who puts the group at ease ♦ ➔ 0.573	Q58 tell me exactly what syllabus I need to cover for each scenario, avoiding uncertainty ♦ 0.704	Q47 guide us subtly back on the right track and depth if going off at a tangent or into too much detail ♦ ➔ 0.679	Q19 always look to involve everyone in keeping the session moving ♦ 0.658	Q49 avoid wasting precious time getting us to reflect back on every session ♦ 0.649	Q48 avoid wasting precious time getting us to reflect back on every session ♦ -0.580	Q20 help us by discussing his/her own personal experiences of science and medicine ♦ 0.636	Q51 avoid wasting session-time on students with personal problems ♦ 0.560	Q38 be enthusiastic even if it is not his/her subject-area ♦ 0.665	Q31 come right out and regularly judge our group and individual performance ♦ 0.619	*Q37 come right out and regularly judge our group and individual performance* ♦ *0.657*	*Q35 avoid asking questions that worry us into having to go away and recheck our work all the time* ♦ *0.638*
Q56 take responsibility for complicated discussions by telling us the answers to difficult objectives ♦ ➔ 0.645	Q56 be a friendly character who puts the group at ease ♦ ➔ 0.758	Q60 give us the faculty learning objectives ♦ ➔ 0.703	Q53 know how and when to interrupt the discussion without taking over ♦ ➔ 0.568	Q62 take responsibility for complicated discussions by telling us the answers to difficult objectives ♦ 0.647	Q58 know how and when to interrupt the discussion without taking over ♦ ➔ 0.676	Q21 look interested enough in what we have to say to want to be there ♦ 0.657	Q32 make sure that the group takes time to evaluate how things are going at the end of each session ♦ -0.623	Q24 always look to involve everyone in keeping the session moving ♦ 0.576	*Q37 remain detached in the background so as not to put us off our discussion* ♦ *-0.588*	Q52 communicate with students in a formal way ♦ 0.500	Q37 understand and stick to the rules of PBL ♦ 0.647	Q45 avoid wasting session-time on students with personal problems ♦ 0.584	Q54 use our time to seek and respond to student feedback about his/her effect on the group ♦ 0.616	Q43 contribute to the group dynamics and process rather than the content of the discussions ♦ 0.588
Q43 avoid wasting precious time getting us to reflect back on every session ♦ 0.629	Q27 look interested enough in what we have to say to want to be there 0.723	Q34 know the detailed content and answers of each objective we set ♦ ➔ 0.598	Q51 ask questions that challenge us to think whether we really understand what we're talking about ♦ ➔ 0.564	Q61 give us the faculty learning objectives ♦ ➔ 0.641	Q29 help get us moving again if we are well and truly stuck and missing things right under our noses ♦ ➔ 0.597	Q33 be enthusiastic even if it is not his/her subject-area ♦ 0.581	Q41 save time by letting us skip explanations if we say that we've done it before ♦ 0.529	Q31 make sure that the group takes time to evaluate how things are going at the end of each session ♦ 0.556	Q28 provide extra input to sessions from his/ her particular discipline so as not to waste this expertise ♦ 0.535	Q43 remain detached in the background so as not to put us off our discussion ♦ 0.464	Q36 come right out and regularly judge our group and individual performance ♦ 0.545	*Q41 allow us to report back from notes when we've done the work but not had time to learn it yet* ♦ *-0.445*	Q42 be able to recognize what is important for a doctor to know ♦ 0.478	*Q46 allow us to report back from notes when we've done the work but not had time to learn it yet* ♦ *0.508*
Q34 avoid the messy process of getting us to link various types of knowledge with the scenario ♦ 0.620	Q31 recognize and understand various students' discomforts and difficulties during the session ♦ ➔ 0.698	Q57 tell me exactly what syllabus I need to cover for each scenario, avoiding uncertainty ♦ ➔ 0.594	Q49 encourage us to talk through and use what we already know about things, even simple stuff ♦ 0.550	Q28 act like another member of the group by contributing to the debate ♦ 0.557	Q55 be a friendly character who puts the group at ease ♦ ➔ 0.571	Q48 use our time to seek and respond to student feedback about his/her effect on the group ♦ 0.541	Q40 avoid the messy process of getting us to link various types of knowledge with the scenario ♦ 0.475	Q40 save time by letting us skip explanations if we say that we've done it before ♦ -0.535	Q22 act like another member of the group by contributing to the debate ♦ 0.534	Q50 indicate if we've said something silly so I don't waste time on other people's wrong answers ♦ 0.441	Q51 communicate with students in a formal way ♦ 0.496	Q46 communicate with students in a formal way ♦ 0.357	Q60 ensure that students avoid commenting on his/her tutoring performance -0.367	Q49 indicate if we've said something silly so I don't waste time on other people's wrong answers ♦ -0.415
Q55 give us the faculty learning objectives ♦ ➔ 0.620	Q59 know how and when to interrupt the discussion without taking over ♦ ➔ 0.692	Q44 ensure we focus on one theme or type of topic for most of a session so we work in neat blocks ♦ 0.541	Q42 guide us subtly back on the right track and depth if going off at a tangent or into too much detail ♦ ➔ 0.548	Q35 know the detailed content and answers of each objective we set ♦ ➔ 0.511	Q56 ask questions that challenge us to think whether we really understand what we're talking about ♦ ➔ 0.471	Q26 make sure that the group takes time to evaluate how things are going at the end of each session ♦ 0.533	Q57 ask questions that challenge us to think whether we really understand what we're talking about -0.443	Q32 allow you to drift for now if you want to - it's only you that misses out if you don't participate! ♦ -0.475	Q38 contribute to the group dynamics and process rather than the content of the discussions ♦ -0.421	Q60 ensure that students avoid commenting on his/her tutoring performance ♦ 0.388	Q31 make sure that the group takes time to evaluate how things are going at the end of each session 0.472	Q40 keep feedback mostly indirect and descriptive about how individuals and the group do things -0.321	*Q26 help us by discussing his/her own personal experiences of science and medicine* *0.322*	Q45 keep feedback mostly indirect and descriptive about how individuals and the group do things ♦ 0.410
Q35 save time by letting us skip explanations if we say that we've done it before ♦ 0.601	Q39 be enthusiastic even if it is not his/her subject-area 0.627	Q39 avoid the messy process of getting us to link various types of knowledge with the scenario ♦ 0.490	Q24 help get us moving again if we are well and truly stuck and missing things right under our noses ♦ ➔ 0.515	*Q53 help us to formulate specific learning objectives to sort out relevant gaps in group knowledge* ♦ *0.480*	Q52 help us to formulate specific learning objectives to sort out relevant gaps in group knowledge ♦ 0.452	Q32 understand and stick to the rules of PBL ♦ 0.465	Q55 encourage us to talk through and use what we already know about things, even simple stuff -0.416	Q26 look interested enough in what we have to say to want to be there ♦ 0.431	Q29 know the detailed content and answers of each objective we set ♦ 0.406	Q47 allow us to report back from notes when we've done the work but not had time to learn it yet 0.387	Q28 keep things non-competitive and relaxed so we can make mistakes when trying out explanations 0.353			Q28 keep things non-competitive and relaxed so we can make mistakes when trying out explanations ♦ 0.403
Q39 ensure we focus on one theme or type of topic for most of a session so we work in neat blocks ♦ 0.480	Q29 keep things non-competitive and relaxed so we can make mistakes when trying out explanations ♦ 0.622	Q59 ensure that students avoid commenting on his/her tutoring performance ♦ 0.393	Q25 recognize and understand various students' discomforts and difficulties during the session ♦ ➔ 0.499	Q34 provide extra input to sessions from his/her particular discipline so as not to waste this expertise ♦ 0.463	Q30 recognize and understand various students' discomforts and difficulties during the session ♦ ➔ 0.450	*Q20 help us by discussing his/her own personal experiences of science and medicine* *0.341*	Q47 allow us to report back from notes when we've done the work but not had time to learn it yet ♦ 0.412	Q30 recognize and understand various students' discomforts and difficulties during the session 0.403	Q52 tell me exactly what syllabus I need to cover for each scenario, avoiding uncertainty 0.381	Q45 ensure we focus on one theme or type of topic for most of a session so we work in neat blocks ♦ 0.380	Q53 use our time to seek and respond to student feedback about his/her effect on the group 0.238	Continued overleaf		Q30 recognize and understand various students' discomforts and difficulties during the session 0.356

Q[illegible] indicate if we've said something silly so I don't waste time on other people's wrong answers ♦ 0.474	Q[illegible] guide us subtly back on the right track and depth if going off at a tangent or into too much detail ♦ → 0.572	Q[illegible] come right out and regularly judge our group and individual performance 0.344	Q23 keep things non-competitive and relaxed so we can make mistakes when trying out explanations ♦ 0.479	Q38 understand and stick to the rules of PBL ♦ **-0.371**	*Q[illegible] help us by discussing his/her own personal experiences of science and medicine ♦* *0.423*		*Q61 give us the faculty learning objectives* 0.395	*Q[illegible] act like another member of the group by contributing to the debate ♦* *0.360*	Q32 understand and stick to the rules of PBL -0.359	Q36 avoid asking questions that worry us into having to go away and recheck our work all the time 0.344		Continued from previous page	*Q[illegible] avoid the messy process of getting us to link various types of knowledge with the scenario* *0.345*
Q30 avoid asking questions that worry us into having to go away and recheck our work all the time ♦ 0.462	Q25 always look to involve everyone in keeping the session moving ■ 0.504	Q27 act like another member of the group by contributing to the debate 0.342	Q36 be able to recognize what is important for a doctor to know ♦ 0.459	Q50 indicate if we've said something silly so I don't waste time on other people's wrong answers 0.362	*Q33 provide extra input to sessions from his her particular discipline so as not to waste this expertise ♦* *0.406*		Q58 tell me exactly what syllabus I need to cover for each scenario, avoiding uncertainty 0.380	Q42 remain detached in the background so as not to put us off our discussion ♦ **-0.337**	Q40 keep feedback mostly indirect and descriptive about how individuals and the group do things ♦ **-0.345**	*Q46 keep feedback mostly indirect and descriptive about how individuals and the group do things* *0.310*			
Q47 help us to formulate specific learning objectives to sort out relevant gaps in group knowledge ♦ *0.365*	Q55 encourage us to talk through and use what we already know about things, even simple stuff ♦ 0.490	Q33 provide extra input to sessions from his/her particular discipline so as not to waste this expertise 0.336	Q46 communicate with students in a formal way **-0.356**	Q26 help us by discussing his/her own personal experiences of science and medicine 0.345	Q41 be able to recognize what is important for a doctor to know ♦ 0.375		Q36 avoid asking questions that worry us into having to go away and recheck our work all the time ♦ 0.349	*Q25 help us by discussing his her own personal experiences of science and medicine* *0.333*	Q55 give us the faculty learning objectives 0.338				
Q29 know the detailed content and answers of each objective we set → 0.361	*Q26 help us by discussing his her own personal experiences of science and medicine ♦* *0.468*	Q54 encourage us to talk through and use what we already know about things, even simple stuff ♦ **-0.334**	Q54 ensure that students avoid commenting on his/her tutoring performance ♦ **-0.349**	Q45 ensure we focus on one theme or type of topic for most of a session so we work in neat blocks 0.341	*Q49 indicate if we've said something silly so I don't waste time on other people's wrong answers* *0.303*		Q33 allow you to drift for now if you want to - it's only you that misses out if you don't participate! ♦ 0.341	Q50 avoid wasting session-time on students with personal problems ♦ **-0.325**					
Q41 allow us to report back from notes when we've done the work but not had time to learn it yet 0.328	Q57 ask questions that challenge us to think whether we really understand what we're talking about ♦ → 0.462		Q34 avoid the messy process of getting us to link various types of knowledge with the scenario **-0.319**	Q60 ensure that students avoid commenting on his/her tutoring performance 0.339									
Q27 allow you to drift for now if you want to - it's only you that misses out if you don't participate! 0.286	Q53 help us to formulate specific learning objectives to sort out relevant gaps in group knowledge 0.407			Q44 contribute to the group dynamics and process rather than the content of the discussions -0.286									
	Q42 be able to recognize what is important for a doctor to know 0.327												

Liverpool MBChB curriculum, Year 1 medical students, Study (S)3 & S6, and Year 3, S5

Key: ♦S3 ♦S6 ♦S5: denotes the highest loading of that item, on any component in the model, for that study-element. If symbol ■ ■ ■: ...highlighted: high loading, but should it appear elsewhere in that model? If item: ...highlighted: low loading, but does not appear elsewhere in that model. If item: *...in italics:* ?association in unexpected direction? If item: **...in bold:** negative score. ——— denotes 0.40 cut-off in loadings (only loadings ≥0.32 shown, except where an item does not otherwise appear). → denotes items that appear in that component in all three models with loadings ≥0.40

Appendix 11: Principal components analysis: *Questionnaire survey of Year 1 medical students at start/end of year, 2001/02, Year 3 mid-2001/02, and interviewees (Study-element (S)3 & S6, S5, & S4): Short RASI learning approaches: Loadings in the four 3-component models*

S3 Component 1	*S6 Component 1*	*S5 Component 1*	*S4 Component 1*	*S3 Component 2*	*S6 Component 2*	*S5 Component 2*	*S4 Component 2*	*S3 Component 3*	*S6 Component 3*	*S5 Component 3*	*S4 Component 3*
Strategic	**Strategic**	**Deep**	**Strategic**	**Surface**	**Deep**	**Strategic**	**Surface**	**Deep**	**Surface**	**Surface**	**Deep**
Q9 I put a lot of effort into studying because I'm determined to do well. 0.765	Q7 I'm pretty good at getting down to work whenever I need to. 0.755	Q12 Often I find myself questioning things I hear in lectures or read in books. 0.719	Q9 I put a lot of effort into studying because I'm determined to do well. 0.742	Q14 Often I feel I'm drowning in the sheer amount of material we're having to cope with. 0.737	Q17 When I read, I examine the details carefully to see how they fit in with what's being said. 0.756	Q9 I put a lot of effort into studying because I'm determined to do well. 0.758	Q16 I often worry about whether I'll ever be able to cope with the work properly. 0.718	Q15 Ideas in course books or articles often set me off on long chains of thought of my own. 0.676	Q14 Often I feel I'm drowning in the sheer amount of material we're having to cope with. 0.775	Q18 I often have trouble in making sense of the things I have to remember. 0.799	Q15 Ideas in course books or articles often set me off on long chains of thought of my own. 0.701
Q3 I organise my study time carefully to make the best use of it. 0.757	Q9 I put a lot of effort into studying because I'm determined to do well. 0.751	Q15 Ideas in course books or articles often set me off on long chains of thought of my own. 0.653	Q7 I'm pretty good at getting down to work whenever I need to. 0.670	Q18 I often have trouble in making sense of the things I have to remember. 0.729	Q2 When I'm reading an article or book, I try to find out for myself exactly what the author means. 0.730	Q3 I organise my study time carefully to make the best use of it. 0.731	Q14 Often I feel I'm drowning in the sheer amount of material we're having to cope with. 0.716	Q17 When I read, I examine the details carefully to see how they fit in with what's being said. 0.607	Q16 I often worry about whether I'll ever be able to cope with the work properly. 0.728	Q8 Much of what I'm studying makes little sense: it's like unrelated bits and pieces. 0.647	Q12 Often I find myself questioning things I hear in lectures or read in books. 0.651
Q11 I don't find it at all difficult to motivate myself. 0.717	Q11 I don't find it at all difficult to motivate myself. 0.703	Q17 When I read, I examine the details carefully to see how they fit in with what's being said. 0.630	Q3 I organise my study time carefully to make the best use of it. 0.665	Q16 I often worry about whether I'll ever be able to cope with the work properly. 0.700	Q15 Ideas in course books or articles often set me off on long chains of thought of my own. 0.582	Q11 I don't find it at all difficult to motivate myself. 0.715	Q18 I often have trouble in making sense of the things I have to remember. 0.693	Q10 When I'm working on a new topic, I try to see in my own mind how all the ideas fit together. 0.591	Q18 I often have trouble in making sense of the things I have to remember. 0.640	Q16 I often worry about whether I'll ever be able to cope with the work properly. 0.617	Q17 When I read, I examine the details carefully to see how they fit in with what's being said. 0.584
Q7 I'm pretty good at getting down to work whenever I need to. 0.694	Q3 I organise my study time carefully to make the best use of it. 0.653	Q2 When I'm reading an article or book, I try to find out for myself exactly what the author means. 0.630	Q11 I don't find it at all difficult to motivate myself. 0.607	Q1 Often I find myself wondering whether the work I am doing here is really worthwhile. 0.593	Q12 Often I find myself questioning things I hear in lectures or read in books. 0.559	Q7 I'm pretty good at getting down to work whenever I need to. 0.668	Q8 Much of what I'm studying makes little sense: it's like unrelated bits and pieces. 0.586	Q6 Regularly I find myself thinking about ideas from lectures when I'm doing other things. 0.584	Q1 Often I find myself wondering whether the work I am doing here is really worthwhile. 0.606	Q1 Often I find myself wondering whether the work I am doing here is really worthwhile. 0.564	Q2 When I'm reading an article or book, I try to find out for myself exactly what the author means. 0.562
Q13 I manage to find conditions for studying which allow me to get on with my work easily. 0.566	Q13 I manage to find conditions for studying which allow me to get on with my work easily. 0.571	Q10 When I'm working on a new topic, I try to see in my own mind how all the ideas fit together 0.560	Q13 I manage to find conditions for studying which allow me to get on with my work easily. 0.556	Q8 Much of what I'm studying makes little sense: it's like unrelated bits and pieces. 0.433	Q10 When I'm working on a new topic, I try to see in my own mind how all the ideas fit together. 0.554	Q13 I manage to find conditions for studying which allow me to get on with my work easily. 0.431	Q1 Often I find myself wondering whether the work I am doing here is really worthwhile. 0.536	Q2 When I'm reading an article or book. I try to find out for myself exactly what the author means. 0.542	Q8 Much of what I'm studying makes little sense: it's like unrelated bits and pieces. 0.581	Q4 I concentrate on learning just those bits of information I have to know to pass. 0.390	Q6 Regularly I find myself thinking about ideas from lectures when I'm doing other things. 0.520
	<u>Q10 When I'm working on a new topic, I try to see in my own mind how all the ideas fit together.</u> 0.382	<u>Q14 Often I feel I'm drowning in the sheer amount of material we're having to cope with.</u> 0.467	Q5 I look carefully at tutors' comments on course work to see how to get higher marks next time. 0.506	Q4 I concentrate on learning just those bits of information I have to know to pass. 0.424	Q6 Regularly I find myself thinking about ideas from lectures when I'm doing other things. 0.479	Q5 I look carefully at tutors' comments on course work to see how to get higher marks next time. 0.421	Q4 I concentrate on learning just those bits of information I have to know to pass. 0.455	Q12 Often I find myself questioning things I hear in lectures or read in books. 0.468	Q4 I concentrate on learning just those bits of information I have to know to pass. 0.324	Q14 Often I feel I'm drowning in the sheer amount of material we're having to cope with. 0.363	Q10 When I'm working on a new topic, I try to see in my own mind how all the ideas fit together. 0.482
		Q6 Regularly I find myself thinking about ideas from lectures when I'm doing other things. 0.446	<u>Q10 When I'm working on a new topic. I try to see in my own mind how all the ideas fit together.</u> 0.333					<u>Q4 I concentrate on learning just those bits of information I have to know to pass.</u> **-0.339**			
		Q4 I concentrate on learning just those bits of information I have to know to pass. **-0.363**	Q1 Often I find myself wondering whether the work I am doing here is really worthwhile. **-0.256**								

Liverpool MBChB curriculum. Year 1 medical students. Study (S)3 & S6, Year 3, S5; and interviewees S4

Key: If item: ...<u>underlined</u>: is from another subscale If item: ...**in bold**: negative score on an item from another subscale

——— denotes 0.40 cut-off in loadings (only loadings ≥0.32 shown)

Short RASI=Short Revised Approaches to Studying Inventory from within Approaches and Study Skills Inventory for Students (ASSIST)

Appendix 12a: Questionnaire survey of Year 1 medical students at start of 1999/00 (Study-element 1): Example: Level i of iii (p130) analysis: 70 initial concepts* from Q1 (n=155): "Describe what, for *you*, makes a good doctor"

concept code	**A good doctor…** *70 initial concepts:*	no.	%
15	has good communications skills: communicates clearly	83	53.5
22	is gentle/caring/compassionate/considerate/supportive; understands/responds to patients' needs	61	39.4
18	has good listening skills	54	34.8
7	is knowledgeable; knows the job; has sound professional knowledge	42	27.1
34	instils confidence; is reassuring/calming/assertive/relaxed	32	20.6
1	enjoys/loves the profession; is motivated by medicine/science/health	30	19.4
6	is understanding/sympathetic/not dismissive of patients	30	19.4
36	is down-to-earth/not intimidating	30	19.4
23	is empathetic/able to connect with people	24	15.5
24	is patient/tolerant	21	13.5
25	is willing/able to explain in an understandable way	21	13.5
3	puts the patient's care first & foremost; appreciates patients as individuals	20	12.9
8	is willing to continue learning; has up-to-date knowledge	20	12.9
14	is a teamplayer	18	11.6
19	has integrity/morals; is trustworthy	17	11.0
26	can diagnose and treat well/effectively	17	11.0
9	is competent; has skills	16	10.3
5	is friendly; enjoys working with people	14	9.0
13	is decisive; able to make right/quick/lifesaving decisions	12	7.7
20	is hardworking/diligent/thorough	11	7.1
2	is determined/committed	10	6.5
49	is a quick thinker; thinks on feet/laterally	10	6.5
33	is open-minded/flexible/open to criticism	9	5.8
31	is resilient; has stamina	8	5.2
54	analyses; enjoys problem-solving; deduces; infers; is able to process information quickly	8	5.2
28	works well with others	7	4.5
32	is responsible; takes charge	7	4.5
57	is approachable to all backgrounds/groups; has no prejudice	7	4.5
27	can cope with/enjoys pressure	6	3.9
43	respects privacy/confidential information; has tact	6	3.9
48	is humble/not patronizing/not pretentious	6	3.9
52	is humorous; has a sense of humour	6	3.9
53	is efficient/organized; manages time	6	3.9
55	knows/admits to own limits	6	3.9
4	has a good patient-doctor relationship/bedside manner	5	3.2
10	is intelligent	5	3.2
30	will seek help; accepts own fallibility	5	3.2
44	is professional	5	3.2
46	is polite/well-mannered	5	3.2
11	has experience	4	2.6
29	shows multiprofessional working	4	2.6
35	is non-judgemental	4	2.6
47	maintains outside interests/work-play balance	4	2.6
37	cares about self; is happy	3	1.9
38	is sensible; has common-sense	3	1.9
45	has dignity; gains respect	3	1.9
50	has a good memory/recall	3	1.9
16	is well-trained	2	1.3
41	has academic ability	2	1.3
42	is lifesaving	2	1.3
51	has social skills; smiles *"with all patients"*	2	1.3
56	works well alone	2	1.3
58	is not afraid to try new things/methods	2	1.3
60	is able to focus on the good (s)he can do; is optimistic	2	1.3
63	is curious/inquisitive	2	1.3
67	is not gullible; is perceptive	2	1.3
12	is concerned about furthering medical knowledge	1	0.6
17	is educated	1	0.6
21	is a character on which the community can depend	1	0.6
39	has handwriting skills	1	0.6
40	is in good health	1	0.6
59	wants to make a difference	1	0.6
61	is detached from the situation	1	0.6
62	wishes to provide a service	1	0.6
64	pursues self-actualization	1	0.6
65	is able to cope with long hours	1	0.6
66	has good dexterity	1	0.6
68	understands the psychosocial effects of disease	1	0.6
69	has a creative mind	1	0.6
70	does not compromise on quality	1	0.6
		760	

See Table 2 (p161), which showed Level iii of iii analysis *Liverpool MBChB curriculum. Year 1 medical students. Study (S)1*

1st level of analysis: i: **70 initial concepts (760 mentions) → ii: 23 interim themes (590 first-mentions) → iii: 9 themes (536 first-mentions)*

Appendix 12b: Questionnaire survey of Year 1 medical students at start of 1999/00 (Study-element 1): Example: Level ii of iii (p130) analysis: 23 interim themes* from Q1 (n=155): "Describe what, for *you*, makes a good doctor"

A good doctor...	*23 interim themes*	no.	%
concept code 2	is gentle/caring/compassionate/considerate/supportive; understands/responds to patients' needs~~is understanding/sympathetic/not dismissive of patients~~is down-to-earth/not intimidating~~is empathetic/able to connect with people~~is patient/tolerant~~puts the patient's care first & foremost; appreciates patients as individuals~~is willing/able to explain in an understandable way~~is humble/not patronizing/not pretentious~~is polite/well-mannered~~has a good patient-doctor relationship/bedside manner~~	119	76.8
1	has good communications skills; communicates clearly~~has good listening skills~~	115	74.2
12	is knowledgeable; knows the job; has sound professional knowledge~~is intelligent~~has experience~~has a good memory/recall~~has academic ability~~is educated~~	51	32.9
10	has integrity/morals; is trustworthy~~is hardworking/diligent/thorough~~is determined/committed~~respects privacy/confidential information; has tact~~is professional~~has dignity; gains respect~~is a character on which the community can depend~~wants to make a difference~~wishes to provide a service~~does not compromise on quality~~	44	28.4
6	is a teamplayer~~is friendly; enjoys working with people~~works well with others~~shows multiprofessional working~~has social skills; smiles "with all patients"~~	38	24.5
3	instils confidence; is reassuring/calming/assertive/relaxed~~is responsible; takes charge~~	35	22.6
13	can diagnose and treat well/effectively~~is competent; has skills~~is well-trained~~	31	20.0
4	enjoys/loves the profession; is motivated by medicine/science/health~~	30	19.4
8	is a quick thinker; thinks on feet/laterally~~is open-minded/flexible/open to criticism~~analyses; enjoys problem-solving; deduces; infers; is able to process information quickly~~is not afraid to try new things/methods~~is curious/inquisitive~~is not gullible; is perceptive~~is detached from the situation~~has a creative mind~~	26	16.8
5	is willing to continue learning; has up-to-date knowledge~~is concerned about furthering medical knowledge~~	21	13.5
11	is resilient; has stamina~~can cope with/enjoys pressure~~is able to cope with long hours~~	15	9.7
9	is decisive; able to make right/quick/lifesaving decisions~~is lifesaving~~	13	8.4
7	knows/admits to own limits~~will seek help; accepts own fallibility~~	11	7.1
14	is approachable to all backgrounds/groups; has no prejudice~~is non-judgemental~~	11	7.1
15	maintains outside interests/work-play balance~~cares about self; is happy~~is able to focus on the good (s)he can do; is optimistic~~pursues self-actualization~~	9	5.8
16	is efficient/organized; manages time~~	6	3.9
17	is humorous; has a sense of humour~~	6	3.9
18	is sensible; has common-sense~~	3	1.9
19	works well alone~~	2	1.3
20	has handwriting skills~~	1	0.6
21	is in good health~~	1	0.6
22	has good dexterity~~	1	0.6
23	understands the psychosocial effects of disease~~	1	0.6
		590	

See Table 2 (p161), which showed Level iii of iii analysis — *Liverpool MBChB curriculum, Year 1 medical students, Study (S) 1*

2nd level of analysis: i: **70 initial concepts (760 mentions) → ii: 23 interim themes (590 first-mentions) → iii: 9 themes (536 first-mentions)*
~~denotes end of category of initial concepts

Footnote: Recoding tables for i→ii and ii→iii levels of analysis in Appendix 12a and 12b, respectively

Initial concept code	Recode → interim theme code
1	4
2	10
3	2
4	2
5	6
6	2
7	12
8	5
9	13
10	12
11	12
12	5
13	9
14	6
15	1
16	13
17	12
18	1
19	10
20	10
21	10
22	2
23	2
24	2
25	1
26	13
27	11
28	6
29	6
30	7
31	11
32	3
33	8
34	3
35	14
36	2
37	15
38	18
39	20
40	21
41	12
42	9
43	10
44	10
45	10
46	2
47	15
48	2
49	8
50	12
51	6
52	17
53	16
54	8
55	7
56	19
57	14
58	8
59	10
60	15
61	8
62	10
63	8
64	15
65	11
66	22
67	8
68	23
69	8
70	10

Interim theme code	Recode → final theme code
1	2
2	1
3	3
4	3
5	7
6	4
7	7
8	7
9	5
10	3
11	3
12	6
13	5
14	4
15	8
16	9
17	8
18	9
19	9
20	5
21	8
22	5
23	1

"The ability to communicate well with patients (oh and handwriting skills too!), also, being able to put a patient at ease and being honest with the patient about their condition, treatment and prognosis."

"Good communication skills and the ability to empathise with others."

"A caring, considerate attitude, coupled with good technical knowledge and an ability to communicate [sic] in a suitable manner with the patient."

"Someone who treats patients as people not as an illness. Someone with commonsense who cares about their job and always does their work to the best of their ability"

"Competent + knowledgeable with ability to make quick decisions and live with the consequences. Also good at listening and able to convey information in a manner which is clear and understandable."

"Someone who is:

supportive

approachable

has a sense of humour

compassionate

efficient"

- "Somebody kind and understanding.
- Somebody honest & discreet.
- Somebody who loves people & working with the public.
- Somebody who is diligent & very enthusiastic about their job.
- Somebody who is reliable & who can be trusted to keep confidential matters, confidential.
- Somebody assertive but friendly."

"Good Communicator

Good listener

A passion for the subject (enthusiasm)

Good powers of deduction."

"Someone who is able to apply both their medical knowledge and expertise with a compassionate and caring nature to apprieciate [sic] each patient as individual."

"A calm, kind, interested person who would listen and reassure the patient."

"A good listener & communicator. Sound & up to date medical knowledge. Down to earth & able to connect with people. Patient, able to cope under pressure. Ability to maintain outside interests away from the job & have a normal life. Efficient. Not patronising. Good sense of humor [sic]."

"Competent in areas of relevance. Good communication skills – keen listener [with] clear explanation. Thoughtful."

"A doctor who will listen and communicate effectively w/o patronisation."

58. "Someone who enjoys and is good at working with people, who has an interest in the welfare of others. They also must enjoy the challenge + variety of science and the application of science."

153 + 65 / 218 Records

"THE ABILITY TO DIAGNOSE QUICKLY & WHEN IN DOUBT TO SEEK HELP IN DECIDING. SOMEONE WHO DOES NOT 'CRACK' UNDER PRESSURE AND IS ABLE TO COMMUNICATE WITH ANYONE AT ANY LEVEL"

"Someone who is : caring,

understanding,

hard working,

motivated"

"Someone who puts you at ease and then listens and sympathises with you. Also someone who appears [to] want to help you, not look as if it's just another day's work. Someone who also keeps you informed abo[ut] what's the problem and what they are going to do for you, explaining it all in a basic level of understanding."

"A doctor who is able to understand his/her patients needs, explain in lay mens' [sic] terms the diagnosi[s] to communicate well. Be prepared to empathise with patient & family. Work well in team of clinicians allied to medicine in addition to other doctors."

- "An individual who CARES – about others, about themselves – this will show in their approach and attitude to the job.
- A good listener is also important, responding to both emotional and physical needs.
- A hard worker, being dedicated to the improvement of the medical profession.
- Trust, openness and sense of humour also aid patient care"

"Someone who can communicate to their patients well, who is caring. Someone who is confident in their actions who can take responsibility and always does as much as possible for their patients."

- "Someone who listens well & takes time to understand patients needs and concerns
- Able to make decisions & think on feet.
- Interested in people."

"Ability to correspond well, clearly, and sensitive to others' [sic] feelings; not pretentious; skilled in profession."

"Ability to listen to patients and staff (eg. Nurse)

Ability to make decisions.

Nice bedside manner.

My tutor at college said to me that the most important thing is to smile with all patients."

"A committed individual who is essentially a team player. Able to communicate very effectively with colleagues & patients. Puts patients care first and makes patient aware of this. Always motivated and

218 + 34 / 252 Records

Question 1

enjoys the challenge · variety of science · enjoys a challenging career
motivated · passion/enthusiasm for subject · very enthusiastic about their job

1. loves their profession, enjoy what they do most, dedicated to work, (work for self-satisfaction), loving to be a doctor..., interested in medicine/science/health, well-motivated, genuine motivation to heal, cares about their job, enjoys challenge/variety of science
2. devote herself, determination, a committed, dedicated to the improvement of the medical profession, perseverance, determined to persevere, determined and see things you struggle with as a challenge
3. * puts patient's care first & foremost, do what's best for the individual, appreciate each patient as an individual, able to treat his patients to the best possible, interest in patient as a whole, treats the person within the patient, patient is always the most important, not look at it's just another day's work, does their best for the patient, always does as much as possible for their patient
4. good patient-doctor relationship, bedside manner, doctor of patient where they cooperate to heal the disease
5. interested in people, friendly, loves people, enjoys working with people, want to help you, desire to help without necessarily being rewarded, ... in the interests of the patient
6. not dismissive of patient's ills, understanding, sympathy, interested in what you say, interested in human nature, genuinely cares about the wellbeing of people
7. good scientific understanding, understands a wide variety of conditions, detailed knowledge of the anatomy/physiology of the human body..., knowledgeable, knows his work well... when questioned... off the top of his/her head, knows his job, good clinical knowledge, knows his/her profession to the extent that they are making the least possible mistakes, sound professional knowledge, knows how to treat
8. never-stop learning, keen to keep up with the new medical information, up-to-date knowledge, aware that there is always more to learn, continuous learning, strives for self development, ideal of knowledge
9. competent, necessary taught skills, skilled in profession, skill, continually willing to learn, ability to learn in order to further standards of care, keep up to date with current practices, learn and keeps up to date with the current...
10. intelligent
11. experience, good life experience, frequent practice, a varied life experience, have the ability to continually evolve with a changing medical profession
12. concern about [furthering] medical knowledge, keeps up with the latest developments by learning throughout their career
13. quick [life-saving] decisions, decisive, able to make important decisions, making effective decisions, makes decisions about what is best for patient
14. teamwork, team player, able to make decisions, makes the right decisions, ability to make accurate and quick decisions
15. good communication skills, ability to correspond well clearly, communicate very effectively, excellent, communicate clearly
16. well-trained, ...
17. educated
18. good listening skills
19. integrity/morals/trustworthy/honest (with the patient) /openness/ethical
20. hard working, diligent, thorough
21. character on which the community can depend
22. gentle, caring, sensitive to others' needs/compassionate, considerate/helpful, appreciate the needs of the patient, eager to fulfil patient's needs, supportive, kind, humane, thoughtful, interested in welfare of others, understand his/her patient's needs, responding to both emotional and physical needs
23. empathy, able to connect with people, makes patient aware of this able to relate, [putting them first], able to identify with the patient, not quite a mind reader but pretty close, understand patients' needs and concerns, sensitive to others' feelings
24. patient, tolerant
25. patients should be able to understand what they're being advised, explain themselves well, clear explanation, explaining it all in a basic level, technical medical knowledge in lay-man's terms, explain complex information to people in a way they understand, explain in understandable language, informative/willing to explain things
26. good & accurate diagnosis of illness, efficiently diagnose and treat, isolate what symptoms indicate what problems/deciding treatment, good at... diagnosing, curing, surgery, clinical skills, apply both their medical knowledge and expertise, diagnose quickly, ability to carry out a quick and accurate diagnosis and suggest suitable treatment, ability to identify problems or causes and can aid in the healing process..., make a logical diagnosis
27. [coping with] stress of strain, cope under pressure, does not crack under pressure, enjoys pressure
28. work well with others
29. multiprofessional working
30. will seek help, willing to ask for help and will seek help, knowing when to ask other colleagues in an area you feel unqualified, acceptance of own fallibility
31. stamina, resilience
32. responsible/reliable, accept responsibility, taking charge
33. open-minded, a flexible open-minded approach to new concepts and developments, ability to adapt to different situations, flexibility, adapt to change, versatility, open to criticism/change
34. instilling confidence, reassuring nature, put patient at ease, assertive, calm, confident, calming influence, set people at ease, makes them feel in good hands, relaxed, feel comfortable with him, can have faith in, make the patient feel confident enough and comfortable enough to be completely open with him/her
35. non-judgemental, not necessarily guilty
36. approachable, down-to-earth, friendly, easy to talk to, not intimidating, someone to talk/confide in..., not so intellectual that it is intimidating... realistic, good nature

* make me feel like a person and not a patient or a number from his list, respects patient's view, treats their patients as they would treat a member of their family (ie to their best ability), first concern is caring for their patient

37. cares about themselves, happy, appreciative of everything they have
38. commonsense, sensible, level-headedness
39. handwriting skills
40. good health
41. excellent academic skills, academic ability
42. life-saving
43. respect and protect confidential information, respect privacy, discreet, tact
44. professional
45. respect dignity
46. polite, well-mannered
47. maintain outside interests, a good life away from work, ability to differentiate between work and play - balance ... but not a workaholic
48. not patronising, not pretentious, humility, humble spirit (not arrogant)
49. quick thinker, think on feet, initiative, lateral thinker, to think around a problem, never assume a situation, resourceful, can think in many paths of approach
50. recall information and use it, ability to recall... bits of information, good memory
51. social skills, smile with all patients
52. humorous, sense of humour
53. efficient, good personal organization, organised, organization especially of time management, [well] disciplined
54. good powers of deduction, problem-solving, enjoys analysing, make inferences from several facts put together, ability to link together bits of information, ability to process information quickly
55. knows their own limits, accept that he or she will never know it all, aware of ... own inefficiencies, faults & inadequacies, knows his/her own limitations, know and admit to limitations... not be afraid to admit that he/she doesn't know and seek help
56. work well alone
57. [approachable] to all age groups, races, diseases etc, [communicates with] different backgrounds, [empathise] with a variety of..., free from prejudice, irrespective to who they are, what religion do they have, what are their background etc, has no prejudice/bias, [communicate with] social, intelligence...
58. not afraid to try new things, not afraid to try new methods techniques
59. wants to make a difference
60. able to focus on the good he/she can do, optimism
61. detached from the situation
62. wishes to provide a service
63. curiosity, inquisitive
64. self-actualization
65. able to cope with long hours
66. good dexterity
67. not gullible, perceptive
68. understands the psychological and sociological effects of disease
69. creative mind
70.

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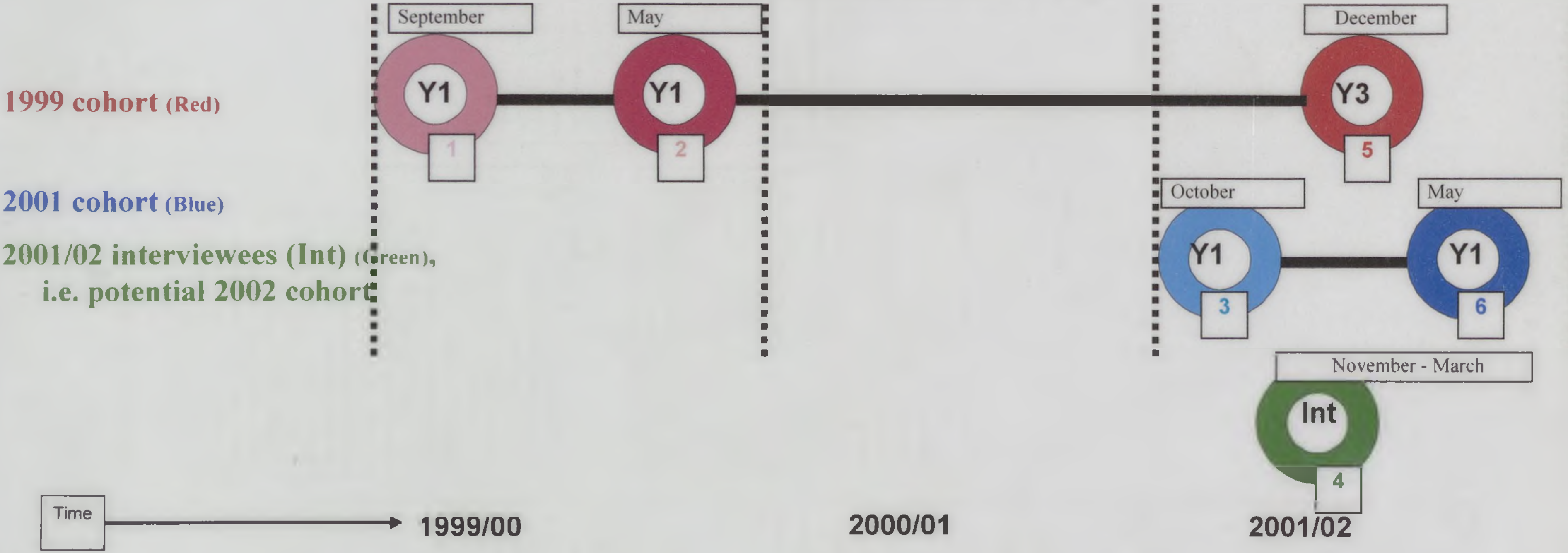
IN BACK POCKET

Figure 1: Six study-elements (questionnaire surveys), in chronological order, involving three cohorts of medical students/interviewees



Liverpool MBChB curriculum, medical students (and interviewees) 1999-2002

From p151

Figure 2: Six questionnaire surveys (Study-elements 1-6) of three cohorts of medical students (and potential medical students) about learning to be a doctor

Study-element 1 (155/228=68.0%)
1999 cohort, Year 1 at entry
2-page questionnaire:
Open-ended: good doctor; successful Year 1; preregistration house year; previous and expected learning experiences
Closed: career intentions
· Research question: Towards what image of doctoring might new medical students focus their learning, and from what prior learning experience?
· Aim: To explore new medical students' conceptual baseline about 'learning to be a doctor'

Study-element 2 (137/224=61.2%)
1999 cohort, end-of-Year 1
1-page questionnaire:
Open-ended: factors affecting learning; characteristics of PBL and good tutoring; (dis)advantage of PBL
Closed: career intentions; importance of nine good doctor themes
· Research question: How do those same Year 1 medical students conceptualize good tutors (and doctors) and learning after a year?
· Aim: To revisit their notions of the 'good doctor' and explore their perceptions about learning in a problem-based curriculum, including notions of good tutors

Study-element 5 (159/204, 77.9%)
1999 cohort, mid-Year 3
2-page questionnaire:
Open-ended: comments on & (dis)advantage of PBL; Population Perspective
Closed: learning approaches inventory (18); ideal PBL tutor (38); ranking nine good doctor themes; career intentions; would they do Medicine... problem-based... here... again?
· Research question: How does those same medical students' satisfaction with a problem-based curriculum (mid-programme) relate to: their learning approaches; notions of good tutors and doctors (and to their population health perspective)?
· Aim: To explore their notions of curriculum satisfaction and a population health perspective, while revisiting notions of learning, good tutors, and good doctors

Study-element 3 (201/283=71.0%)
2001 cohort, Year 1 at entry
2-page questionnaire:
Open-ended: a critical incident in PBL; why Medicine?
Closed: learning approaches inventory (18); ideal PBL tutor (38); career intentions
· Research question: How do medical students' learning approaches relate to their notions of good tutors, critical PBL incidents, & motivation at start of Year 1?
· Aim To explore how medical students' learning approaches relate to notions of good tutors, critical PBL incidents, and career motivation

Study-element 6 (198/279=71.0%)
2001 cohort, end-of-Year 1
2-page questionnaire:
Open-ended: Why PBL might not work well for me (if I... if others... if tutor...); Population Perspective
Closed: learning approaches inventory (18); ideal PBL tutor (38); career intentions; would they do Medicine... problem-based... here... again? ranking nine good doctor themes
Research question: How do medical students' learning approaches relate to their notions of good tutoring (and to a public health perspective) after a year?
· Aim: To revisit their learning approaches and explore notions of good tutors, good doctors (and a population health perspective)

Snapshots at entry to MBChB
Snapshots end-of-Year 1 MBChB

time

Study-element 4 (973/1064, 91.4%)
2002 cohort, applicants attending for interview
1-page questionnaire:
Open-ended: nil
Closed: learning approaches inventory (18); ranking nine good doctor themes; career intentions
· Research question: How do prospective medical students' learning approaches relate to their notions of good doctors and to being admitted to this curriculum?
· Aim: To explore learning approaches and notions of the good doctor amongst candidates attending for interview and those subsequently admitted to this programme

Liverpool MBChB curriculum, medical students and interviewees