Supporting Students Through Course Design

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The STAR (Student Transition and Retention) Project
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Preface

The purpose of this booklet is to describe practices that have worked in some institutions to ease the stresses of students' transition into Higher Education and to help to improve retention. This is important because student retention has become a significant issue both for students and for institutions. Students waste valuable time and resources if they drop out from a university course in which they have invested their hopes and aspirations and institutions waste money and staff effort. Early withdrawal of students frustrates the purposes of all. It is, however, just the measurable component of a more general malaise. For every student who takes the decision to leave a course there must be many more who are *just* able to pass, who are *just* able to cope with the stresses of Higher Education and who are failing to reach their full potential. Equally, there will be students at university who should never have joined or who should have joined a different course. They might be too immature, too deficient in the basic skills required or their talents might lie in different directions.

Every institution that has highlighted student retention as a significant component of its strategies has investigated the causes of early leaving and most will have drawn similar conclusions. The STAR consortium was formed at a time when the generality of these causes was becoming apparent but the responses to them were less clear. The first action of the consortium was to list a set of outcomes that, if achieved, would contribute to the alleviation of problems associated with student transition. These we published as the *Guidelines for the management of student transition* (Cook *et al*., 2005). The consortium then identified practices that were likely to assist the achievement of the outcomes in the *Guidelines* booklet and researched them.

The STAR booklets, of which this is one, are small compendiums of practices that have worked in some institutions to ease the stresses of

students' transition into Higher Education. Many have been shown to improve retention. Many are the practical expression of institutional policies. All are descriptions of the dedicated work of teaching and support staff in the Higher Education sector who have introduced, maintained or developed practices for the benefit of students. The practices are derived from three sources. First, some were identified through survey. These were researched by STAR staff and written in collaboration with practitioners. Second, some staff volunteered to write about their practices independently. Third, some new practices were introduced and some existing ones evaluated using funding provided by the STAR project. Most practices have been described by staff and then validated by students through questionnaires or focus groups. All the reports contained in these booklets have been refereed independently and then approved by the STAR Steering Group.

This booklet describes the practices in enough detail to allow others to adopt or advocate that practice in their own institutions. The practices, however, should not be considered as definitive. They work in the institutions in which they were implemented by the staff who implemented them and with the students who participated. They are unlikely to remain the same. They will almost certainly evolve further even in the institutions in which they have been described and, when adopted elsewhere, will need to be adapted to suit local conditions. They are, therefore, offered as foundations on which to build appropriate practices to suit the staff, the students and learning environments involved.

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Curriculum Change as a Means of Supporting University Students

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The design of the curriculum for a university course is now governed by the benchmark statements issued for 46 subject areas by the Quality Assurance Agency for Higher Education (QAA). These statements:

> " *… set out expectations about standards of degrees in a range of subject areas. They describe what gives a discipline its coherence and identity, and define what can be expected of a graduate in terms of the techniques and skills needed to develop understanding in the subject*."

> QAA (2006)

General reading of the benchmark statements (and, including the one for Bioscience, QAA (2002)) indicates that they do not specify the detailed content of the curriculum but that they allow curriculum designers to produce unique programmes within an "overall framework" (QAA, 2002). They are, however, focussed on learning outcomes, both subject specified and generic (so called 'graduate skills'). The challenge facing academics is in designing and developing curricula against a back-drop of widening participation which brings with it highly diverse classes. Such diversity is evident in socio-economic diversity, ethnicity and disability but also in, crucially, academic background and attainment. Thus the uniform pattern of university entrant of 20 years ago (three A levels or four Scottish Highers) no longer pertains and increasingly academics see a wide diversity of entrance qualifications, many focussed on vocational areas rather than academic ones. It is critically important

to create a 'level playing field' (e.g. Eales-Reynolds, 2003) as quickly as possible within a course so that all students can progress and achieve their full potential.

Ensuring that support is available within the curriculum either formally within modules or informally in meetings such as tutorials is important for many students and essential for others – if this support is in place, then retention rates should fall. The scale of the problem may not be large but it is significant. For example, Lowe and Cook (2003) surveyed year one students prior to enrolment and then again at the end of their first term and found that although anticipated academic problems did not materialise in the majority of students, for between 15-20% of respondents they reported that their academic difficulties were worse than expected. It is, presumably, this very group that can be helped by subtle changes to the curriculum or by the use of support mechanisms within modules. Unfortunately, this support may not always be forth-coming – Lowe and Cook (2003) also report that 35% of their sample did not find teaching staff 'helpful and friendly' and 41% did not see teaching staff as 'sympathetic and reassuring'. Clearly, much needs to be done.

Three of the case studies reported in this booklet address this area of student support. At the University of Ulster, a bridging course ('transfer' module) has been developed which requires 100 hours of student effort and which enables students from Hong Kong and local colleges to 'top-up' their qualification in one year for an honours degree. The programme focuses on those areas where the staff have found support necessary for successful completion of the final year – report-writing, data analysis, analysing and synthesizing published information, etc. Thus the students enter their final year on, hopefully, a 'level playing field'.

At the other end of the degree time-line, two case studies address the needs of year one students.

The professional Skills Tutoring System, developed at the University of Wolverhampton, covers topics such as communication, use of information technology, the application of numbers, problem solving and teamwork and this is then interlinked to a number of subject-specific taught modules such as Techniques in Biology. Small group tutorials are a key feature of this provision and integration of the skills within a subject context is an important part of this approach.

Somewhat different is the case study from the University of Plymouth where a generic skills oriented module (a module in Study in Higher Education) is aimed specifically at in-coming students on a foundation course – its aim is to "ease the transition of all the students into the Higher Education environment".

Standards of literacy (e.g. Luck, 2004; Marrin, 2006; Spurling, 2006) and numeracy (Tariq, 2002)) among university undergraduates are now causing general concern. Within the biosciences, chemistry has created similar concern over many years and the case study from the University of Ulster shows how curriculum support can be provided using a variety of mechanisms (extensive printed handouts, regular summative computer-driven tests, weekly assessment of practical work, tutorial support and a web-based message board and text-messaging for improved communication) for year one bioscience students doing a service course in chemistry.

One clear message to emerge from the bench-marking statements is the importance attached to graduate skills – for example the QAA Bench-marking statement for Bioscience (QAA, 2002) lists the following "Self-management and professional development skills":

- "*Developing the skills necessary for self-managed and lifelong learning (e.g. working independently, time management and organization skills);*

- *Identifying and working towards targets for personal, academic and career development;*

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- *Developing an adaptable, flexible and effective approach to study and work.*"

These skills are often addressed and acquired through a period of work-experience and the final case study in this booklet outlines the way in which the placement year is organised within the bioscience area at the University of York where work-based skills are important learning outcomes. This case study also provides evidence that a period of work experience can bring about improved student performance.

Perhaps inevitably, the work described in these case studies is largely concerned with curricula content. However, as students move through our university system they are expected to acquire the abilities to criticise, to synthesise, to evaluate, etc. (Griffiths, 1999). As curriculum designers we are much more comfortable with 'content' because it is not as obvious how we might develop high-level skills in our undergraduates. Thus, how do you get a first year undergraduate in, say, biology, to start to criticise the work of academics and the foundations of the subject itself? It is probably a very slow process in which the student is firstly encouraged to evaluate and criticise the work of him/her self (self-assessment) before moving on to evaluating and criticising the work of peers (peer-assessment) and then the actual textbooks and research papers, theories, ideas, etc. that form the cornerstones of our subject area. One of the contributions in this booklet introduces these ideas through the work of Perry (the Perry Model of Intellectual Development). In terms of curriculum development we can begin to see a model developing as students move through different stages initially accepting that all questions have right and wrong answers through stages where the student has to find the 'right' answer (but there is still a right answer) through to interpretation of evidence and thus the development of these high-level skills that we expect of all graduates.

These case studies serve to demonstrate the support mechanisms that can be put in place to ensure that students progress satisfactorily through the system. They are largely led by individual academics working either within their own modules or at the level of the course committee rather than as top-down initiatives and they thus illustrate how effectively support can be achieved at the grass-roots level. However, embedding ideas such as those of Perry throughout the curriculum remains a challenge for most of us.

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The Influence of Student Development on Practical Curricula

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SUMMARY

The development of curricula is subject to many national and institutional guidelines that assure quality. The Perry Scheme of intellectual development proposes that students move through a series of stages within each subject area. It is argued that practical curricula need to take these stages into account, particularly as they relate to assessment.

Keywords: intellectual development, Perry Scheme, curriculum development, student transition.

INTRODUCTION

The proposal, development and acceptance of new curricula in Higher Education are governed by a series of administrative guidelines that involve notions of progressive levels (National Qualifications Framework, QAA, 2001), of subject based graduate qualities (Subject Benchmarks, QAA, 2002) and quality assurance procedures (Codes of Practice, QAA, 2000). Implicit in this process are concepts of progression and student development but the details are not often apparent and a common interpretation by staff is that it is the subject that progresses, becoming more complex, more novel and more 'demanding'. The students and the ways in which they engage with the subject, however, also progress and student centred curricula need to be developed with both the necessities of the subject and the progression of the students in mind.

It may seem that a rather abstract theory of intellectual development would hardly be relevant to the construction of practical curricula. Nevertheless the Perry scheme of intellectual development resonates with our own experiences both of the ways in which we might have learned our specialist subjects in the past and also the ways in which students react to curricula. An account of it is offered here as a dimension which should be taken into consideration when developing year one curricula and their associated assessments.

RELEVANCE TO THE STAR GUIDELINES

At its outset the STAR project researched, produced and published a set of guidelines based on the causes of student attrition and which pointed the way towards possible good practice. The STAR guideline relevant to this account is 3.2, although the consideration of the ways in which students develop in their engagement with their subjects should inform many other aspects of the ways in which institutions interact with learners.

> 3.2 The course and its delivery should assist students' transition from their previous educational experience to studying at tertiary level as well as addressing the different needs arising from the subject backgrounds of the student cohort.

Cook *et al.* (2005)

THE PERRY SCHEME

On the basis of extensive interviews with students in the 1950s and 1960s William Perry proposed that students passed through nine developmental positions when learning a subject. Rapaport (1984) has offered a succinct description of all these positions. A position is a student viewpoint and they have been grouped into four major categories:

- Dualism;

- Multiplicity;

- Contextual Relativism; and

- Commitment within Relativism.

From a curriculum development viewpoint the last two may be treated as one. A critical feature here is that progression is required from one position to the next and that well designed curricula should take students rapidly through the early steps rather than assume them. Positions are subject specific so that just because a student has reached a relativistic position in one topic does not necessarily mean that he/she will take up a similar position towards another.

Dualism

In a dualistic position, a student believes that all questions have answers that are either right or wrong. Often the rightness or wrongness of the information depends on the authority of the information provider rather than the evidence that might support or not support a particular view. This is characterized by a student attitude that demands to know the truth so that it can be learned and repeated for assessment.

In the Perry scheme, Dualism is divided into two parts. The first ('Basic Dualism') is probably a theoretical extension in the context of Higher Education and describes a position in which students believe that all questions have right answers and that the role of a student is to learn these right answers from their teachers.

The second stage is 'Dualism' itself and occurs when faced with conflicting information. The student role is now to find and learn the right answer. Dualistic students prefer highly structured teaching dominated by the teacher from which they can learn the right answers.

Multiplicity

This stage is also divided into two. 'Early multiplicity' is characterized by the student who classifies questions into two types:

- Those for which the teacher knows the right answer; and

- Those for which the teacher does not yet know the right answer.

All questions still have right answers. However, the student now acknowledges that some questions have not yet been answered.

The student role is still to find and learn the right answer. The teacher's role, however, is perceived to be to provide the methods for students to reveal the right answer.

As students gain experience they appreciate that many questions being discussed do not yet have definitive answers. As students enter this position of 'late multiplicity', teachers lose some authority and the student's role becomes one of, not only learning those answers that are known to be right, but also offering answers themselves to those, which as yet, have no answers. Single questions may have many answers, each of which might be equally valid. Teachers are seen as helping students to think about problems.

Relativism

Relativism is subdivided. In the first position, 'Contextual Relativism', students understand that they are not necessarily being asked to learn the right answers but to address problems for which there is evidence pointing to a solution. A later position is 'commitment within relativism', in which students increasingly make their own decisions.

Science subjects are essentially factual even though those facts are initially dependent on an accumulation of evidence. The value of

opinion, other than in giving varying weights to different pieces of evidence, is sometimes limited. Nevertheless the changes in students' positions described in this scheme are relevant to evidence based subjects until at least the stages of late multiplicity and all stages are applicable to ethical aspects of these subjects.

In summary, the Perry sequence of positions is descriptive of a process through which students pass as they learn a topic. First they seek for the facts, then in seeking evidence for that fact they discover that not all things are known. This leads to a realization that a fact is merely one of a range of interpretations of the evidence and that their interpretation might be just as good as that of anybody else. Finally, in factual subjects, the different interpretations are given values that depend on their origin, the weight of evidence, etc.

EXEMPLARS

Developing Understanding

The relationship between the MMR (Measles, Mumps and Rubella) vaccine and autism has elements of evidence-based fact, of opinion and belief, and of ethics.

Students beginning to study this topic would be expected to seek the truth, most likely from the teacher. This would be a 'dualist' position. When it became apparent that there were at least two opposing theories relating the MMR to the development of autism, students would be expected to collect the evidence in an attempt to determine which of these two represented the truth, activities which involve an element of 'multiplicity'. It would be likely that, given the strength of opinion involved and the involvement of non-specialists as proponents, that students would conclude that their own opinion was just as valid as anybody else's and thereby demonstrate characteristics of 'late multiplicity'.

Differentiated Assessment

It is worthy of note that students at one position in a subject may not understand questions directed at the assessment of another, higher, position or may consider assessment directed at a lower stage to be facile.

Rapaport (1984) further illustrates this with an example of an assessment exercise that is differentiated by Perry stage. We can translate this into a biological example. Consider the following exemplar question:

Summarize the factors that contribute to a programme of vaccination preventing the spread of a disease and one of the following:

> a. Describe the advantages of using the MMR vaccine;
>
> b. Give a reply to the following statement. 'MMR should not be used because there is evidence that it causes disorders such as IBD (Inflammatory Bowel Disease) and autism'; and
>
> c. From the viewpoint of a parent, outline your attitude to having your child vaccinated with MMR.

Alternative 'a' requires a relatively simple recall of the factual basis of the subject, which favours a 'dualist' approach. Alternative 'b' encourages a consideration of the evidence of a relationship between MMR and various disorders and should favour a 'multiplicity' approach. Alternative 'c' invites the student to adopt the viewpoint of another and weigh the public health advantages against the parental fears of individual disadvantage. This would require a relativistic approach.

A Student Dialogue

Richard Felder at North Carolina State University has developed a useful didactic tool of simulated dialogue between students to

illustrate a variety of approaches to learning. An adaptation of Felder (1997) is included as Appendix 1 to illustrate three students in different Perry positions.

CONCLUSION

From the standpoint of the management of transitions, the Perry scheme offers insight into a process that is often ignored by lecturing staff and curriculum developers. That is, not only does the subject develop and build its concepts from the simple to the complex but also the students themselves develop within each subject in their ability to engage with different approaches to the manipulation of information. This should affect they ways in which we teach and assess our subjects.

ACKNOWLEDGEMENTS

Appendix 1 is based on an article by Richard Felder (Felder, 1997). It has been adapted to suit a British context and moved from a focus on engineering to one on aspects of biology.

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APPENDIX 1. Meet Your Students.

Adapted (with permission) from Felder 1997

Three BioSciences classmates are heading for lunch after a lecture on insect excretion. Mary and Bob are discussing the subject and Dave is listening silently and looking grim.

Mary: "OK, so insects are different. But just asking us to design an excretory system which would operate in the absence of a significant blood pressure. What was that about? Why can't he just give us the facts?"

Bob: "Sure he could but all the systems we have looked at so far depend on blood pressure to produce an ultrafiltrate of the blood. And then you get to work on that. These 'what if' questions are really quite stimulating."

Mary: "Maybe, but it's just a matter of conjecture in questions like that. Remember when he asked us to design an animal to live on Mars? Biology is a body of evidence that we can interpret to find the facts. These creative games he plays have no place in a classroom."

Bob: "Come on, Mary – most real problems don't have just one solution, and he's trying to ..."

Mary: "Yeah, yeah – he's just trying to get us to think and I'm okay with that game as long as I don't lose marks if my solution isn't the same as his. What do you think, Dave?"

Dave: "I think that these problems are pointless! I just want the facts."

Mary: "Its not that kind of question – not everything is the same."

Dave: "OK, so when did he tell us the answer? I memorized every lousy word he said after I failed that last test and not one had anything to do with ..."

Bob: "It's a thinking question – you have to try to come up with as many ..."

Dave: "That's bull, man! I already know how to think – I'm here to learn some biology."

Mary: "Dave, not everything in the world is black and white – some things are fuzzy."

Dave: "Yeah, in those woolly humanities courses and things like astronomy where you cannot do proper experiments but not in biology – our questions have answers, and Cookie's job is to teach them to me, not to play guessing games or put us in those dumb groups and ask us to ..."

Mary: "Yeah, I'm not too crazy about those groups either, but ..."

Dave: "… and that's not all – on Monday, Jim asked him that question about the best sort of gas exchange system and he starts out by saying 'It depends' ... I'm paying fees for the **answers**, and if this bozo doesn't know them he shouldn't be up there."

Mary: "It is obvious that mammals are better than insects. Their size, intelligence, everything shows that. Lungs are clearly better than these airline thingy's."

Bob: "Look, the teachers don't know everything ... you have to get information wherever you can – like in those groups you two were trashing: we can learn from each other – and then evaluate it and decide for ourselves, and then you can ..."

Dave: "That's a load of ..."

Mary: "Um, what happened in the prac trying to measure the power exerted by locust leg muscles? I used the formula for the trajectory and worked out a reasonable value for the initial force exerted by the leg muscle."

Bob: "I did the same thing at first. I reckon it was far too low. I thought about it some more and I remembered those trajectory

equations only hold in a vacuum. My locust kept tumbling around after it jumped and air resistance must have reduced the length of the jump. I reckon a better way of doing it would be to video the jump and then we could get a direct measure of the initial velocity without having to worry about estimating the height and length of the jump. I wonder if I could sneak in during next week's class and try out a few things."

Mary: "Whoa – he never said anything like that in class."

These three students illustrate three levels of the PERRY MODEL OF INTELLECTUAL DEVELOPMENT. The Perry model is a hierarchy of nine levels grouped into four categories of which the first three are of relevance here:

Dualism (levels one and two): knowledge is black and white, every problem has one and only one correct solution, the authority (in this case, the teacher) has all the solutions, and the job of the student is to memorize and repeat them. Dualists want facts and formulas and do not like theories or abstract models, open-ended questions, or active or cooperative learning ("I'm paying tuition fees for him to teach me, not to teach myself."). At Level two, students begin to see that some questions may seem to have multiple answers but they still believe that one of them must be right. Like many first year university students, Dave is at Level two. He has a good grasp of the facts but cannot cope with hypothetical or unanswerable questions.

Multiplicity (levels three and four): some questions may not have answers now but the answers will eventually be known (level three) or responses to some (or most) questions may always remain matters of opinion (level four). Open-ended questions and cooperative learning are tolerated, but not if they have too much of an effect on marks. Students start using supporting evidence to resolve issues rather than relying completely on what authorities say, but they count preconceptions and prejudices as acceptable evidence and once they

have reached a solution they have little inclination to examine alternatives. Some first year students are at level three in their specialist subjects and most graduates are at level three or four. Mary is at level four. She considers evidence to be important but shows little sign of being able to make value judgements between different sources.

Relativism (levels five and six): students in relativism see that knowledge and values depend on context and individual perspective rather than being externally and objectively based, as level one to four students believe them to be. Using real evidence to reach and support conclusions becomes habitual and not just something teachers want them to do. At level six, they begin to see the need for commitment to a course of action even in the absence of absolute certainty, basing the commitment on critical evaluation rather than on external authority. A few graduates like Bob attain level five. He enjoys thinking critically about his work even to the extent that he questions the teacher's approach and methodology.

The key to helping students move up this developmental scale is to provide an appropriate balance of challenge and support, occasionally posing problems one or two levels above the students' current position. If teaching is confined to single-answer problems, students will never be impelled to move beyond dualist thinking; on the other hand, expecting most first year students to think critically when solving problems and to appreciate multiple viewpoints is a sure recipe for frustration. Lecturers should assign open-ended real-world problems throughout the curriculum but should not make assessments heavily dependent on the outcomes, especially in the first two years. They should have students work in small groups (automatically exposing them to multiplicity), model the type of thinking being sought, and provide supportive feedback on the students' initial attempts to achieve it. While doing these things cannot guarantee that all of our students will reach level five or

higher by the time they graduate, the more we move them in that direction the better we will be doing our job.

A Module in 'Study in Higher Education'

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SUMMARY

The School of Earth, Ocean and Environmental Sciences in the University of Plymouth runs a skills module (Study in Higher Education) in the first term of a foundation course in Extended Science (level 0). It consists of 12 two-hour sessions, which include how to write a scientific report, how to use electronic information sources, how to take lecture notes and also matters of learning and the problem of misconceptions in science. The last half hour of each session is for student liaison. The aim of the module is to ease the transition for all of the students into the Higher Education environment. Feedback about the module is collected at the end of the autumn term via a questionnaire and this is followed up in the summer term by a further, more reflective questionnaire and focus groups. The assessment of the module is via a portfolio of work carried out during the course, demonstrating the students' achievement in a number of key areas.

Keywords: retention, induction, study skills, transition to Higher Education.

INTRODUCTION

Students entering the Higher Education environment now come from a wide variety of educational and social backgrounds. The change into the Higher Education environment from the controlled environment of school, college or Further Education institution can be challenging for a number of students, particularly if they are mature and/or have prior poor experiences in learning environments. The class sizes can differ dramatically (frequently much larger in Higher Education) and the teaching and assessment styles are based on more independent learning styles rather than being developed around a particular set of study skills and learning strategies, as in many secondary schools (Lowe and Cook, 2003). Not all students are well equipped for this change and can have difficulties in making the transition to their new learning environment. This case study relates to a module, which directly addresses the need for students to rapidly change their study habits and adapt positively to their changed circumstances.

RELEVANCE TO THE STAR GUIDELINES

At its outset the STAR project researched, produced and published a set of guidelines based on the causes of student attrition and which pointed the way towards possible good practice. The STAR guidelines relevant to this case study are:

2.3 Induction activities should support the development of those independent study habits suitable for Higher Education.

2.4 Induction events should provide the foundations for social interactions between students and the development of communities of practice.

2.5 Induction activities should promote the development of good communication between staff and students.

3.2 The course and its delivery should assist students' transition from their previous educational experience to studying at tertiary level as well as addressing the different needs arising from the subject backgrounds of the student cohort.

3.3 Students should receive regular, formative evaluations of their work early in their course or course component.

3.4 Attendance at all teaching sessions is a key requirement for success.

Cook *et al.* (2005)

THE PRACTICE

A Study in Higher Education module was begun in 1990 as part of the Extended Science foundation course at the University of Plymouth. This course aims to enable non-traditional applicants to progress to a degree course in science at the University. The module has developed naturally over the last 15 years from an overtly skills oriented module to one with a wider remit to support transition.

This Study in Higher Education module was developed to introduce the students to the Higher Education environment and to develop scientific, learning and study skills early in their undergraduate career. The formal module description includes the following:

"*This module is designed to enable learners to adapt to the Higher Education learning environment by the development of a more independent, reflective and self-managed approach to study, learning and time management.*"

The module aims to:

- Assist the development of an independent, reflective and self-managed approach to study;

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- Enable learners to plan their time more effectively;

- Build confidence in learning, study and approaches to finding information; and

- Familiarize learners with the Higher Education learning culture.

At the end of the module the student will be expected to be able to demonstrate the following learning outcomes:

- Write a laboratory report using an accepted model;

- Present a piece of work using a word-processing package;

- Closely reference work using one of the accepted protocols in science;

- Reflect intelligently on their approach to information finding; and

- Critically review sources cited as references.

The module runs throughout the first term and is a ten-credit point module (100 hours of student effort). Each weekly session lasts for about two hours and some of the topics covered are:

- Writing a science report;

- Approaches to information finding and referencing;

- How to take lecture notes and what to do with them;

- Revision, test and examination techniques; and

- A skills audit.

The module is taught by one member of staff, the programme manager (DJH), who is a scientist and also teaches a large part of the chemistry modules. Other academic staff who are teaching on the foundation year are aware of the content and ethos of this module and reinforce the approach in their teaching. The skills developed in the module are applied in other concurrent modules so that the skills acquired are contextualized more widely. For example, the use of electronic information sources is encouraged and rewarded in laboratory report writing in Chemistry, Physics and Biology. Students are also expected to critically review their sources of information in order to discern the scientific credibility of their material.

The last half hour of the two-hour session each week is for student liaison. The lecturers remain after the more formal proceedings and any student has the chance to speak to them about anything that they think could be improved on the course as a whole, administrative aspects of the course, academic subject matter or areas that are giving students cause for concern. This is a good opportunity for interaction: the students are empowered by being able to voice their opinion and the lecturer has a chance to get high quality feedback from the students about their progression and the elements of a module or the course with which they are having difficulty. These sessions also help to identify those students who are not adjusting quickly enough or appear 'weaker'. These students can then be directed to appropriate support, for example the Mathematics drop-in centre, on-line tutorials or a specific tutor or learning counsellor, as appropriate. It also allows students to receive timely feedback on how they are progressing and helps them to focus on areas where they might need to improve. This aids self-development.

The policy of this foundation course is to provide frequent and high quality feedback on assessments. For example, in the Chemistry and Physics modules during the autumn term, laboratory reports are produced weekly, marked by lecturers and returned within seven

days. This represents a considerable workload for staff with a cohort of 150 students but it has been found to be of immense value in improving students' learning and understanding, as well as boosting their confidence. Assessments in the spring and summer terms are less frequent, as the students have developed considerably during the rather more intense opening term and the subsequent assessment regime closely mirrors that of stage one of a science degree course.

The Study in Higher Education module is assessed by a portfolio in which students accumulate evidence of their developing skills. It also provides a reference work to assist in the assessments associated with other modules. It has been found that in addressing the requirements of the portfolio, students' written assessments improve and hence the module has a direct and measurable effect on their performance on the course. For example, the portfolio criteria address best practice in laboratory report writing and referencing. In order to produce work for the portfolio students are motivated to improve their practice in science modules in this respect and hence score higher marks in the science modules. There is also clear evidence of development of report and essay writing and presentational skills as well as greater sophistication in information finding, constructing arguments and the emergence of reflective writing.

RESOURCE IMPLICATIONS

The main resource implications of running the module are in terms of lecturer's time and the administrative aspects of running the module. There are 12 two-hour sessions run by one member of staff and with preparation time this represents a considerable workload. The assessment of up to 150 students by portfolio takes around three days for one lecturer to mark. The other modules in the course have evolved to support learner development, particularly during the crucial first term. A typical first year undergraduate module would have two or three assessments per term but Chemistry has nine and

Physics ten, with each module reverting to four in the spring term. Hence, the marking load in concurrent modules is considerable, even when divided between the four members of staff taking the laboratory classes. The course, however, is so successful in facilitating the entry of non-traditional students into degree courses and with pass rates around 85%, that staff are convinced of the efficacy of the assessment strategy and committed to its continuation.

EFFECTIVENESS

The effectiveness of the Study in Higher Education module is monitored in a number of ways:

1. By formal questionnaire at the end of the autumn term;

2. By a more reflective formal questionnaire in the summer term; and

3. Continuously and informally throughout the course: during the module sessions in the autumn term.

Students are encouraged to reflect upon their performance in the various modules on the course, as well as changes and developments in their interests in science as they progress. Liaison with admissions tutors, students and other academic staff during the year is encouraged. This helps students to make an informed choice of science degree course and encourages them to adopt a reflective attitude to their undergraduate experience and learning habits. Feedback, particularly from the questionnaire completed at the end of the summer term shows that the students find Study in Higher Education to have been practically useful in terms both of helping them to take notes and of improving their performance in assessment but also as an aid to their development as independent learners. A recurring theme from many students is their enhanced confidence;

mature students, in particular, often lack confidence in their ability to study at university level since their school or college experience may have been some years before. Many do not have a family or cultural history of university. Many non-traditional entrants too may have had problems with negative experiences of their past academic history and hence they too need to develop the skills and self-confidence required to succeed at university.

The formal, University administered summer questionnaire shows agreement with all the positive statements about the module. There was strong agreement with statements related to the quality of the teaching (93% positive), the structure and organisation of the module (83% positive) and nearly 60% agreeing that the module was interesting and informative. Forty-two students completed the free response section. This asked students about the best aspects of the module and things that could be improved. Some critical comments were elicited such as requests for earlier information on, for example, writing laboratory reports and essays, or for shorter sessions. The majority of comments, however, related to the need for more information. These were balanced by other positive comments praising the course for general support in the development of study skills (ten students), helping them write laboratory reports (eight students) and the relaxed atmosphere. Although cited by only six students the timetabling of the session (early in the week and not at 9.00 a.m.) may have done much to contribute to the relaxed atmosphere. Thus two students referred to the best aspects as:

> "*Good time slot as it starts the week not too early.*"

> "*Brill! Really useful to get us off to a good start each week!*"

Although it is difficult to please everyone:

> "*The worst aspect? – Getting up at 9.30 a.m.*"

One student commented on the best aspects of the course:

"*Introduces you to University life and facilities (especially the Library). Puts a voice and a face between formal requirements of University admissions and departments, and new students with questions and concerns. Gives an informal space for students to ask questions, and express concerns. Prepares you for tasks/demands of the laboratory and lecture theatre. Essential for the module to continue, as it builds your abilities for the oncoming challenge – a University degree*."

and also cited as the things which could be improved:

"*No critical comments really, only that it continues. University is daunting in the first few weeks. This module is vital for this pre-degree course*."

CONCLUSION

The investment in this type of foundation course in terms of staff time and teaching expertise is considerable. Over the past 15 years, however, over 1,500 students have become graduates of the University of Plymouth after attending this course. These are students who would not normally have been able to enter university directly into stage one to study for a science degree. Once a student has developed sufficiently as a learner they tend to require less support than average and it has been found that former Extended Science students are more likely to obtain a first class or upper second degree than a standard A level entrant. The extra year's experience of university is clearly a critical factor here.

CONTEXT

University of Plymouth	28,000 FTEs 936 academic staff
Departmental context	The School of Earth, Ocean and Environmental Sciences has approximately 74 academic staff and 1,500 undergraduate students
Course context	Students who are admitted onto the Extended Science Course are largely mature and often lacking in traditional qualifications. Completion of the foundation year permits automatic entry to any one of a range of Honours degrees at Plymouth. Students study two sciences from biology, chemistry and physics – each with five hours of teaching contact time per week. There is an emphasis on practical work. In addition, there are two hours of mathematics per week which is complemented by a drop-in centre to provide further support and help. The centre is open each day of the teaching term. In 2001-02 there were 150 new undergraduates on the foundation year, 100 were mature students and 46% were male. Of these 150 students, 127 proceeded to year 2 (Stage 1 of an honours degree), 11 leaving early (6%) and 7 failing academically (3%).

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Bridging – Preparing International and Local Students for Final Year BSc Honours Studies

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SUMMARY

The University of Ulster has chosen to focus on providing articulation opportunities for entry from sub-degree levels as one of its key teaching roles. The preparation of such top-up students (average of seven local and twelve Hong Kong students per year) for final year studies in BSc Hons Food Technology Management at Ulster is the practice under consideration in this case study. The practice is built on knowledge of the entry qualifications, a working relationship with transfer course leaders, staff commitment to student support and an additional cultural experience for Hong Kong students. The practice focuses on an assessed transfer module (credit level 2), involving students in 100 effort-hours during the summer, which emphasizes the development of transferable and graduate skills over subject specific knowledge. The practice is most valued by top-up students for the time allowed to adjust to the new learning environment and confidence gained to commence final year degree studies 'running'.

Keywords: international students, top-up degrees, bridging courses, graduate skills, transferable skills.

INTRODUCTION

The Student Progression and Transfer (SPAT) project highlights the importance of timely information and the development of skills in the preparation of top-up students for entry to university where the

curricula places more emphasis on student-centred and independently achieved learning outcomes (Carter, 2002). Whilst UK government policy on Higher Education widening participation speaks to this constituent, it is important to also recognize the needs of an increasing number of international Further Education students progressing to UK universities. Drawing on the international student exchange literature, Thomas and McMahon (1998) refer to the varied cultural, political and social experiences at institutions in different parts of the world, however, less is known about the transition of international students to award bearing Higher Education qualifications in the UK.

INSTITUTIONAL CONTEXT

BSc Hons Food Technology Management at the University of Ulster ran from 1988-89 to 1995-96 as a four year, sandwich placement programme, with a typical annual intake of 20 students. The course was first accredited by the Institute of Food Science and Technology (UK) in 1993 and still is, based on a re-appraisal in October 1999. In 1996, a top-up pathway, comprising a summer bridging course and the normal final year programme, was introduced. This pathway has helped build a truly international degree with students from the island of Ireland (local) and Hong Kong. In 2001, it was decided to only offer the programme as a top-up degree for students with a BTEC Higher National Diploma or equivalent qualification in a food related discipline. Today this top-up degree lies within a 'Food, Nutrition and Dietetics' subject area, run by the School of Biomedical Sciences.

Between 1996-97 and 2002-03, 135 students (51 local and 84 Hong Kong) successfully bridged and graduated on the BSc Hons Food Technology Management top-up degree. In addition, six students successfully bridged over this period but either withdrew early on health grounds (one local and one Hong Kong) or failed final year

(four local). This represents a 100% success rate on the bridging course, a 100% success rate in final year for Hong Kong students and a 92% success rate in final year for local students. Approximately 50% of these students can be classified as mature (22 years or above) and the gender balance for all students (141) favours female (88% local and 61% Hong Kong).

INTENDED OUTCOMES OF PRACTICE

The intended outcomes of the bridging course are to:

1. Provide students with confidence in their new learning environment and a knowledge of the standard of work expected of a BSc Hons Food Technology Management graduate; and

2. Enable them to start final year as well prepared as peers returning from a placement year.

In addition, the bridging course addresses the cultural adjustment of Hong Kong students to life at the University of Ulster as well as the local environs.

OUTLINE OF PRACTICE

The focus of this case study is practice within a Transfer Module (credit level two). This module requires 100 hours of student effort within the bridging course and is considered effective in meeting the two above-mentioned intended outcomes. The Transfer Module builds on a number of pre-requisites, which are now outlined.

An analysis of the curricula for the feeder courses at the four Further Education Institutions (three local and one Hong Kong) highlighted a close fit with the curriculum of the degree thereby allowing the

bridging course to emphasise the development of transferable and graduate skills over subject specific knowledge. Good working relationships between the BSc Hons Food Technology Management Course Director and the leaders of all the feeder courses were established. A small team of academic and support staff who were committed to the delivery, evaluation and continuous improvement of the summer bridging course, and the ongoing support and pastoral care of students throughout the final year of the degree, was formed. Finally, a cultural experience was designed to involve Hong Kong students in sight seeing, factory visits, events with local and other international students and an introduction to the University's host family programme.

The Transfer Module accounts for 90% of the bridging course effort hours, with the remainder spent on the social induction programme. The module provides students with the opportunities to further develop their study, transferable and practical skills within the context of food technology management. A successful student will be able to show that he/she can:

Knowledge and Understanding

- Draw on knowledge from prior learning in food technology management; and

- Identify, obtain and analyse relevant literature on a topic in food technology management.

Intellectual Qualities

- Analyze, synthesize and summarize information critically, including published research;

- Prepare a written scientific report, citing and referencing work in an appropriate manner; and

- Analyze practice within a food company, against (technical standard/innovation) benchmarks.

Professional/Practical Skills

- Record observations on technical standards and innovation in a food company;

- Analyze a data set in food technology management using appropriate computer packages;

- Present a scientific report in a format that complies with accepted conventions;

- Present findings of an investigation in a essay format under examinations conditions; and

- Use the internet critically as a source of information.

Transferable Skills

- Communicate effectively in writing.

The module is delivered intensively over three weeks by lectures, tutorials, computer practicals and factory visits. Lectures cover study and transferable skills, and the subject background for the assessed written scientific report and an investigation of technical standards and innovation within a food company, which is assessed under examination conditions. Group and individual tutorials provide students with guidance in searching the literature, carrying out an investigation in a food company, presenting and interpreting data, writing scientific reports and standards of marking for examination questions. Each student meets twice with his or her assigned tutor.

Practicals require students to use Excel and SPSS to present and analyse relevant data.

EVALUATION OF PRACTICE

Since the introduction of the Transfer Module in summer 1998, 117 students (44 local and 73 Hong Kong) have successfully completed it and gone on to graduate with BSc Hons in Food Technology Management (Figure 1).

There is a highly significant correlation between the overall performance of local students in final year and their Transfer Module performance (p=0.000; R-sq (adjusted) = 56.1%) whereas there is no correlation in the performance of Hong Kong students. Based on student-staff consultations and the results of diagnostic tests (basic mathematics and chemistry concepts), a number of important factors have come to light, which help interpret the results in Figure 1. All Hong Kong students and not just some as in the case of local students have strong basic numeracy and scientific abilities, and, furthermore, a strong motivation and commitment to their studies and to supporting their peers. As expected, many (local and Hong Kong) students possess weaknesses in the use of scientific literature, referencing and scientific writing and a number of Hong Kong students (academically weaker and stronger) are limited in their use of English and industry experience which present barriers to good performance in final year examinations.
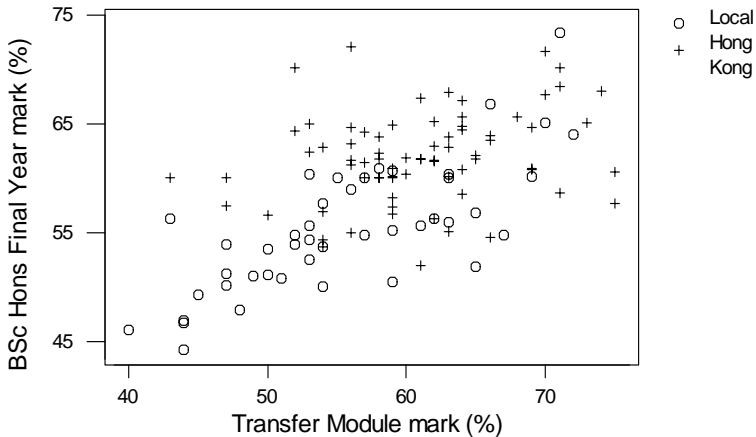
Figure 1: Scattergram of performance of BSc Food Technology Management top-up students in the final year and the summer transfer module (1998-99 to 2002-03).

The good fit between previous course and degree, students' motivation and the time the Transfer Module affords for adjustment and confidence building, lead to good performance in the degree by Hong Kong students but the above mentioned barriers and strong peer support also produce a narrower range of final year performances. Although local students also highlight that they know what is expected of them in final year upon completion of the Transfer Module, it appears the follow up early in semester one, final year by weaker students to address identified knowledge and skills gaps, with the support of their peers, is not happening.

FURTHER DEVELOPMENTS

A better training in scientific report writing should be provided in the Transfer Module by selecting a simpler, yet interesting and realistic data set within the food technology management context, and ensuring the students follow-up the feedback given by tutors. More basic mathematics and chemistry tutorial support and use of English workshops, early in the final year should be provided for local and Hong Kong bridging students, respectively.

CONCLUSION

The success of the Transfer Module (level two, 100 effort-hours) for top-up students entering BSc Hons Food Technology Management at the University of Ulster is built on a knowledge of the entry qualifications, a working relationship with transfer course leaders, staff commitment to student support and an additional cultural experience for Hong Kong students. The assessed Transfer Module, which emphasises study, investigative and transferable skills within the subject context, is most valued by top-up students for the time allowed to adjust to the new learning environment and confidence gained to commence final year degree studies 'running'.

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Doing Biosciences for Real: Acquisition of Work-based Skills During External Scientific Research Placements

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SUMMARY

The Department of Biology, University of York organises a placement year with paid research experience in the laboratories of industrial or research institute employers for biology and biochemistry students between their second and final year. This case study outlines the time-lines for the pre-placement period and the placement year itself and the support mechanisms that have been put into place to support the students before, during and after placement.

Keywords: Work-based learning, placement, sandwich courses, student transition, management of placement, industrial study, research study.

INTRODUCTION

> *"The development and place of skills and capabilities in the curriculum have been major aspects of the Higher Education agenda for more than ten years. During this time developments and shifts of emphasis have occurred, influenced by debates at both national and institutional*

level. There has been an increasing emphasis on student experience, focussing not only on the development of academic and intellectual capabilities and subject knowledge, but also on the development of skills to equip students for employability."

Nobel (1999)

The importance of work-based skills was recognised by the Committee of Vice-Chancellors and Principals when it reported that "*it is one of Higher Education's purposes to prepare students well for working life*" (CVCP, 1996) and is emphasised in many university websites (e.g. University of Bath, 2005). Different models exist for the integration of work-based skills within the curriculum – industrial visits embedded within the curriculum through to short (typically four to six week) placements to one-year industrial placements. In these latter cases, it is now widely recognised that students need extensive support and guidance equivalent to the support and guidance that is offered to students prior to entry to Higher Education and through induction. Thus students who choose to spend an extended period away from the university on an industrial placement must be prepared appropriately for the challenge ahead, given help and advice about making applications to employers, attending interviews, etc., advised about health and safety issues whilst on placement, supported throughout the process and, subsequently, inducted back into university life after placement. Fortunately, ASET (Association for Sandwich Education and Training – integrating work and learning) (2005) is available to support practitioners in this process and the QAA Code of Practice (Anon, 2001) provides a framework for good practice.

This case study describes how the placement scheme works in Biosciences at the University of York. They have been organising placement since 1975 and each year between five and thirty-five percent of their students undertake a year-long industrial placement.

They have now built up an extensive network of supportive employers.

RELEVANCE TO THE STAR GUIDELINES

At its outset the STAR project researched, produced and published a set of guidelines based on the causes of student attrition and which pointed the way towards possible good practice. The STAR guideline relevant to this case study is:

> 3.1 The curriculum should be relevant to and inform students' vocational aspirations early on in the course.

<div align="right">Cook et al. (2005)</div>

THE PRACTICE

The Department of Biology at the University of York offers sandwich courses in Biology and Biochemistry that include a year's paid industrial research experience in the laboratories of industrial or research institute employers. Known as 'Year in Research' the placement period starts at the end of the second year and culminates with students returning to the University for the autumn term of their fourth year.

Year One

First year students who are interested in joining the scheme are invited to attend an introductory meeting in May. Those wishing to proceed make a preliminary application to the Year in Research Administrator via their academic supervisor; this is accompanied by an initial CV and a personal statement. The academic supervisor also provides a statement of suitability.

Placement opportunities are limited and, as competition is high, preliminary selection interviews are held with the Year in Research Organiser. During this interview the first year students' performance is assessed and skills and work preferences are established. Usually

only a few students who have both poor marks and poor motivation are prevented from participation in the scheme.

Successful applicants then take part in a number of training workshops organised by the Careers Service in preparation for their placement year. In the summer term of their first year they attend two sessions. One session is run by the Year in Research Organisers – this is a 'Sequence of events' meeting designed to outline the whole placement process and to highlight milestones. See link below:

http://www.ulster.ac.uk/star/curriculum_development/Sequence_Events2005.DOC

The students then attend a CV writing course run by the Careers Service and academic staff that lasts about an hour. In this session they examine a variety of CVs that illustrate poor and good aspects of CV preparation. See link below:

http://www.ulster.ac.uk/star/curriculum_development/cv_writing.doc

They then have to prepare a final e-CV by the end of term and a supporting personal statement for potential employers. The CV writing meeting is compulsory and an attendance list is taken. The students receive feedback on their CVs and they also show them to their academic supervisor who may also comment on them. The CV writing course is the only 'event' the students attend before the second year and as long as they have submitted their CV and personal statement, then they will be allowed to stay on the Year in Research programme or to transfer into it if they have not already done so. The sequence of events that take place before placement are summarised in Table 1.

Period	Activity
Summer Term Year One	1. Introductory meeting
	2. Registration
	3. Preliminary interview
	4. Training workshop on job applications
	5. Submission of e-CV and personal statement to accompany eventual job applications submitted to the Year in Research Office
	6. Those not already registered for a four-year course do so before the end of the summer term
Summer Vacation	1. The Year in Research Office matches applicants with potential placements and seeks additional placement opportunities
Year Two	1. Year in Research meeting for all selected students
	2. Year in Research talks presented by returning students
	3. Students notified of placement opportunities by e-mail and website
	4. Students are responsible for applying for jobs; applications are sent to the prospective employer by the Year in Research Organizer
	5. Training workshops on interview techniques
	6. Employer interviews (usually held at employers' own sites)
	7. Acceptance for placement (generally by Easter)
	8. Unsuccessful applicants revert to three year, non-placement course

Table 1: The sequence of events prior to placement in Biology and Biochemistry, University of York.

The Summer Vacation

Over the summer, the Year in Research Organisers work to try and find new contacts to add to the existing list of placement providers. The students are allowed to find their own placements, which they do occasionally, but they have to provide all the details to the staff so that the potential placement can be vetted before they can accept. The key criteria are that the placement can provide a genuine research project (i.e. one that provides the opportunity to investigate a real industrial/research problem) and is not just routine work and also that the placement provides a reasonable salary and has the people in the organization to support the student during their time there.

Year Two

The training workshop on job applications occurs in the first week of the autumn term when the students return for their second year.

The second year students also attend the 15-minute talks that are given by the returning students; these talks are not assessed. The sessions allow returning fourth year students to give the second years (and some first year students) an idea about the range of placements available, about living in a different environment as well as a brief summary of the science that has underpinned their placement. Each student is allowed four slides only in their presentation. The first slide is solely about where they did their research and their reflective comments on this; the last three are their Introduction, Results and Conclusion of their placement research project. Pizza and refreshments are provided after the talks to encourage the first and second years to talk to the fourth year students and find out more about their placements in an informal setting. First and second year students may also view preliminary reports ('First impressions') on a website – these are prepared as informative and reflective accounts by students just starting placement (see below).

During the autumn term, students are notified of placement opportunities by e-mail and opportunities are also posted on a

website. Attempts are made by the Year in Research Administrator to match applicants to placements. Students have to take the initiative to apply for specific jobs but applications are sent to prospective employers by the Year in Research Organiser. The vast majority of the applications go out through the Year in Research Office, but as more companies move to online applications (e.g. the big pharmaceutical companies) then the students are tending to make more applications themselves. Generally, most students apply for between five and ten positions and attend between two and five interviews.

A training session on interview techniques is organised by the Careers Service and, again, attendance is compulsory. The students can also do a mock interview at the Careers Service though this is not compulsory and only about 20% of the students use this opportunity. Interviewers at these mock interviews are Careers Service staff and not industrialists; extensive feedback is provided.

Once interviews with employers have been held and placements secured, a number of students will remain unplaced. These students revert to the three-year degree programme pattern and enter their final year in the autumn term.

Some students are placed very late in the academic term (even as late as the last week of the Summer term) though most are placed by April of their second year. This is largely dependent on the placement providers, as some do not know if they have funding for a student until very late in the year.

The Year in Research

The time-line for the placement year is given in Table 2. Once the placement has been organised students are provided with an on-line booklet – the Year in Research Booklet. See link below:

http://www.ulster.ac.uk/star/curriculum_development/YearResearch. doc

This covers contact with the Department while away, the mid term report, the assessment of the Year in Research and writing the placement project report. It also covers the eligibility for Council Tax exemption, applying for University accommodation in the final year and important contact details.

Soon after the students start placement, usually in September, they are asked for an entry for the 'First Impressions' booklet. This booklet is posted on the Year in Research website for the benefit of students currently choosing a placement year. The booklet is also produced in hard copy format for exhibition stands for potential undergraduate students considering placement.

A visit by a member of academic staff during placement ensures that the student has settled in, is doing meaningful work, is planning a suitable research project in cooperation with the industrial supervisor and is generally performing well. There may also be informal contact, largely through e-mail, between the students and their academic supervisors though the extent of this varies between individuals. Apart from engaging with the work of the placement provider, the student has no formal academic work to complete. The visit allows for a tri-partite discussion (academic staff, industrial supervisor and student) to resolve issues. When the students are out on placement they are sent all the documents they need in order to make decisions for their final year modules and final year research project; these are sent out early in the summer term.

The majority of students are placed with large companies and therefore Health and Safety issues are well covered. Where a student is placed in a smaller organisation or where there is an above normal risk, contact is made with the student to ensure that Health and Safety issues have been addressed.

Month/Period	Activity
September	'First impressions' entry in on-line booklet
November – December	Mid term visit. Completion of reports by student: http://www.ulster.ac.uk/star/curriculum_development/Student.doc Academic supervisor: http://www.ulster.ac.uk/star/curriculum_development/ASupervisor.doc Placement supervisor: http://www.ulster.ac.uk/star/curriculum_development/ISupervisor.doc
Early Spring term	E-mail alert to availability of module and project choice booklets for final year with deadlines for decisions
End of placement	At the end of the placement the student performance is assessed by a report completed by the industrial supervisor coupled with a student report
Enrolment Year Four	Welcome back party for returning Year four students
Autumn term Year Four	Seminar presentation to an audience of academic staff and Year two students contemplating the Year in Research
Spring term Year Four	Evaluative questionnaire on the placement experience

Table 2: The sequence of events during the Year in Research in Biology and Biochemistry, University of York.

Anecdotal evidence suggests that students returning from an extended placement period require a measure of re-induction to academic learning. However, the nature of the placements undertaken by students at the University of York is such that they

require little academic induction. However, a Welcome Back Party is organised for returning students in order to ensure that they 'touch-base' with the academic staff and re-new acquaintances among their peer group.

Assessment

The Year in Research is assessed by a report from the industrial supervisor on the student's attitude to and aptitude for the research undertaken, combined with a scientific report of that research from the student. The industrial supervisor's assessment is confidential and is not prepared in consultation with the student. The students' reports often contain commercially sensitive and confidential material. In these cases, confidentiality agreements have to be drawn up and only nominated members of academic staff are allowed to see the work for assessment purposes.

RESOURCES

The placement scheme in Biosciences at the University of York caters for approximately 30-40 students per year and is organised by two academic staff (Year in Research Organisers) with part-time clerical/secretarial help (Year in Research Administrator).

EVALUATION

Students are required to submit a feedback questionnaire (not anonymous) at the end of January following their return from placement.

Student Opinions

The STAR project held a student focus group with Bioscience students from the University of York, some of whom had completed a placement period. The students were very positive about the experience and the support they had received.

Their main reasons for doing a placement were for the research/industrial experience and the opportunity to earn a living rather than as a lead into any specific job though they did appreciate that undertaking a placement was a positive career move, especially as many employers look for experience in the field as a pre-requisite. For one student, it did provide a negative (though also positive) experience:

"*[It] taught me that I didn't want to do a PhD.*"

They valued enormously the support given by the academic staff and thought it was sufficient, but indicated that it focused more on getting a placement, rather than preparing them for what to expect when they got there. They were surprised by the nature of the work they were asked to do (not that they were 'making the tea', but they had not really thought about or been introduced to what goes on in a research or commercial environment). Adjusting to placement was, however, satisfactory: they

"*Grinned and got on with it.*"

They seemed very keen on the placement system and confirmed that they were not concerned about the amount of time they had to devote to preparing for it. They valued the sessions on CV writing.

The placement is assessed via the research report they produced and this contributes to the overall degree award (it counts ten percent of the final mark for the honours degree). They thought that as an element of the placement mark derives from the industrial supervisor's report there could have been a more objective way of assessing performance.

The visit by the academic staff during the year was seen as very beneficial in assisting them in overcoming difficulties but they were also concerned that perhaps assessment of performance during a single visit by just one member of staff could be rather subjective.

Overall, however, the students in the group would do a placement again.

Staff Attitudes

The academic staff generally acknowledge that a period of work-based learning is very beneficial but this has not been assessed in any formal way. It is recognised that it would be very difficult to objectively assess the importance of placement, as those students who choose to go on placement are usually those students who are already performing well. There is a feeling that they are much better prepared for their final year than those who have not been away – they have well developed time-management and planning skills, communication skills (verbally and in writing), group-working skills (including leadership skills), decision making and problem solving skills and are able to work under pressure. Typical comments include:

> "*They [the placement students] have got a lot of experience. They have got a lot of self-confidence, and it shows up in finals marks too*."

> "*They go mainly to research organisations, and for many of them it is to confirm their aspirations for a research career. That is what they would like to do. Or for some [it] helps them to decide what they do not want to do*."

Improved Student Performance

At the University of Ulster, a year's placement is optional in Environmental Science and Geography and some analysis of student performance supports some of the above observations though it must be acknowledged that students who choose a placement option are often the better students. In these degree programmes, 14 students undertook a placement in the years 2002-03 and 2003-04. Of these, all ultimately obtained either a 2i or a first class degree. Further, there was an overall five percent increase in their marks between

Year One and Year Four (after placement) – Year One, 61.4% average; Year Four, 66.4% average. This difference was significant (using a matched t-test) at between 0.01 and 0.001. Analysis of students who did not go on placement indicated that there was also an overall increase between Year One and Year Four (from 58.0% to 60.4%) but this was less than that for placement students and was not significant.

CONTEXT

University of York	In 2003 there were 9,277 FTE students. Eighteen of its 23 departments, including the Department of Biology, were rated 5 or 5* in the last Research Assessment Exercise.
	All first year undergraduates are guaranteed accommodation in one of the eight colleges or in University residences within walking distance of the colleges.
Course title	Biology single subject degrees
Size of course	103 undergraduates (2002-03)
% mature	"*Very few – one or two per year.*"
% living at home	"*Practically none.*"
Relevant entrance data	Intake requirements – ABB to BBB including BB in Biology and Chemistry
	Average on intake 254 points (equates approximately to AAB)
	89% offered A level or Highers in fulfilment of the entry requirements

Retention	In 2003 there were six early leavers; four changed course within York. (Four of these left immediately after registration and a further two students transferred into the course.)

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Professional Skills Tutoring System

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SUMMARY

The School of Applied Sciences in the University of Wolverhampton runs a Professional Skills Tutoring System, which is interlinked to a number of taught modules such as 'Techniques in Biosciences'. The students are divided into groups of about ten and assigned a tutor. The module starts during induction week and contains some diagnostic testing, introductions to basic techniques and the encouragement of individual learning skills. The professional skills are further developed in the second semester using links with other modules.

This system provides for continuity of support for students and the motivation which assessment brings to student work within a modular system.

Keywords: student retention, student attrition, tutoring, induction.

INTRODUCTION

With increasingly larger university class sizes, containing students from a wide range of social and academic backgrounds there is even greater need for small group tutorial classes. Small group tutorials can play a significant role in helping students cope with the transition into the Higher Education environment. In these classes students can get to know their tutor groups socially and also get additional

academic help. The tutorials are a good student support system and help weaker students identify areas where they may potentially have problems early in their studies.

RELEVANCE TO THE STAR GUIDELINES

At its outset the STAR project researched, produced and published a set of guidelines based on the causes of student attrition and which pointed the way towards possible good practice. The STAR guidelines relevant to this case study are:

> 2.3 Induction activities should support the development of those independent study habits suitable for Higher Education.
>
> 2.4 Induction events should provide the foundations for social interactions between students and the development of communities of practice.
>
> 2.5 Induction activities should promote the development of good communication between staff and students.
>
> 3.2 The course and its delivery should assist students' transition from their previous educational experience to studying at tertiary level as well as addressing the different needs arising from the subject backgrounds of the student cohort.

> Cook *et al.* (2005)

HISTORY OF THE PRACTICE

A dedicated study skills module was first run in 2003-04. It grew out of a skills tutorial system that was not incorporated into a module. The implementation of the original skills tutorial system was a direct result of criticism during a QAA inspection in relation to student progression and achievement.

Among many otherwise complimentary comments, the reviewers noted:

> "*An analysis of the most recent HND entry cohort indicates that 43 per cent of the entrants left the University without gaining at least the level of qualification for which they had registered … the corresponding figure for the most recent B.Sc. entry cohort was 26 per cent. Furthermore, the failure rate in examinations for many modules in year two is high, requiring a significant number of resits. The reviewers acknowledge that the Division's access policy will result in lower completion rates; that its student profile is such that it will inevitably suffer more than the average from financial pressures; and that some of the students left with a sub-degree or diploma qualification. Nevertheless, they believe that these issues give cause for concern.*"

QAA (1999)

THE PRACTICE

The School of Applied Sciences in the University of Wolverhampton has developed a Professional Skills Tutoring System and an outline is attached as Appendix 1. Although not a free standing module the system utilises elements in taught modules, one such being 'Techniques in Biosciences'. The summary of the module description includes:

This module covers many of the basic laboratory, safety, IT and study skills which all practically-based scientists should need for successful completion of programmes in Biosciences. In addition it develops techniques of basic numeracy, use of word processing/spreadsheet/data manipulation software in common use throughout the University, and key information-gathering and

library skills. The module also covers generic and personal study skills. Towards the end of the module you will be introduced to the first phase of an Integrated Career and Personal Development Learning Programme, which will permeate your studies and is specifically designed to improve your eventual 'readiness for the world of work'.

This 15-credit module runs in semester one starting in the induction week. The development of basic scientific skills forms part of the module. In particular, it includes a number of diagnostic tests so that the ability of the students in a number of different areas can be assessed (see Appendix 2 for an example). These are in IT skills, basic scientific numeracy and literacy. The teaching methodology is to use these tests as vehicles for encouraging the informal contacts that form part of the Professional Skills Tutorial System. This is accomplished by using the professional skills tutor as initial assessor for these skills areas. The assessment is designed to be diagnostic. Areas of weakness highlighted by the student assessment can then be addressed by one-to-one tutorials with the professional skills tutor. The number of sessions that are required will vary from student to student with some students needing no more than a reassurance that all is well with the identified skills whilst may need more help. An area, which commonly requires more support, is the use of logarithms.

Other skills are then covered in modules that operate in the second semester modules. These include statistical methods, which are linked to the genetics curriculum of a cell biology and genetics module. The professional skills tutor is also responsible for overseeing the student's personal development plan (PDP). In this way areas of weakness and strength identified through these modules form part of the student's individual action plan and will be integrated into the PDP.

The aims of the 'Techniques in Biosciences' module are integral to this approach and emphasise the development of subject specific skills:

- To introduce a variety of commonly used techniques, experimental, analytical and observational, together with generic communication skills;

- To encourage a responsible and safe approach to work in the laboratory;

- To become familiar with basic IT software in common use within the University; and

- To foster an attitude of self responsibility and motivation and to acquire personal effectiveness qualities of use to potential employers.

Three to four academic staff supported by three demonstrators who hold temporary appointments as academic staff teach the 'Techniques in Biosciences' module. The demonstrators are Wolverhampton graduates and therefore know the School and the systems in operation and also, being relatively young, provide an informal interface with students and the students feel more able to express any concerns. Where possible the tutorials are taken by experienced academics supported by demonstrators. Pressure from other activities currently means that some tutorials have to be taken by less experienced staff.

The subject areas covered include:

- Health and safety – safe working practices;

- Interpreting data;

- Design of bioscience experiments;

- Presentation skills; and

- Self assessment.

The key skills covered are communication, problem solving, improving own learning and performance and information technology. Assessment is directly related to the learning outcomes of the module.

Within this module many of the practically based classes or workshops are conducted with groups of 25 students. However, the sessions that are linked to the Professional Skills Tutoring System normally consist of about ten students with a single member of staff (or less commonly a demonstrator). The student group is selected to give a representative cross-section of backgrounds. This is done by including students studying for a variety of awards including the HND sub-degree award and Honours degrees.

There are six scheduled meetings included in the Professional Skills Tutoring System, three in each semester with each one-hour session timetabled by the tutor. These professional skills sessions may take only a short time with a group of able students but are supplemented with one-to-one tutorials where problems are encountered. This mix of small group teaching and one-to-one tutorials means that an allowance of 50 hours is given for the tutoring process.

RESOURCE IMPLICATIONS

The tutorial system is labour intensive in terms of time and the tutors get 50 hours contact time per Professional Skills tutorial group.

> "*It is quite labour intensive but a big part of it is about developing a relationship with the students so that they can trust you so that they will come to you when they have a problem. We tend to withdraw from this after the first semester so it is important to get the students up and*

running and to be able to identify at an early stage those that may have problems."

<div align="right">Professional Skills Tutor</div>

The second semester further enhances the skills of the student. The details are given in Appendix 1. The purpose of the second semester activities is to promote the student as an independent learner able to diagnose weaknesses and develop strategies for coping without the tutor's help.

EVALUATION – STAFF AND STUDENT OPINIONS

There has been an overall improvement in student retention and progression in the School of Applied Sciences and this has been linked to both the continuity and support provided by the Professional Skills Tutoring System and the development of a new re-assessment policy within the University (McLaughlin and Sutton, 2006). Overall progression rates from first to second year rose from the mid-80% to well over 90% for the first two years after the implementation of these policies.

The staff noted that the Professional Skills Tutorial System also:

"*Allows them [the students] to build informal networks*."

Student opinion indicates an understanding and appreciation of the help that the tutorial system provides.

"*Excellent, I find the tutorials and my personal tutor brilliant as my progress is constantly assessed and I am given the chance to rectify my mistakes and brush up on my skills, as there is always somewhere to go for help if my tutor cannot, they point to someone that can*."

"*The skills module is really good because it's showing me how to do different skills and apply them to other modules. And also this is helping me develop new skills*

> *which are completely different to ones I learnt at the college*."

<div align="right">First year students</div>

Students seem to like the flexibility of the Professional Skills element with one commenting:

> "*Good because you can work through at your own pace but staff are on hand to help if needed*."

There was a diverse range of students interviewed and while some students suggested that there was some repetition of A level, others disagreed. Some recognised that the tutorial system was:

> "*Useful as a grounding to fill in any gaps of the course*."

With others noting that although they had covered much of the material in the tutorials they thought that they would be useful for others and as a revision for themselves.

The only criticism other than having covered some of the topics already at A level was in relation to the group size:

> "*Not enough time with tutors due to large groups*."

Overall the student opinion is positive. Although some have covered the information prior to coming to University, they see the benefits of everyone having an equal experience of the skills needed for the rest of the course.

CONCLUSION

In its initial survey of bioscience departments, the STAR project found that staff cited a tutorial system as the single most effective practice for student retention. Small group teaching offers an effective bridge between the school experience and that experienced in the large groups common at university. Small group teaching, however, often needs to be integrated into modules since students

can perceive unassessed, freestanding tutorial schemes as not being compulsory. The tutorial system described here is integrated into a modular scheme and contributes to the assessment of those modules and thus provides a supported and assessed development of skills. The institutional value placed on it both in terms of the staff time devoted to it and the marks assigned to it convey the importance of skills development to students.

CONTEXT

University of Wolverhampton	12,612 full-time undergraduates
	5,211 part-time undergraduates
	794 staff
	University agenda includes widening participation
Departmental context	120 Bioscience undergraduate students
	45% male, 55% female
	19 academic staff
	10-20% mature students via access course
	2/3rds students live in West Midlands and majority live at home

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FURTHER INFORMATION

http://www.flinders.edu.au/teach/teach/firstindex.htm − Strategies to teach first year students

http://www.support4learning.com/education/study.htm − Resources for education/revision, study skills

http://www.studygs.net/ – Study guides and strategies

http://www.vark-learn.com – A guide to learning strategies

APPENDIX 1. The Tutorial Scheme in Outline

Induction Week
Icebreaker Social Gathering

Tutorial Number One: Mid-late October

	Communication: Prior to tutorial, as part of AB1001 intensive week WWW exercise, tutees will have established e-mail contact via Biosciences intranet and provided a Personal Portrayal ProFile (electronic version). Tutors will have been given a copy of their tutee's ILP completed during welcome week. Discussion takes place on tutor and tutee specialisms.
	Use of Information Technology: Essay from IT Word on AB1001 should have been received, marked (graded pass/fail only) and feedback sheet(s) discussed. Tutees informed about key skill assistance sources, feedback diaries and given a list of 2nd discursive essay topics for selection. Initial thoughts on planning and run through of assessment criteria.
	Application of Number: Work for Tutorial two – AB1001 Units and Measurement Exercise to be completed and handed in to skills tutor by agreed deadline. Selection of extended essay topic confirmed via e-mail. Complete feedback diary page.

Tutorial Number Two: End of November

	Application of Number: As part of AB1001 tutors have marked Units and Measurement Exercise and completed assignment feedback forms for discussion in this tutorial. Tutees undertake an additional Units and Measurement unseen short exercise to re-enforce/check understanding and provide entries from skills feedback diaries for

	checking.
	Improving Own Learning and Performance: Produce outline plans for extended essay, which will be written before or over Christmas vacation period. Preparation of a short talk (three minutes) on choice of topic and aspects to cover.
	Keep feedback diaries up-to-date. Select lowest graded piece of assessed work from one of the level one modules (not AB1001) and critically analyze performance. Tutees should be prepared to explain how they have reflected on this low assessment mark and how they will respond to the feedback comments.
Tutorial Number Three: Mid December	
	Communication: (oral) Tutees give a three minute oral presentation on progress with extended essay topics, and also report on how they have responded to the low-grade score for the piece of assessment selected. Tutors complete interim reports on student progress.
	Improving Own Learning and Performance: Work for Tutorial four – AB1001 CPD Skills Tracker and Interests and Working Styles Profiles completed with help of families and friends + SWOT analysis and handed in by set date.
	Complete extended essays and hand in by stated deadline, together with self-assessment of their work judged against pre-disclosed criteria.
	Note: Remind students to bring calculators to Tutorial Four.

Tutorial Number Four: Mid January-Early February	
	Improving Own Learning and Performance: Return extended essay with completed front sheet feedback form. Summarise collective strengths and weaknesses of essay writing/IT skills. Return SWOT analysis with appropriate commentary.
	Application of Number Work for Tutorial Five: Complete statistical exercise (as part of AB1000) by set deadline. Up-date skills feedback diaries.
Tutorial Number Five: Late March	
	Application of Number: Group tutorial.
	Review success or otherwise AB1000 statistics.
	Package – discuss any feedback comments.
	Communication: Plan activities and tasks for group poster exercise.
	Topic to be based upon students' choice of best-extended essay submitted by the group.
	Work for Tutorial Six: Complete group poster work and up-date feedback.
Tutorial Number Six: Early May	
	Communication: Tutors to conduct process review of poster group work and tutees to provide a group critique of poster presentation.
	Teamwork: Group assessment of all posters according to the specified pre-disclosed assessment criteria.
	Improving Own Learning and Performance: Tutors/tutees to complete individual structured student reports as part of Progress Files developments.

APPENDIX 2. Exemplar Diagnostic Test

AB1001: Techniques in Science – Units and Measurement

The booklet that accompanies this work sheet covers the SI and non - SI units that you are likely to meet in science. This work sheet is designed to give you experience working in various units and converting between them. There is a mixture of very easy through to not very hard calculations that you are likely to use on the course. The 'maths' involved is nothing more complicated than simple 'sums' and proportions. Those of you that have studied maths and the sciences to GCSE or GCE O-level will find little to trouble you and should finish well within the time. Those who feel less secure with calculations may take a little longer but there is plenty of time for you to reach the pass mark. You may use the booklet and you will not be penalised for asking the staff for help if you get stuck.

You are to attempt ALL the problems on the work sheet and have them marked BEFORE you leave the session. There are a total of 80 marks attainable and to pass this session you must get AT LEAST 56 marks.

The first FIVE questions are designed to test your general mathematical ability and are to be performed WITHOUT A CALCULATOR. The questions are similar to those used on foundation level science modules of the Open University. These are specifically designed for students with very little formal mathematical background.

1.   Solve the following equations:

   a. $2 \times (-5) =$ ....

   b. $(-3) \times (-2) =$ ....

   c. $\dfrac{4}{(-2)} =$ ....

   d. $\dfrac{(-8)}{(-4)} =$ ....

   e. $10 - (-5) =$ ....

   f. $(-10) - (-5) =$ ....

2.   Express the following numbers in scientific notation:

   a.   24328   ....

   b.   3000000   ....

   c.   0.000003   ....

   d.   1.0   ....

3.   Express the following scientific notations in ordinary numerical form:

   a. 5.5×10^4 ....

   b. 5.5×10^{-4} ....

   c. 10^3 ....

   d. $1E^{+3}$ ....

   e.   1E-2   ....

4. Solve the following problems and express your answers in scientific notation:

    a. $(2 \times 10^5) \times (4 \times 10^{-3}) =$ ....

    b. $\dfrac{(4 \times 10^6)}{(2 \times 10^{-3})} =$ ....

    c. $\dfrac{0.005 \times (2 \times 10^6)}{50} =$ ....

5. Given that $\log_{10}$ of $2 = 0.301$ and that $\log_{10}$ of $8 = 0.903$ what are the values of the following?

    a. $\log_{10}$ of $16 =$ ....

    b. $\log_{10}$ of $4 =$ ....

    c) $\log_{10}$ of $\frac{1}{4} =$ ....

6. Complete the following table using items from the list provided:

Prefix	Symbol	Multiple
centi	c	10^{-2}
deci		
femto		10^{-15}
kilo		
mega		
micro		
milli		

nano		
pico	p	

10^6 10^3 10^{-1} 10^{-3} 10^{-6} 10^{-9} 10^{-12}

f   n   m   μ   d   k   M

7.   Express the following in grams

1.0 tonne	………….	1.0 mg	………….
1.0 μ g	………….	0.5 mg	………….
1.0 g	………….	0.5 kg	………….
1.0 kg	………….	0.5 tonne	………….

8.   The image of a bacterial cell observed with an electron microscope is 90 mm in length. If the magnification of the electron microscope is 6 x 10^4, what is the length of the original bacterial cell? (One correct answer)

a.	540 mm	d.	1.5 μ m
b.	6.6 mm	e.	540 μ m
c.	1.5 mm		

9.   The relative molecular mass (RMM) of $MgSO_4.7H_2O$ is 246.5. How many grams of $MgSO_4.7H_2O$ will there be in 450 ml of a 1 molar solution? (One correct answer)

a.	123.25	d.	110.93
b.	0.12325	e.	0.1205
c.	0.01109	f.	120.50

10. If 246.5 g of the anhydrous salt ($MgSO_4$) is used to make 1 litre of solution, what would the molarity of this solution be? Assume RMM of H=1 and RMM of O=16. (One correct answer)

a.	1.0 M	d.	2.05 M
b.	0.5 M	e.	2.25 M
c.	0.5 mM	f.	2.25 mM

11. Complete the following table:

Item	Convert to	Answer	Units
2 kg	g	2 000	g
0.5 kg	mg	$5x10^5$	mg
3 mg	g		
15 g	μ g		
500 g	kg		
150 g	$\log_{10}$		
150 g	$\log_e$		

12. Convert 1000 Å (Angstrom) to the following units

nm	……………	cm	……………
μ m	……………	m	……………
mm	……………		

13. Which of the following have the same volume? (Five correct answers)

a.	500 dm^3		e.	5 x 10^{-4} dm^3
b.	500 mm^3		f.	One-twentieth (1/20) of 10ml
c.	500 μ l		g.	5 000 cm^3
d.	0.5 cm^3		h.	50 mm^3

14. A sample of gold dust contains 2 x 10^{12} particles. Each particle has a mass of 1 μ g. What is the mass of the whole sample? (One correct answer)

a.	2 g		e.	200 kg
b.	200 g		f.	2 tonnes (2 x 10^3 kg)
c.	2 kg		g.	2 x 10^6 mg
d.	2 000 mg			

15. Physiological saline solution contains 0.85% by weight of salt in water. How many grams of salt would be contained in the following volumes of solution?

100 cm^3	……………	10 litres	……………
1 dm^3	……………	10000 μ l	……………

10 ml ……………

16. A 20% solution of sodium iodide (NaI) contains 20 g of NaI per 100 ml of solution. Which of the following are also 20% solutions of NaI? (Five correct answers)

a. 20 g in 100 cm^3 f. 20 g in 10 ml

b. 2000g in 1 dm^3 g. 2 g in 1 ml

c. 0.2 g in 1 ml   h. 200 g in 1 dm^3

d. 200 mg in 1 ml   i. 2000 mg in 1 dm^3

e. 0.2 μ g in 1 ml   j. 2000 mg in 10 cm^3

17. Calculate the molarity (moles per litre) of a 20% (weight per volume) solution of sodium iodide. The RMM of NaI = 149.89.

.... moles per litre

18. If the solution in the previous question was diluted five times (1 vol. of solution added to 4 vol. of solvent), what would be the concentration of NaI in % and in molarity?

................................%

.... moles per litre

19. The RMM for tartaric acid is 150.09. How many grams would be required to make one litre of the following solutions?

| 25% | …………… | 0.75 molar | ……………. |
| 250 μ molar | …………… | 1.0 molar | ……………. |

750 .... 1.0 mmolar ....
mmolar

20. Microbial cells in a liquid suspension can be counted directly using a specially ruled microscope slide. The formula for converting the number of cells seen on the slide to the number of cells per ml of suspension is $N \times 4 \times 10^6$ where N is the average number of cells seen in a given area of the slide. USE YOUR CALCULATOR to determine the number of cells per ml of suspension when N is equal to 50.

Write your answer here ....

The correct answer is 2×10^8 cells per ml. If you get 2×10^9 cells per ml it is likely that you are using your calculator incorrectly. If so ask for assistance, as you will get the next question wrong if you make the same mistake.

21. One gram (= 1 ml) of beefburger was homogenised in 9 ml of sterile water. 0.1 ml of this homogenate was added to 99.9 ml of fresh sterile water to give Sample A. 100 µ l of Sample A was spread onto an agar plate, which was incubated for 18 hours at 37°C. After incubation there were 55 colonies on the agar plate. Assuming that each colony grew from 1 viable cell in Sample A calculate the number of viable bacteria per gram of beef burger. Show all your working.

Supporting First-year Chemistry for Students of Bioscience

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SUMMARY

Bioscience students require a broad background in chemistry in order to underpin much of modern-day biology; however, differential performance in Chemistry A level or its equivalent or even students entering bioscience without a Chemistry A level qualification make the teaching of chemistry to such heterogeneous groups extremely difficult. A first year, first semester chemistry module taken by a very wide group of students (biology, biomedical sciences, dietetics, food and nutrition, human nutrition, molecular biosciences, optometry and pharmacology) has put into place a variety of mechanisms to support these students in a module where the students have traditionally struggled. These have included: printed handouts; regular, computer-driven summative tests (supported by practice questions); weekly assessment of practical work using standardised proformas; tutorial support with topics chosen by the students; and a web-based message board and text-messaging to improve communication. These have been welcomed by the students and course directors have also noted that there has been a marked increase in the general satisfaction with chemistry teaching. However, further enhancements are planned to continue to improve this element of service teaching.

Keywords: chemistry, service teaching.

INTRODUCTION

Students entering university bioscience degree programmes are normally required to take one or two modules of chemistry to provide them with the necessary foundational theory and practical skills that underpin biochemical or advanced chemistry modules. As more and more students are now entering university from a diverse range of educational backgrounds the level of chemistry that some have attained prior to enrolling may be negligible while others who have done well at A level chemistry, for example, may be much better equipped.

Many first year undergraduates find the transition from school to university difficult. Their difficulties include an inability to make adequate notes from lectures and an inability to manage their study time effectively – in particular, they tend not to make a serious attempt to understand the material they are being taught until immediately before the examinations at the end of the semester. These difficulties are exacerbated when the class contains a wide range of students with different levels of background knowledge in the subject, since those students with little knowledge feel overwhelmed and those with much greater knowledge become bored with the earlier work and under-perform.

A solution to these problems was developed for the first year biological chemistry classes for undergraduates studying Clinical Physiology and Podiatry at the University of Ulster (Adams *et al*., 1998). The associated computer-based tests have subsequently been further developed into Question Banks (Adams *et al*., 2002; Adams, 2003; Adams *et al*., 2004).

The techniques thus developed have now been applied to a large first year undergraduate class in Introductory Chemistry numbering around 160 students enrolled on a number of courses including biology, biomedical sciences, dietetics, food and nutrition, human

nutrition, molecular biosciences, optometry and pharmacology. The module handout for 2005-06 is given in Appendix 1.

Since the 2003-04 academic year an ever-expanding student support system has been evolving within the module which we perceive has led to greater engagement by the students in the module, a greater level of satisfaction with the support offered and an increase, if small, in the overall pass rates.

RELEVANCE TO THE STAR GUIDELINES

At its outset the STAR project researched, produced and published a set of guidelines based on the causes of student attrition and which pointed the way towards possible good practice. The STAR guidelines relevant to this case study are:

> 3.2 The course and its delivery should assist students' transition from their previous educational experience to studying at tertiary level as well as addressing the different needs arising from the subject backgrounds of the student cohort.

> 3.3 Students should receive regular, formative evaluations of their work early in their course or course component.

> 3.4 Attendance at all teaching sessions is a key requirement for success.

> 4.2 Staff should recognise that expertise in ensuring appropriate support and guidance of students is as important as expertise in their subject.

> 4.3 Staff should seek to monitor their own performance in managing student transition through a process of focussed investigation, personal reflection and development and seek to communicate the outcomes to others.

> Cook *et al*. (2005)

THE PRACTICE

Teaching Support

The module handout is provided in Appendix 1. The twelve-week semester was divided into three equal sections; the syllabus of each section was defined by a comprehensive handout that the students purchased at (printing) cost price. The handouts were illustrated with numerous diagrams and chemical equations and had space in the margins for the students to make additional notes. Sample problems were included where appropriate.

The students were informed that there would be a computer-based test after four and eight weeks, to ensure that they had studied the first two sections. There was a paper-based test at the end of the third section.

To allow the students to familiarise themselves with the computer-based testing system (QuestionMark 'Perception'), practice questions were available at any time (over the Web) for the students to try out. These were of similar style to the summative tests (multiple choice, multiple selection, fill in blanks) and gave feedback for each question, but did not contribute to the overall coursework mark. We initially allowed the students to login anonymously to these; we felt that it would encourage participation if there were no danger of silly errors being identified with particular students.

There were three 50-minute lecture periods per week, plus a weekly three-hour practical class that (as far as possible) covered material that was related to that week's theory. The practical results were recorded on a proforma before leaving the laboratory; these were returned with comments the following week. The lectures were used to give an overview of the main points in the printed handout, but the lecturer discussed the more difficult aspects (e.g. chemical equations and any mathematics) in detail. Since problem solving (including numeracy) is considered an essential skill, the lecturer went through most of the example types in the handout, giving the students

opportunities to ask questions. There was an additional weekly one-hour tutorial class for a small number of students identified as needing extra tuition.

The summative tests contributed (with the practical work) to the coursework mark. For logistical reasons the class was divided into three groups who took the test in consecutive 50-minute supervised sessions. To prevent students logging in elsewhere (and getting unauthorised assistance) a password was only available from the supervisor in the computer laboratory and the test was restricted to a particular time slot for each student.

The results were available to the staff immediately, and could be released to the students the next day. Staff were able to analyse the performance of each question and could make amendments to the scoring with immediate effect or amend the wording for subsequent use.

The module has a summative examination following the Christmas break. Since some students find the strange environment intimidating, the test at the end of the third section was a paper-based one held in the examination hall, but supervised by their lecturer. This, as far as possible, mimicked examination conditions right down to the style of answer booklet used by the students. The tests were then marked by the lecturing staff and returned a few days later at a feedback session.

Student performance in the first year in which this module was run in the way outlined was better than in previous years (taught by traditional methods). However, it was felt that improvements could be made if the students were under more pressure to attend the lecture slots and if they felt that staff would know how much effort they had put into doing the practice questions. Accordingly, a lecture attendance register was kept (numbers in the lecture theatre visibly increased) and the students had to login to the practice tests using their identification number. A more regular pattern of study was also

imposed by substituting four shorter scoring tests at two weekly intervals (the practice tests were subdivided to correspond with these). The test results and examination performance have again improved.

A downside of the reliance on computer testing is that virus attacks on the University's servers have sometimes delayed the processing of the tests, and in one case caused a test to be postponed for a week.

In addition, compulsory tutorials were introduced on a weekly basis for all students and based upon cohort group. As far as was possible tutorials were student-led. An A4 page was circulated at every tutorial where students could anonymously list the parts of the course that were causing concern. These areas then became the focus for the tutorial the following week.

Common practice within the tutorial group was to consider one examination question per week that was relevant to the part of the course being studied at that time. Students, in small groups, were asked to prepare an overhead transparency with an outline of their answer to the question and the academic member of staff then fed this back to the group. Such an exercise provides useful examination preparation.

Early in the semester students had been asked to complete a short survey on the module website regarding their previous experience of chemistry before coming to university. Those who had not studied chemistry previously or those who expressed concerns about the module were placed on an e-mail distribution list and contacted periodically throughout the semester by the module co-ordinator as to their progress. This provided a useful communication tool for those 'at risk' students who may normally disengage with the module should they find difficulty with it.

RESOURCE REQUIREMENTS

Currently (the third year the test-driven module has run) there are three 50-minute lectures per week during the semester shared between two members of academic staff who also share the three weekly three-hour practical sessions. Two other members of academic/academic-related staff assist with organic chemistry practicals during the last three weeks of semester and there is also input from the Faculty Health and Safety Officer on Control of Substances Hazardous to Health (COSHH) and Risk Assessment. To support the practical classes six postgraduate demonstrators are available during the sessions and they mark the practical books to a prescribed marking scheme.

The academic member of staff responsible for the lectures also delivers the accompanying three compulsory 'small group' tutorial sessions each week throughout the semester. For these, as with the practicals, students are kept in their cohort groups as much as possible with each class having 70, 55 and 40 students corresponding to human nutrition, dietetics, and food and nutrition courses; biomedical sciences, pharmacology and molecular biosciences courses; and biology courses respectively. Academic members of staff also administer the class tests (either written or computer-based); other academic members of staff on a separate campus supply support for the administration of the module.

EVALUATION

Towards the end of the semester, module evaluation information was garnered from students. Module evaluation for that year (the second year the module had run in this format) revealed that students greatly appreciated the provision of written notes, online support material and tutorial support. There was also a general consensus that even more tutorial support would be appreciated. Casual student feedback to staff in terms of satisfaction with the module indicated that this

had again improved upon previous years. A student focus group acknowledged that although there were support mechanisms in place some students still struggled and there was still work to be done in supporting students in chemistry teaching:

> "*It was tough to understand the material.*"

> "*In school when we did something we spent time on it, did work on it but here they just mention it and move on. We have to go and look it up and learn it ourselves.*"

Nevertheless, some things do seem to be working. About the tutorials:

> "*When you're in a big lecture group it is very hard to put up your hand to say if you have a problem.*"

> "*Yes, mine [the tutor] told us to write any problems we had on the back of the attendance sheet and that was good because you didn't have to say in front of everyone that you had a problem.*"

and, the computer tests:

> "*It was a good idea, it got it over quickly.*"

> "*For me it broke the material up into smaller sections. I found the module tough but it would have been even tougher if I had all the material to learn at once.*"

and the practice questions:

> "*It was good being able to see the structure of the questions and get used to the way they looked on screen and what buttons you had to press and stuff.*"

and, on text messaging:

> "*We were texted reminders of when assignments were due and when exams were and if the lecturer couldn't make it.*"

> *"It's always good to be reminded if assignments are due*
> *or if we have a test, just in case you forget."*

In addition staff within the School, particularly course directors, have noted that there has been a marked increase in the general satisfaction with chemistry teaching. A paper correlating the use of online practice questions with overall examination performance is in preparation.

These enhancements to the module have continued into the present academic year. In addition, the module website has been redesigned to provide further support to students in the form of a message board and an online coursework mark look-up facility. Communication with students has also been enhanced by using text messaging which is a fast and efficient method of reminding students of class tests, changes to the timetable, etc.

THE CONTEXT

University of Ulster	4 campuses
	26360 students
	Undergraduate: 20490
	Postgraduate 5870
	Full-time: 17825(15865 undergraduate, 1970 postgraduate)
	Part-time: 8525 (4620 undergraduate, 3905 postgraduate)
	>3,500 staff
The School of Biomedical Science	580 FTE students in eight major undergraduate, largely vocational, courses
	74 academic staff

	Intake requirements vary with the course. Optometry requires AAB at A level, Biology requires BC at A level.
	8.6% early leavers (2004-5)

REFERENCES

Adams, K. (2003). Use of QuestionMark assessment software to improve learning and teaching. *Proceedings of Computer Based Learning in Science*, 206-213. University of Cyprus, Nicosia.

Adams, K.R., Byers, W., Cole, R.F.J. and Ruddick, J.D. (2002). Implementation of computer-based assessment. *Proceedings of Variety in Chemistry Teaching*, 25. Keele University, Keele (published by the Royal Society of Chemistry, London).

Adams, K., Cole, R.F.J., Ruddick, D. and Cole, M. (2004). Computer assisted assessment. *Proceedings of Variety in Chemistry Education,* 12-13. Plymouth University, Plymouth (published by the Royal Society of Chemistry, London).

Adams, K., Ginn, B. and Ruddick, D. (1998). Independent learning in an introductory module in biological chemistry: use of QuestionMark software to provide an assessment tool and tutorial support. *University Chemistry Education*, **2**, 40-44.

Cook, A., Rushton, B.S., McCormick, S.M. and Southall, D.W. (2005). *Guidelines for the management of student transition*. University of Ulster, Coleraine.

APPENDIX 1. Module Handout for Year One Chemistry Module

Rationale

The module is designed to establish a foundation for subsequent study of biochemistry or more advanced topics in general, inorganic or organic chemistry. It comprises general descriptive Physical, Inorganic and Organic Chemistry.

Aims

To develop an awareness of the principal factors which influence the structure, physical behaviour and chemical reactions of organic and inorganic molecules and/or groups and to develop skills in making quantitative calculations about chemical behaviour.

Module Contributors

Five staff with contact details

Hours

Lectures and Tutorial	48hrs
Practicals	36hrs
Private study (includes assignments, etc.)	114hrs
Total	200hrs

Lectures/Tutorials

Lectures for the module will be held at the following times. Attendance is compulsory.

Monday	1.15 p.m. to 2.05 p.m. in LT1 (South Buildings)
Thursday	1.15 p.m. to 2.05 p.m. in LT8
Friday	12.15 p.m. to 1.05 p.m. in LT8

Tutorials for the module will take place according to course group as described below and will commence during week two of semester. Attendance is compulsory.

Monday (time/location): Biomedical Sciences, Pharmacology and Molecular Biosciences

Tuesday (time/location): Human Nutrition, Dietetics, Food and Nutrition

Tuesday (time/location): Biology and Optometry

Lecture Programme

The course content will be delivered as follows:

Week number	Topics covered
1	General Introduction
1 - 8	Atoms. Bonding in compounds.
	Water, Hydrogen Bonds and Solubility.
	Chemical equations. Solutions.
	Chemical Kinetics. Chemical Equilibrium.
	Acids, bases, salts. pH.
	Buffers. Thermodynamic equations.
9 - 12	Introduction to Organic Chemistry. Nomenclature of simple hydrocarbons.
	Alkanes, alkenes, alkynes. Isomerism, polymerization. Types of Reactions.
	Alcohols. Aldehydes, ketones.
	Carboxylic Acids and derivatives, amino acids and peptide bonds.

Please note that the lecture content is subject to change at the discretion of the module co-ordinator.

Laboratory Practical Sessions

All students (apart from those enrolled on the Optometry course) are required to attend laboratory practical sessions. These will take place each week in Teaching Laboratory Six at the times specified below. Please note the session that corresponds to your course of study. Attendance is compulsory. If you fail to attend a particular session and have no extenuating circumstances you will receive no marks for that session.

Monday (time/location): Human Nutrition, Dietetics, Food and Nutrition

Monday (time/location): Biomedical Sciences, Pharmacology and Molecular Biosciences

Thursday (time/location): Biology, etc.

Necessary equipment:

- A scientific calculator;

- A (cotton) lab-coat; and

- Safety spectacles. Those who need to wear spectacles should make sure they have a pair made of shatter-proof material, which fully covers and protects the eyes.

These items will be available for sale during the first session.

Assessment:

- 50% Coursework; and

- 50% Written Examination.

The module is assessed by:

- Written examination (one three-hour paper) and by;

- Coursework
  - o Laboratory work   25%
  - o Tutorial work / homework / class tests   25%

During the semester there will be four class tests in Computer Aided Assessment (CAA) format. These will be conducted in G096 Computer Laboratory at the following times:

Times and locations of four occasions (about two week intervals)

Closer to the time of the test students will be divided into groups and given a specific time to present themselves at G096.

A written class test to assess the organic chemistry material will be held towards the end of semester.

Module Website

A module website is available at the following address:

> http://PlanetChemistry.com

Please visit the website ASAP and complete the online survey regarding your experience of chemistry to date and your use of computers/Internet. The same form is also used to collect your mobile phone number so that we can contact you by text message and keep you updated that way!

We have also introduced a message forum so that you can post messages and receive help on the module content.

This site also provides a link into the computer aided assessment website where a number of practice questions are available which complement the lecture program by Dr Paul Hagan. Select the link for 'JDR Introductory Chemistry'. Students are expected to use this resource in preparation for class tests and for reinforcement of lecture material.

Reading List

    Required:

Fry, M. and Page, E. (2005). *CatchUp chemistry for the life and medical sciences*. Scion Publishing, Bloxham.

Organic Chemistry Notes to complement lectures by Dr Stephen McClean

Ruddick, J.D. Chapter one and Chapter two notes to complement lectures by Dr Paul Hagan.

    Recommended:

Freifelder, D. (1985). *Principles of physical chemistry with applications to the biological sciences*, 2nd ed. Jones and Bartlett, Boston.

Johnson, A.W. (1999). *Invitation to organic chemistry*. Jones and Bartlett, Sudbury. [This text is appropriate for students who have very limited prior knowledge of Organic Chemistry, and is supported by a website.]

Vollhardt, K.P.C. and Schore, N.E. (1999). *Organic chemistry*, 3rd ed. Freeman, New York. [This book is highly recommended for the organic section of the course. A CD ROM, which features a range of supporting material, is included.]

Acknowledgements