Problem based learning in practice: listening to lecturers

An investigation of academics' perceptions and practice concerning problem based learning

SHEER Final Report

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Contents

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Executive summary

This report is aimed at a general readership. It will be of interest to lecturers, educational developers and senior managers in universities. The further reading section provides more specific detail on background literature and context.

Aim
The study investigates academics' perceptions and practice concerning problem based learning. Our aims are best summarised by our research questions. These were:

1. How do lecturers perceive problem based learning?
2. What is lecturers' working definition of problem based learning?
3. What are lecturers' opinions on the effectiveness or otherwise of problem based learning?
4. What are lecturers' observations concerning the student experience of problem based learning?
5. What materials do lecturers typically use during problem based learning sessions?

Method
Twenty-one academics at the University of Abertay, the University of Dundee and the University of the West of Scotland and two academics from Temple University, Philadelphia USA volunteered to participate in open ended participant-led discussions about the nature of problem based learning and its use in teaching. The sessions included both group and individual discussions arising from a predetermined set of facilitating questions (see Appendix 1). The disciplines represented included biology, chemistry, contemporary science, construction and the environment, creative technology, engineering, food technology, nursing, nutrition, physical activity and health, psychology, and sport and sport coaching. A university careers advisor and the business director of a multimedia teaching space also participated. The lecturers ranged in experience from newly appointed lecturers at the start of their teaching careers to experienced lecturers to lecturers in senior management positions. Participants were willing to have their comments paraphrased or quoted verbatim.

Findings
This report is based on written records of the data collection sessions. Specific topics raised by participants are summarised and structured below. Consideration of all of the responses reveals six approaches adopted by academics when preparing problem based learning material. These approaches are as follows:

- Operational focus
- Knowledge focus
- Graduate attribute focus
- Relative contribution focus
- Student engagement focus
- Student self-monitoring focus

Appendix 2 details methodological considerations of relevance to this report.

Implications
The specific comments of the participants provide a unique window into academics' current thinking concerning the use of problem based learning. The seven approaches detailed here could provide a template for designing PGCert material to facilitate academics. This material could be focused to assist lecturers in developing their own individual approach to creating problem based learning material in their teaching.

Introduction to problem based learning

Problem based learning describes a range of pedagogical techniques wherein the learner acquires knowledge or skills through enquiry rather than direct instruction. This concept of learning through problem solving pervades education from kindergarten to higher education and encompasses virtually all disciplines to some extent. The roots of the notion can be discerned in ancient philosophical training. Socrates emphasised the importance of the student *testing* knowledge; he rejected the notion of authority of the teacher and proposed *guiding the student to discovery*, known as the *Socratic,* or *Dialectic* approach to teaching. Issues concerning the role and authority of the lecturer in problem based learning arose in our responses from participants and are discussed later.

The ethos of enquiry guided the early work of Piaget who predicated the whole of cognitive development on exploration and discovery. In his account the infant examines the world testing hypotheses and *learning by doing*. It is through enquiry that the child develops a concept of objective reality, memory, language, and social skills. Later development of problem solving ability is driven by meeting challenges to understanding. Cognitive development relies on the child discovering circumstances where they lack the means to a solution. This allows the child to appreciate the gap between what they know and already understand and what they need to know. There is no substitute for independent exploration and early cognition is largely unaffected by direct instruction. By this account the best way to influence problem solving ability is by facilitation through the setting of tasks and puzzles. Piaget's theories influenced primary education throughout the 1970s leading to the growth of group work and projects rather than lessons. Our respondents mirror these concepts and we report their comments on acquiring thinking skills in higher education.

Piaget also afforded an important role to peer learning. He showed that in interactions between children of different levels of advancement the development of all the children was accelerated. However, there is also some evidence that less able children benefit disproportionately. Many argue this benefit is achieved to the cost of more able children so the issue remains controversial. Our participants also took a view on the effectiveness or otherwise of peer learning and this is covered in a later section of our report.

Vygotsky advocated independent problem solving as a true test of intellectual ability. He coined the term 'zone of proximal development'. Learners must be challenged by a problem just beyond their scope. The 'zone' describes the knowledge space occupied by a learner during this learning process. Intellectual development results from the combination of the type of problem set and facilitation by a teacher or a more advanced peer. Note that the extent of the challenge must be meaningfully related to the learner's current understanding. A problem that is too simple or too complex will be counterproductive. We return to this notion later when discussing the responses of our participants on the scope and breadth of topics in problem based learning.

Thus problem based learning has an honorable tradition in education. In higher education the technique emerged first in medicine and dentistry. These disciplines combine subject knowledge with practical skills so they are ideally suited to this teaching method. Later the approach was employed in the health professions, engineering and sciences. By definition all science disciplines are taught through the medium of enquiry so again there is a good match between discipline and technique. Almost all of the research on problem based learning is carried out and published in the disciplines described above. There is a great need for empirical work in disciplines where practical skills are less central and where abstract concepts and ways of thinking are fundamental, such as arts or humanities. Our participants commented on differences between disciplines in their use of problem based learning techniques and their responses are considered below.

The term 'problem based learning' (PBL) covers a huge variety of practices in education. Virtually every type of enquiry has been defined as being an example of this technique. Typical examples of problem based learning used by our respondents included students commenting on scenarios, participating in debates, competing in quizzes, undertaking laboratory practical classes, complex textual analysis, pitching ideas to industry, creating

commercial products and many more. We return to lecturers' materials for problem based learning later in the report.

The variety of disciplinary approaches with regard to subject matter, ethos, preferred or appropriate teaching methods, and staff experience as facilitators of learning poses a significant challenge to the educational developer in relation to the successful introduction of PBL. There is a body of research beyond the scope of discussion here covering 'educating the educators' and there is a growing literature on enquiry based learning, and specifically problem based learning; however, there is less specific research across the disciplines on how best to facilitate lecturers to create and use PBL materials. We hope our report goes some way towards addressing this lack. Our participants commented on best practice in training lecturers to use and enjoy this teaching method and their suggestions are summarized later.

Since problem based learning requires students to approach their studies in a unique way, so it requires lecturers to think about their curricula in a unique way. This goes beyond understanding teaching in a general sense and touches on staff and students' metacognitive awareness, their ability to reflect upon their own cognitive processes. It also requires lecturers to have a particularly acute model of the student's mind. These abilities touch on the lecturer's personal qualities in addition to their professional ones. Our respondents addressed this topic in detail and with candour.

The nature of problem based learning

Working definitions of problem based learning

'Education is the kindling of a flame not the filling of a vessel' Socrates

Our participants agreed that the means of acquisition of knowledge differs fundamentally between the traditional lecture based versus problem based teaching approaches. Lectures typically provide students with knowledge ready packaged whereas problem based methods require students to create knowledge for themselves by exploration. Participants defined problem based learning in terms of active learning rather than passive absorption of knowledge. They put great emphasis on the technique as a means of inspiring thinking skills in their students.

Respondents discussed the impact of thinking versus doing on student learning. Some felt that problem based tasks required too much doing and not enough thinking whereas others felt that such tasks developed critical thinking ability. One participant characterised problem based techniques in terms of implicit learning very much like that of the developing child. She said that problem based techniques were like teaching reading to children by getting them to play with plastic letters. The child does not know that the toy shapes are letters until their later encounters with reading and writing words. Thus the student may not make an immediate connection between the problem based session and the lecture content and but they nevertheless acquire subliminal knowledge that has value later. Our respondents' comments in this respect mirror classical approaches like Piaget's.

The respondents were interested in the difference between enquiry based and problem based learning. The Centre for Excellence in Enquiry-Based Learning (EBL) describes EBL as 'an environment in which learning is driven by a process of enquiry owned by the student' and outlines it as an approach that covers projects and research; small scale investigations; and problem based learning (http://www.campus.manchester.ac.uk/ceebl/ebl/). Kahn & O'Rourke (2004) note the 'evident overlap' between EBL and PBL but differentiate between the two by describing PBL as 'the handling of a problem [which] defines and drives the whole learning experience of the students' and EBL as covering a 'broader spectrum of approaches'.
The respondents concluded that both approaches were student-centred but they differed in their degree of lecturer involvement. Problem based learning involves more input from the lecturer who devises if not the whole problem then at least the boundaries of the problem. The lecturer predetermines the scope of the work needed while the activity of the student is

strongly constrained and focused and the end point of the task is clear. In enquiry based approaches the problem can be chosen by the students, the task is completely open ended, the student can range in their research in any direction and depth and there is typically no end point at which the task can be said to be completed.

All participants appreciated the link between problem based approaches and the challenges of the workplace to the extent that this aspect became part of their working definition. Vocational disciplines in particular have a practical context. They can provide placements that show the student the value and relevance of their work and these placements are in effect problem based learning experiences. The corollary of this is that a well planned problem based learning activity even within the university context can also become an employability tool. We return to this topic later in the report.

A lecturer on a vocational course observed that for her discipline the boundaries between problem based and less specific and wider enquiry based learning are blurred. Although she welcomed problem based learning tasks involving creating commercial products for industry those types of problems often proved too circumscribed for her purposes as an academic. So a blend of both problem and enquiry based approaches was crucial to ensure scholarly depth in the student.

Another respondent shared the concern about scholarly depth. She believed that sometimes people ignored the fact that 'real world' problems are often fairly straightforward and do not necessarily require the qualities of a graduate. Academic problems are independent on a so-called 'practical' context and need higher order analytical skills to address them.

' I think that the ideal teaching scenario is one that engenders in the student scholarly activity. It isn't a requirement that an academic problem must have an outside context – in fact it is the opposite'

One lecturer asked if the 'real world' was the best place to learn properly. He wished to emphasise that abstract principles confer the ability to find solutions in *any* context whereas practice in solving specific problems may not generalise.

'If every problem you've encountered so far is a nail and every solution is a hammer then what do you do when you meet a screw?'

Another lecturer questioned whether the focus on outside context was simply a ruse.

'Juicy issues motivate students. I use cultural resources, newspaper, telly, the social context for their work. It's the easiest way to get attention – but it may be erroneous <in terms of promoting scholarly depth>'

'they remember bizarre things or attention grabbing things not just <what they see as> boring facts and principles and not necessarily what you wanted them to learn'

Respondents agreed that the context and nature of that task would vary in its ability to provoke actions and thoughts.

'We don't have to have a commonly shared understanding of what it <problem based learning> is. Or what is the experience we want the learner to have. It will be distinctive to each individual lecturer's style, ability, and subject context. It's not one size fits all. The problems are unique so the delivery needs to be unique'

Interestingly, all respondents equated problem based learning with students working together in small groups in order to promote engagement by students. However, some pointed out that, while difficult, it was not impossible to carry out problem based tasks in very large groups. We describe some examples of large-group problem based tasks in Appendix 4.

Group dynamics were held to be crucial in a successful session and small groups enhance group cohesion and the opportunity for everyone to speak. Free communication between all

members of a group was seen as essential to inspire learning. In large classes maintaining the same group members throughout the lectures may assist in this respect by fostering relaxed interaction with time. The consensus was that the potential benefits of problem based sessions would be driven by peers. However, our lecturers' experiences did not necessarily concur with Piaget's positive account of peer learning during child development. We return to this point later in our discussion of 'people management'.

The notion of 'transformation' was an important consideration for our respondents. A key benefit of problem based learning was the developmental trajectory of scholarship. The best problem based learning tasks enable students to track their own growing knowledge and understanding. The method can allow students to take stock and feel a sense of achievement. Might we be seeing echoes of Vygotsky's *'zone of proximal development'* here? Certainly there was a theme among respondents of their students 'travelling' though a knowledge space.

'It is like a journey – they need to see how far they have come'

Awareness and use of problem based learning
Everyone in the study had heard of problem based learning as a teaching technique but the majority felt ill-informed about its effectiveness. Several said that although they were aware of problem based approaches in teaching they were concerned about the lack of an evidence base for its employment. More experienced staff worried that there had been a lot of 'hype' around the method. This could be detrimental and lead to more or less random use of the technique in inappropriate contexts. They also commented that to be 'on trend' some people claimed to use problem based methods routinely when in practice this was not the case.

About two thirds of our respondents were using problem based learning though some people did not use that label. Many respondents assumed that the use of problem based learning was more widespread than it is in practice. In fact, some respondents justifiably felt emphasis on problem based learning was 'old hat'. They argued that part of the pursuit of excellence in teaching is that everyone ought to be using problem based learning *all the time*. They went further in suggesting that it was impossible to teach properly without some element of problem based learning in your teaching methods.

Some respondents used problem based learning methods as an enjoyable and amusing support to traditional lectures. However, they also commented that students sometimes failed to make the connection between their orthodox lectures and the student led tasks of the problem based learning session thus undermining the potential learning benefit.

Perceived differences between disciplines' use of problem based learning
All respondents commented that problem based learning fitted some disciplines better than others. Indeed a food technology lecturer said her subject lent itself so easily to the method that she sympathised with lecturers in arts subjects. There was agreement on the differences in use of problem based learning between vocational and non-vocational courses. When students choose vocational courses they have a career in mind, they know the skills and competencies required to secure a post and they expect teaching delivery to emulate what they will experience in their careers. In non-vocational courses the link between university and employment is often more abstract even though this need not be the case. All university disciplines require critical thinking skills, independence of thought and the ability to work under one's own initiative. These are immensely practical attributes. However, students and even staff sometimes fail to appreciate that their discipline confers these 'graduate attributes' and do not realise the scope within their subject for using problem based methods; something which is being addressed through the QAAS Research-Teaching Linkages Quality Enhancement Theme which has explored the role played by research, or enquiry based, skills in the development of graduate attributes.

Psychology lecturers were among those who said their subject could not be taught without a problem based approach. Students are required to undertake an independent research project as part of their degree and this would be impossible if the student did not put enquiry at the centre of their learning or acquire independent problem solving skills.

The minority who did not advocate problem based learning asserted that their particular topic was unsuited to problem based or student led approaches. They argued that their subject required so much factual content to be delivered by a lecturer that the subject could not be 'discovered' by a student during problem based learning. Paradoxically some science lecturers held this view. This opinion is related to the concern of respondents across all disciplines that emphasis on problem based techniques can enhance thinking skills at the cost of student engagement with the factual content of curricula. We return to this point later.

Personal development planning and problem based learning
Personal development planning (PDP) can confer insight into one's own thought processes, that is, metacognitive awareness. Problem based learning also facilitates reflection on one's own intellectual performance. Students must bridge the gap between what they already know and what they need to discover in order to supply a solution. Problem based learning makes this knowledge gap explicit to the student. Thus PDP and problem based learning complement one another. One respondent who was a new lecturer did not know about PDP for students and commented that their use should be the first part of a lecturer's training. A university careers adviser reiterated this point and expressed frustration that PDP was sometimes perceived by staff as 'the thing careers ask the students to do' rather than an integrated part of the degree. Endorsing this, the lecturer's further point was that though appreciating how students approach PDP she could better understand their mind set when designing teaching materials. Thus PDP can facilitate metacognitive awareness in both students *and* staff and allow them to 'read each other's minds' during the teaching dialogue.

Employability and problem based learning
Historically employers and the general public condemned the 'ivory tower' and universities now argue persuasively that they share the same concerns as the 'real world'. Problem based learning done well can make very explicit the relationship between what a student learns as part of the degree and what is needed in the workplace, that is, the attainment of graduate attributes.

If problem based learning is carried out badly it can make the outside world seem remote from the 'other academic stuff'. If students don't make the appropriate connection then problem based learning can become a gimmick or add-on and fail to meet learning objectives.

A major obstacle in enhancing employability is that it is very difficult to determine how graduate attributes arise from academic pursuits. It is assumed that they are emergent properties of a university education. This can lead to an assumption that the better a student's degree classification the more they will be able to demonstrate graduate attributes. This belief is not borne out by evidence and is not helpful to graduates or to employers. One solution is for universities to provide students with experiences, such as PDP, that will allow them to show evidence of their employability. Furthermore, universities can provide employers with information about graduates that is illuminating to them and meets their needs. Well designed problem based learning can meet both academic and workplace needs. It can distinguish between students on the basis of measures other than exam or essay technique and provide students of varying interests and abilities the opportunity to make the best of themselves.

'Employers only look for high degree classifications. They don't realise that a first class student doesn't necessarily mean they have the other qualities they are looking for – they shouldn't rule out 2:2 graduates because sometimes these students are actually better.'

It is possible that problem based learning may help students to be aware of the broader skills they are acquiring beyond subject knowledge alone.

'My students are doing degrees in nutrition. Yet even when I ask them about eating, something they all do of course, the students struggle to answer. Even if tell them to not be embarrassed, they feel judged, though they are learning to be nutritionists. Students are not aware of the goal state as a graduate – there's a lack of insight into the connection between what they are doing at university and their later lives. They just don't realise that the

challenges in university are a practice for even greater ones outside. Problem based learning can take them out of their comfort zone.'

Workplace problems are not circumscribed and often there is no unique correct answer. You must work in a team to come about a solution that may be better than that which could be supplied by one person alone. These characteristics can also be true of problem based tasks. A careers adviser discussed how students were not aware of what they could offer to employers.

'…students don't sell themselves to employers. They need concrete examples of their abilities. They need to understand that they must be 'evidence based' in their claims, students find it hard to apply the benefits of their degrees to the workplace.'

Lecturers using problem based learning

'A teacher is one who makes who makes himself progressively unnecessary' Thomas Carruthers

Demands on the lecturer
Some respondents claimed that preparation for problem based learning was different to preparing for traditional lectures, others argued against this. Oddly, the evidence cited for each view was the same. The characteristics mentioned as distinctive to one method could equally be true of the other.

The first characteristic of preparation they discussed was keeping up with relevant and recent research which places demands on time and effort. As can be seen, participants cited distinctive challenges of problem based learning which are also true of how they must prepare for lectures.

'…in my discipline change is driven by technology and things happen so fast. So you have to keep your materials in constant review. I even include work based on what is in the news that week.'

A corollary of the above is that the pressure to keep abreast can undermine the lecturers' confidence and their feeling of being 'on top of their game'. Undertaking problem based learning challenges the role of the lecture and places demand on their identity.

'The lecturer must see it <problem based learning> as work in progress. Often they don't work - you need to be confident in yourself. It is a worry that students can see that you are flying by the seat of your pants.'

A recurring theme was that of authority versus democracy. There was an appreciation that problem based learning puts the student rather than the lecturer in charge of learning (a Socratic approach as mentioned earlier) and this places demands of various kinds on the lecturer, as seen below.

First, the session plan must be flexible:

' You have a lack of control over what they learn or the resources they use. Also they tend to remember bizarre things after class – they don't always learn the thing you wanted them to.'

'You need a good plan if you want to use problem based learning. This is a good thing but also a bad thing. You must anticipate and orchestrate the session. You're less in control of the script and the plot.'

'You think it <the problem based learning session> is going to provoke one learning outcome but it turns into another one during the class.'

However, it is vital for the lecturer to avoid complete anarchy. Intriguingly, some staff had experience of students' resentment.

'…the students feel they are doing all the work so what's the point of the lecturer then?'

'You must take back your authority at the end because your experience is needed to make sure they meet the learning objective.'

Understanding the mindset of students is a key consideration in creating problem based learning material. We return to this topic in a later section.

'Students are driven by assessment they want to know what it <problem based learning> is for and how will it help their marks.'

'…in the sessions you can overestimate or underestimate students' abilities. In fact some staff get upset – they pigeonhole people and then get a shock when people they thought were good <intelligent> are not!'

There was concern over 'people management' of groups. Problem based learning places responsibility on the lecturer to ensure that the group works well together and nobody is disadvantaged or harassed by others.

'You have to manage people's egos and confidence. There could be a student who thinks they know it all but they don't. You also need to manage poor students so they aren't left behind. You have to be able deal with over confident and under confident people. If under confident people step forward and they are wrong then you must be careful with them – you have to be more skilled in teaching.'

'…can we meet the learning needs of the top students? Other people in their group might be dumb or timewasters.'

This observation is related to the one below. Some able students believe that they are disadvantaged by working with students who they perceive to be less able than themselves, an interesting variation on Piaget's account of peer learning.

'My students are so competitive they do not like working together.'

An important concern for all participants was covering the entire syllabus while still making time for students to discover things for themselves.

'You don't have the security of where the learning output is in the module. It's harder to navigate through your module content and ensure everything is covered for the exam so it is more scary.'

Earlier we mentioned participants who felt that the density of fact in their particular discipline meant that it was impossible for students to discover their topic in problem based sessions. Perhaps the beliefs of these participants are related to the understandable fear expressed in the previous comment?

Finally there were concerns about how lecturers themselves may be evaluated in their practice.

'Evaluating the success of a lecturer when doing lectures it is fairly clear what excellence is. But it is not clear in problem based learning.'

This worry mirrors that of the student who feels judged by their performance in problem based learning sessions. In both cases the feeling can arise even when it is made explicit that assessment is not part of the activity.

Personal reactions to the challenges of problem based learning were revealing. Our participants were very open in sharing often quite personal information about their own professional concerns. In summary, there were three conceptions of what makes a good lecturer.

'To be a student in the right sense is to be a learner. I am not a teacher, only a fellow student' Soren Kierkegaard

The first conception was that of the lecturer as a *seeker of knowledge*. People with this self concept identified closely with problem based learning. They were excited rather than daunted when students' knowledge exceeded theirs and welcomed it. So far as they were concerned their professional status was unaffected and did not reside in exhaustive command of their discipline. An advantage of this approach is that it squares well with technological advances in the availability of knowledge. When everything is online and easy to access the lecturer's role changes. Some participants saw their role as understanding research and helping their students to do the same. These individuals did not feel compromised by focusing on teaching rather than participating in the research community and appeared to experience no role conflict. Their role was the facilitation of understanding. These respondents thought that what they had to offer is being an expert and experienced learner who can communicate that skill to others.

'The students take a fresh approach on things. They ask 'why' and that's challenging.'

'They make me think of things in a new light and that's a benefit.'

'They see that we are students too.'

There are benefits when the lecturer identifies as part of the group rather than director of the group. As the lecturer is open to admitting limits to their knowledge these individuals set a good example to students. The students may feel more confident about exploring the gaps in their own knowledge. There is more possibility to build the students' self confidence during problem based sessions.

The second approach is that university is seen as an extension of earlier educational experiences and the lecturer is *a source of knowledge.* Here competence in the job requires complete command of the subject. This is a common sense approach often shared by the general public and endorsed by students. Lecturers with this concept of their role feel they must 'know everything' to do justice to their students. A positive outcome of this approach is the confidence engendered in the student. They can rely on the lecturer to answer any question. A negative outcome is that this approach is very demanding on the lecturer.

'<In problem based sessions> we try to constrain them <the students> to particular readings to avoid them flooring the lecturer. But the problem exists that they can go beyond the lecturers' knowledge. Staff must be expert and cannot afford to teach in areas that they are not expert.'

Research by definition is problem based learning. Everyone agreed that teaching must be based around research but they varied in the extent to which the research should be their *own* research. This brings us to the third conceptualisation of the lecturer as a *creator of knowledge* achieved through their research activity. One of the most sensitive issues among participants was the relationship between research and teaching (see earlier reference to the QAAS Enhancement Theme). As expected, some of the variance in belief is accounted for by the prestige of a lecturer's institution.

A significant proportion of new lecturers and those with active research programmes experienced dissonance in their roles. Some felt that, however specialist their research, communicating it was the purpose of the enterprise and part of their professional identity. These individuals suffered conflict in dividing their time between research and teaching.

'I am falling behind because of time constraints. It is hard to keep up to date <with my research> and also feel confident enough to do problem based learning.'

'The reality is that RAE matters to everyone employed as a lecturer. Lecturers are measured and obtain posts by their publication record. It is all very well asking people to put effort into student centred learning but the effort isn't recorded or rewarded. The best advice to young academics is to be competent at teaching but to excel at research.'

When these three conceptualisations of the good lecturer are considered they give us useful material for training. In order to meet the full challenge of problem based learning lecturers should be aware of how they define their role. They should also reflect on the extent to which they could benefit by diversifying their definition of themselves.

Benefits to the lecturer
Many participants pointed out benefits to the lecturer that accrue from problem based learning techniques. One such benefit is the directness of the insight they get into the students' abilities.

'You can identify potential in a student and extract it and direct it. You can maximise their potential and identify their limitations. You can make a developmental plan for a student.'

'It is important to know what they <students> bring to the party. You have to be able to see what each student can potentially contribute.'

However, it is easy to overestimate the students' personal resources.

'You expect them to know about the world. That it <problem based learning> would engender an interest. But does it? They need to 'see' it.'

There was wide-ranging discussion on how problem based learning provided academic benefits to students and enhanced the effectiveness of the lecturer. In lectures students are provided with knowledge that is already organised and evaluated. One of the strengths of problem based learning is that students are placed in the position of finding out appropriate information for themselves. Students often assume that what we seek when we set assessments is the one 'correct answer', whereas it is important that we open their minds to appreciate that academic problems are sophisticated and there are a variety of possible answers.

'…problem based learning allows us to become part of the group and less of an authority figure. This backs up the idea that nobody has the monopoly on correct answers – it is more about possible solutions.'

'…it <problem based learning> promotes a scientific analytical approach in students. Some solutions are better than others; most will work, but will have different consequences.'

'We can show students how theory may not give a slick solution in practice. Students have to work out why a theory doesn't give all the answers. Any given result of a problem based learning is not THE solution but A solution.'

There was agreement that well conducted problem based sessions had a positive effect on students' understanding.

'It's like the law of unintended consequences. Students share solutions with each other to explore the consequences. It makes everyone's understanding deeper. It is revealing to the students when they see consequences and see people change their minds.'

'…problem based learning extends the learning experience over time and outside the lecture.'

Participants also felt that the challenges of designing problem based learning were worthwhile.

'It <problem based learning> forces people <lecturers> to reflect on their practice.'

One lecturer commented that he enjoyed the dynamic nature of running problem based learning sessions.

'The 'fix it as you go' idea is different to the usual model of teaching and learning. I tweak it <the session> on getting more information on how it is going. It is iterative. It is ok for me to get it wrong and figure out how it happened. I even negotiate with students on the way to do the session to find out how to do it better. It is important you don't stop being inquisitive.'

Another participant welcomed the ease with which she could engender enjoyment of her sessions.

'…as a lecturer we are expected to entertain. It <problem based learning> is more fun for both students and lecturers.'

Facilitating lecturers' creation of problem based learning material
As has been established in the discussion so far, problem based learning is a distinct approach to learning and teaching which may not sit comfortably, at least initially, with students and staff. For lecturers, this appears not be a discipline-specific phenomenon but one that is prevalent across the range of disciplinary backgrounds and may be more rooted in conceptions of what it 'is' to be a lecturer and what learning and teaching traditionally 'looks like' in their discipline area:

> *'…<you> can't force it, <problem based learning> needs the right frame of mind.'*

For some participants there was a feeling that,

> *'Older folks say 'why should I?' 'New people say 'why not?'*

while for others there was the belief that,

> *'When new lecturers start to teach they try to put in everything and this is not how you should do PBL.'*

Although problem based learning is not a new concept many new lecturers may not have had experience of it in their own undergraduate careers and may see it as too much of a 'touchy-feely' approach to teaching that is irrelevant to their discipline. They may also experience real anxieties about apparent loss of 'control' over students' activities and learning and thus view it as a more developed and sophisticated form of practice used only by more experienced colleagues. Or they may simply not know how to do it. For new lecturers, who may already be struggling with planning and writing lectures or programmes of study, the need to think about the most appropriate teaching methods is often lost in the need to 'deliver' the content and individuals fall back on a lecturing approach. This can often be reinforced by colleagues who either take a traditional approach to their teaching, and thus role model the 'tried and tested', or who eschew anything which they see as innovative or different.

It is important, therefore, that lecturers are helped to be confident in their approach to teaching and learning. Uncertainty over the principles or technique of PBL can be a challenge for new staff, who like many of their students can be looking for the 'right' answer or way in which to approach their teaching.

> *'Unfortunately you have no evidence base for your assumptions <about how PBL works>. This is both bad because it undermines credibility <of the technique> and good because you have freedom to interpret it.'*

PGCert programmes can help in that process; and not just through explaining the mechanics of problem based learning but in the emotional and affective aspects of 'being' a lecturer. As one participant stressed, it is important to appreciate the emotional response for new

lecturers as they attempt to establish ownership of their field, to develop their identity as a new lecturer in the discipline and to make teaching approaches, such as problem based learning, 'feel part of their own style'. It was acknowledged that any development activities must facilitate this process.

It was felt that there must be individual dialogue during such development activities between the new lecturer and those teaching them how to use PBL and an acknowledgement that it can't be taught in a traditional way. For some participants that meant that it

> *'Must be informal support and more like mentoring.'*

while others noted that new lecturers 'must trust the person <offering training>' because it is very revealing of oneself.

Several new lecturers also commented that it would be useful to be paired with experienced lecturers outside the PGCert programme and that this should be part of the standard mentoring procedure for new staff. This is an idea that has already been put in place at one of the institutions involved in the study with mixed results, as the standard probationary mentoring approach does not necessarily identify potential mentors as those individuals with sufficient time, or interest, or similar philosophies of teaching as those advocated by the PGCert programme. Nonetheless, the issue of support and confidence building for new staff is central to encouraging them to be innovative. Recent developments in PGCerts have included buddying current PGCert participants with previous graduates of the programme. This could facilitate the learning sets of both the person who is mentored and the mentor. Positive role models and opportunities to experience problem based learning for themselves are also important for new staff.

Several participants addressed the issue of when and how to introduce an approach such as problem based learning to new lecturers.

> *'It is important not to frighten new staff before they have the chance to flap their professional wings. On the other hand they tend to be more open to new ideas because they have no preconceptions.'*

PGCert programmes can help in this by identifying confident problem based learning practitioners and organising opportunities for new staff to observe or to participate.

> *'You must teach lecturers how to do PBL by using PBL.'*

More experienced colleagues can also benefit from working with new staff in this way. Several experienced lecturers who participated in the study commented,

> *'I can't imagine teaching my subject any other way.'*

Therefore opportunities for them to work with new staff and in conjunction with educational developers can bring new insights. Although problem based learning may be at the heart of their teaching, nevertheless there is scope for them to explore how they do it. Their participation in this way could also add an important dimension to PGCert activities.

> *'Even though I have been teaching for over 20 years I still find I change in myself even now. There's till scope for improvement even for experienced staff. You CAN teach an old dog new tricks – but I can see it would be harder for a less practical subject.'*

This form of role modelling and mentoring can also help new staff to gain insight and greater understanding of their new roles in the light of the experience of others.

> *'It doesn't matter if you're experienced or not - you can't assume experience makes you better. It is a two-way thing between your students and you. You don't assume authority over students anyway in PBL so your seniority is irrelevant.'*

Much of the value of PGCert programmes is in allowing new staff to meet colleagues from other disciplines and to facilitate and environment for discussion, sharing of ideas and problem solving.

'I get ideas from talking to students or even from this interview.'

In many ways PGCert programmes thus reflect the environment for enquiry based learning techniques and are highly appropriate and potentially extremely useful vehicles for the development of skills and approaches in the effective practice of PBL.

The Associate Vice Provost for Teaching and Learning from Temple University in Philadelphia adopted an approach to lecture training focusing on small group projects for service development rather than direct academic instruction within the context of a PGCert qualification. Temple found most success by instituting 'Communities of Practice' with their faculty. These comprise self-selecting groups of lecturers at various stages in their careers. The group identifies an appropriate agenda for their work based on current issues and concerns in their departments. Choosing the agenda enhances the lecturers' ownership and makes the outcome directly relevant to their particular working situation. They feel they have input to implementation of changes and the work is personally relevant to them. Rather like students in problem based sessions, lecturers discover for themselves the issues that need to be addressed in their teaching approaches. They identify gaps in their knowledge and share information on good practice.

Communities of Practice can tackle difficult issues directly by consulting colleagues and students on how to address departmental and institutional problems in teaching and learning policy. Here lecturers are not just developing means to use problem based learning in their own work and in their department's, they are also exploring the impact of such techniques on institution – wide issues and feeding into the development of overall institutional teaching policy.

The challenges of cultural and ethnic diversity for problem based learning
Participants noted that group dynamics and the notion of authority are important and that the success of group work relies on students working well in teams. Therefore potential cultural or ethnic difference between lecturers and their students or within a group of students adds an extra dimension to problem based sessions and peer learning. A great benefit of diversity is that students' minds are opened to the wider world. However, there are potential disadvantages that need to be addressed. Obviously, any assumption of cultural superiority by either staff or peers is inimical to education. All learners should feel equal. Several lecturers noted another potential challenge. Some cultures engender obedience and strongly discourage challenge to authority or any form of questioning. Students from these backgrounds are likely to be bewildered by problem based learning. These students must be helped to feel empowered in order to benefit from a problem based approach.

Students with special needs and problem based learning
Students with special needs must also freely access the benefits of problem based learning but there are some potential obstacles. When groups of students undertake problem based tasks they often prefer to meet off campus. Students with mobility problems must solve this additional constraint. Similarly, the requirement to interact fairly closely with other students may be difficult for students with communication difficulties, social phobias or mental health problems. Of course, the challenge for these students is no different from that encountered outwith their studies. Nevertheless, responsible institutions will consider how to facilitate students with disability to make the most of this distinctive learning experience.

It is an institution's legal responsibility to insure accessibility to learning for all students. Some reasonable adjustments will be identical to those implemented for other forms of learning, for example accessible environments, teaching materials, and learning technology. Institutions can and do accommodate diversity. Lecturers in all institutions are well informed about the impact of the Disability Discrimination Act in education. However, this is not the case for all

students who may be insensitive to the needs of their disabled peers. We return to this in the discussion of training students for problem based learning.

Problem based learning at work for students

Demands on the students
A major demand on students is how to perform well in a problem based learning session and determining what the lecturer is looking for. A student learns quickly what to do in a lecture which resembles a school lesson in some ways. Most students take copious notes and believe this is an optimal strategy and is 'what good students do'. It is not so clear how to make best use of a problem based learning session since note taking is not the focus of the session. A lecture is a solitary intellectual activity independent of but surrounded by other people; there can be problems of self-consciousness when learning 'in public' in a group for the first time. Students believe, as do pupils, that lectures and lessons require you to be quiet and there is no expectation to enter into debate. This strategy would be of no use in a problem based learning session.

'…knowing the script of being a student in one of these <sessions> is hard at first.'

'I have sympathy for students - how can people know where they have gone wrong or whether or not they are participating properly?'

Respondents observed that problem based learning allows students to demonstrate abilities that are different to those that usually predict examination success. Thus sessions can be a shock to both able and less able students. A student who is accustomed to excel may find problem based learning a challenge. There may also be some students who perform well in a problem based setting but nevertheless do not achieve high grades in examinations and coursework. Lecturers understand this incongruity but the student may be demoralised.

'What you might call 'dumb firsts' sometimes can't do problem based learning or personal development planning.'

'I had two students who came to everything. They were really conscientious. But then they didn't do well in the exams in spite of their hard work in the sessions. I felt really sorry for them.'

It is clear to lecturers that a student's habitual learning method may be ineffective in a problem based learning session. But students may not appreciate this and stick to their old tried and tested study behaviours. Problem based learning invites students to explore different approaches to study. In particular problem based approaches provoke *active learning*.

'It < problem based learning > stops them being like a sponge.'

Participants where clearly aware of their students' fears and tried to be sensitive during sessions.

'There's no nice neat answer to the problem and this unsettles students. The issues are much more open with lots of factors and maybe they can't finish in time.'

'Students have to finish it <problem based learning> up themselves it's not neat and tight like a lecture, there's no beginning middle and end.'

'They need a lot of reassurance because they are thrown on their own resources.'

One participant worried about the effect on attendance of problem based sessions. She suspected that if a student found problem based sessions frightening then they would opt out to avoid future difficult experiences.

'Some students at the low end of confidence and independence get left behind <in the course> – why? I think that maybe they are not turning up. They can avoid the issue and not have to care.'

Several respondents reflected on the underlying obstacles to student engagement in problem based sessions. Several participants focused on the students' fear of being judged and that what they did in the session was somehow observed and 'taken account of'.

'We assess them so much they think they are always being assessed.'

Others discussed the intellectual and personal challenges presented when students take responsibility for their own learning. Problem based learning requires that they must evaluate their own thought processes. This abstract task is hard for students if they are literal minded.

'They find reflective learning very hard because they are too factual.'

One respondent noted that students' fear could make them hostile and unmotivated. They can feel aggrieved at being asked to do more than trawl literature and to push themselves in a different way.

"They say things like "but I went to library what else do you want me to do then?".'

Benefits for the student

Tell me and I'll forget; show me and I may remember; involve me and I will understand. Attributed to Confucius

Respondents were agreed that problem based learning can give students significant learning advantages. Student engagement in problem based sessions improves their retention of knowledge. It also allows motivated and able students to excel.

'…it <problem based learning> is about intrinsic motivation. The student takes ownership of the knowledge and the meaning sticks. Also they have to communicate their ideas to others so they are learning to speak the language of the subject.'

One participant observed that problem based learning makes the importance of scholarly thought more explicit discouraging the students' typical focus on outputs like exams and assessments.

'I always hope the students can appreciate the 'process' aspects of their learning, the organic side of intellectual development.'

There is a sense in which problem based learning experiences allow students to join the research community. The approach can encourage students to discuss their ideas with lecturers as equals and these discussions help them to understand what it means to be an academic.

'Lecturers learn by problem solving. They see we are just like them.'

Problems and prospects for assessment
Participants varied widely in their support for assessing problem based learning. Some undertook assessment as a matter of course while others were concerned about aligning the assessments, devising appropriate assessment criteria, and assigning fair and valid grades.

Several disciplines assess problem based sessions routinely and the resulting grades contribute a proportion to final marks. The disciplines included food technology, psychology, sport, and creative technology. Some disciplines grade the group as a whole and then require individuals to prepare additional independent work on the project for which they are personally graded. This process is implemented to control for 'social loafers' who do not contribute to the group but nevertheless receive a grade. On the other hand some

participants argued that working together as a team and accepting a joint mark resembles what occurs in their future careers more closely and this experience enhanced a student's employability. Indeed these lecturers went so far as to ask employers to devise problem based sessions and to set assessments.

The most radical approach comprised peer assessments. In this form of assessment students are evaluated by others in their class and accept the grade awarded by their peers. Again, this situation resembles the work place but it is highly controversial for students and staff. Both groups fear the effects of personal rivalry or students simply 'playing safe', giving everyone an excellent grade and avoiding engaging with the judgement of quality altogether.

Participants were interested in the problems of developing assessment criteria for problem based sessions. First, was there a consensus on what qualifies as good performance in such an open ended and interactive situation? This did not seem to be the case and participants commented that if assessment were to occur at all then there was a need for research into criterion based assessments in problem based learning. Second, assessment would have to occur in real time with staff present and participating in the session. If it became clear to the students that staff did not agree on criteria then this could be disturbing to the students. In the worst case scenario the feedback to students may even be contradictory. Students tend to assume there is a 'right answer' based on the same evidence and on which everyone will agree.

'Staff do give different weight to different aspects. But we explain to the students that all people pick up different things in a task and that it is constructive criticism. So when staff mention different ideas then it is better feedback for them.'

All participants mentioned that a student's level of confidence was really important. This includes confidence in assessment process. The fact that students see each other's work and often know each other's marks is a potential problem. If a student achieves a high mark and the class do not understand why or indeed do not agree with the grade then there can be conflict.

'…they say - why did she get that mark? - hers was rubbish.'

A type of 'group think' can arise where misinformation on the judgment of quality is proliferated.

'…if a good student tells a weaker student they are wrong, even if that is not correct the weaker student assumes it must be true because that good student is usually right about things.'

Some participants felt very strongly that problem based learning was a way of learning not a way of assessing. One said he thought the whole notion of assessing problem based sessions was antithetical to the ethos of the approach. One asked whether assessment was even necessary and argued that non-assessed knowledge nevertheless has a carryover to performance on traditional assessments.

One person pointed out that learning objectives in problem based sessions may be general graduate attributes rather than subject based knowledge and thus distal to the discipline. Furthermore, since the session is open-ended and ranges over issues and topics the learning objects will be dynamic. This makes it difficult to achieve constructive alignment for assessment.

Is peer learning possible?
Problem based learning can be undertaken alone but this is rarely the case in university where mass teaching is the norm. A problem based session involves learning in a group and learning *from* a group. This begs the question of how effective this form of learning can be.

The role of peer learning in Piagetian developmental psychology is well established. However in higher education there is scepticism about the possibility of both able and less able

students benefiting equally. One respondent explained that her students often asked her not to be put in groups with certain individuals. Other students had approached her challenging their marks because they had worked in a group with someone they perceived to be lazy or less intelligent than themselves.

Participants with past experience of problem based learning stressed the importance of people management. They spoke of moderating between students with widely different personalities. For example they often needed to contain egotistical students making room for those lacking in confidence while at the same time not offending or discouraging anyone. Several mentioned that they laid down official ground rules and agendas in conjunction with the students to ensure everyone had a similar learning experience. Participants agreed that skill was needed in achieving this.

When students work together it is important to avoid everyone assuming the leader role or nobody doing anything since they hope someone else will take the lead. There was some discussion about whether roles within the group should be directly assigned and if so whether the lecturer of the students in the group should choose. One lecturer used a popular psychometric test to reveal students' leadership style. This exercise was a useful learning experience in itself.

A difficulty of a problem based session is that since a huge range of material may be relevant to the session, and since students research this material, evaluating the credibility of that material is challenging.

'The loudest voice isn't always the most accurate however authoritative it might seem. Also, if they then share incorrect information it is a real problem'

The solution to this is that lecturers act as MC's or like a moderator on a web site. One lecturer said that she always had a full debriefing in which she evaluated the evidence discovered by the students. If she came across incorrect information she could then ask why the students thought it was reliable and this discussion was a learning experience.

Training students for problem based learning
Participants felt that in order to ensure that discipline content was covered they needed to start with a workshop to offer essential material. However participants said that problem based learning should occur as early as possible in a course, even though subject knowledge was necessarily limited at that stage.

Some lecturers adopted a partnership approach with their students. They began by asking the students what they wanted to study during the module. Thus students negotiated with each other and the lecturer about the content of their work. The process of decision and negotiation was good training for the later problem based group work.

Earlier sections have shown the role of group dynamics in peer learning. We have also mentioned that students need to be sensitive to disability issues and cultural and ethnic diversity. A workshop covering these topics at the start of the problem based work would be an important learning experience as well as supporting effective group work

An important element of a degree is that the students must take responsibility for their own learning. They cannot rely on an authority figure to tell them whether or not what they are doing is correct. Indeed they may encounter problems in employment if they fail to adapt.

'…they look for right answer all the time and this is not possible in problem based learning.'

'Problem based learning carries on outside.'

'In a job there is no feedback to say you are clever or when it is ok to stop.'

Some training on how best to take responsibility and be an independent learner would be essential to students undertaking problem based learning.

It must be made clear to students that they should take engagement seriously. They should make a contribution and not rely on others and carry out tasks they are asked to do by their peers in a timely and productive way. Finally if they are given freedom to work elsewhere during a session they should not use that time for things other than university work.

Problem based learning fit for purpose

Operational aspects of problem based learning
We have already discussed in detail the academic challenges of problem based techniques. However, there are wider operational impacts of implementation of this teaching method.

One lecturer identified an institutional advantage.

'You could use it <problem based learning> as a selling point of our university. It could be used in recruitment.'

One of the participating universities, Abertay, has a major institution -wide commitment to enquiry based learning. They feature their approach in their recruitment publicity as a benefit to learning and a unique selling point.

There may also be advantages for staff and institutions of a more flexible timetable. Students with families often find the rigidity of the timetable a problem and would welcome negotiating time with their peers to undertake problem based study. Small institutions with fewer working spaces would benefit from the method if much of the work is done outside the university. Problem based learning also fits well with online delivery of courses and most universities now have significant numbers of online courses of study.

All lecturers emphasised that their institutions would need to give them time to modify their materials in line with problem based practice. There must be recognition that problem based methods are more time consuming than traditional lectures. Lecturers have a usually have large amount of material prepared for lectures already. Delivering these classes or updating them takes very little effort. Problem based work requires lecturers to make a fresh start and build their portfolios all over again. Participants made clear that they have personal pride in their work and did not want to prepare material 'on the hoof'. If the method was to work it should be done thoughtfully and with reflection.

All lecturers also stressed the importance of the teaching environment for successful problem based sessions.

'The physical environment dictates what you can and cannot do.'

Flexible workspace was valued where room size could be modified to suit. An example would be a large lecture space with mobile walls that could be adjusted during the session to create smaller break out spaces. Participants needed to allow movement of students and staff in the session and access to equipment.

The majority of our participants felt that the atmosphere and appearance of the working area was important. Rooms that look like school classrooms provoke the students to behave like school pupils with 'teacher' in the front. Large raked lecture halls can distance the lecturer from interacting with the groups although the lecturer 'visiting' the groups throughout the lecture hall can address this. Shabby rooms can make students not take the work seriously whereas well-planned and attractive spaces engender a feeling of professionalism in the students. If we require students to work actively in groups we need to foster mature engagement and a professional working environment goes some way to achieve this.

Even some purpose built spaces and renovated classrooms and lecture theatres can nevertheless fail to meet teaching needs and respondents from each of the universities had experience of working in such environments. One of our US participants said that student

groups worked well in buildings that had a variety of rooms of different sizes that were flooded with light and of 'human scale'. The effect of environments on learning interested all the participants and they were enthusiastic about working closely with architects and estate managers to create effective learning spaces. Readings on environmental psychology are provided at the end of this report.

Approaches to the design of problem based learning materials
The guiding questions asked participants to imagine they were preparing for a problem based session and to 'think aloud' as they did this. Inspection of their responses revealed seven approaches to the design of problem based learning materials. Participants varied in the extent to which they demonstrated each of these approaches. Some respondents concentrated exclusively on one style of preparation. Others adopted more than one style and in a particular order. Our data do not permit us to determine an order of importance or the presence of incremental development in the styles. Further research on this topic would be revealing. It could show us the genesis of lecturers' materials from inception to finished product.

Operational focus
Lecturers using this mode of preparation concentrated on the practical aspects of the class. Considerations included whether the session was timetabled as a lecture, a tutorial or a 'lectorial' because these factors influenced the number of students, type of room and student expectation. The duration of the class was also a key constraint. The subsequent content of their problem based session was built around these considerations.

Knowledge focus
Lecturers preparing in this style focused on the subject content of the session. Their first thought was of which topic they would choose and whether this would require additional research and reading on their part. They considered the level of subject knowledge of the students and which year they were in. For them, the success or otherwise depended on the extent of the students' prior knowledge and their own command of the subject.

Graduate attribute focus
This type of preparation required reflection on the abilities of students independent of their subject knowledge. Examples of these abilities included critical thinking, independent thinking, and teamwork. For vocational courses this preparation is particularly vital in that students must develop professional skills in their degrees. This style of preparation sometimes makes use of employers or outside experts for advice or participation in the session.

Relative contribution focus
This approach involved lecturers deciding how much they would be involved in the problem based session. Consideration is given to group roles and whether or not these are assigned by students or by the lecturer. Decisions are also made about the boundaries of the task ad the reading that is required, in effect how open ended the task will be.

Student engagement focus
Here lecturers concentrated on how to encourage students to get involved and take ownership of their work. Emphasis is put on getting students interested while not resorting to crowd-pleasing. Attention is paid to the particular responses that are sought from the groups. This type of preparation also involves thinking about the management of group dynamics and dealing with interpersonal issues and loafing. Emphasis is also put on the extent to which the students are experienced learners and are tailored to suit the year of study of the students.

Student self-monitoring focus
This type of preparation focuses on managing the students' learning experiences. Attention is paid to making the 'script' for behaviour clear. When the 'ground rules' are obvious then the student can monitor whether or not they are meeting the demands of the task. Care is taken to help students to evaluate their own learning during the session. Emphasis is put on encouraging reflective learning and metacognitive awareness. Finally, steps are taken to avoid discouragement and de-motivation.

Personal responses to participation in the study
All of our respondents commented very warmly on their enjoyment in participating in this project. They said they appreciated the time to talk at length with colleagues from a variety of disciplines. They found that sharing teaching ideas between disciplines was very stimulating and they were motivated to try out the suggestions in their own teaching. They enjoyed sharing amusing teaching experiences. Finally they appreciated the opportunity to talk in a non-judgemental and supportive environment. It was clear to the investigators that the participants experienced a feeling of fellowship with other academics

Conclusions

Our report summarises the perceptions and practice of a number of lecturers concerning problem based learning. We found that the majority of participants employed and advocated problem based techniques and even those who did not expressed interest in their colleagues' experiences. Regardless of whether they were positive or negative about problem based methods at the outset, everyone who participated achieved a well balanced and informed view after participation. This is a useful outcome for staff development in itself.

Participants supplied a great deal of detail and advice on the practicalities of using problem based techniques. Consideration of their experiences amounts to an evidence-based 'how to' guide for good practice which could be used to inform PGCerts and to support the development of new academic staff.

One of the most rewarding findings of this study was the enthusiasm of lecturers for innovation and for their vocations. It was also clear how much they enjoyed interacting with colleagues and respected the points of view of other disciplines.

We hope that you have found this report interesting and useful. If you would like to discuss the project in more detail or have comments to offer please contact:

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Appendix 1
Guiding questions

1. Do you have an idea of what problem based learning is?
2. Have you used it?
3. What is your working definition?
4. What are the advantages of this method?
5. What are the disadvantages?
6. Do you have any other observations?
7. What is your first thought when you create an enquiry based session?

Additional prompt: if respondents do not mention students ask for details about the student experience. (In the event this was not necessary.)

Respondents sometimes mentioned spontaneously topics that were to come later, questioned each other and returned to earlier topics.

The investigator did not interrupt the flow of discussion. However, she ensured that no topic was omitted.

Appendix 2
Ethical approval

PROPOSAL
SHEER2 'WHITE SPACE IN PRACTICE'*

*SHEER2 'Scottish Higher Education Enhancement Research phase 2' is the name of an initiative funded by the Scottish Funding Council. This body provided the funding for this study.

This study may be more properly described as 'service development' rather than research.

Purpose: The study aims to investigate the practical aspects of designing Enquiry Based Learning (EBL) materials for students.

Participants: The volunteer participants will be drawn from staff undertaking the PGCertHE at UoD and at UAD. Participants will be recruited during a session on their course. Participation is entirely voluntary. It is in the nature of the study that participants will be given full information about the study and debriefing after it. We cannot predict how many volunteers we will recruit but can get meaningful information from 10 individuals.

Procedure: First, participants will be asked for their opinions on general principles of EBL as a technique. These opinions will be compiled without identifying the participants other than listing their disciplines.

Next participants will devise an EBL task for use in their own teaching. They will be asked to write notes on their reflections as they work. These data will be subject to a content analysis. Again, participants will not be identified except for noting their disciplines.

Data security: The opinions gathered during discussion will be summarised without attribution save for discipline. A copy of the summarised opinions will be give to all participants. The reflective notes will be copied for use in the report and returned to the participants for their own later use. These data will be kept secure for 3 years and then destroyed.

The tasks that participants devise will not be examined and will be retained for use by the participants.

The findings will be published as a report to the funding body, Academy Scotland. The findings will also be shared in the Educational Developers' community and the Academy subject groups of Psychology and GEES (Geography, Earth and Environmental Sciences). Although the participants are anonymous their contribution will be acknowledged in the final report.

PIS version 2 19/05/08

PARTICIPANT INFORMATION SHEET
SHEER2* WHITE SPACE IN PRACTICE

*SHEER2 'Scottish Higher Education Enhancement Research phase 2' is the name of an initiative funded by the Scottish Funding Council. This body provided the funding for this study. This study may be more properly described as 'service development' rather than research. The work is collaboration between the University of Abertay and the University of Dundee.

INVITATION TO TAKE PART IN A RESEARCH STUDY

You are being asked to take part in a research study, the details are provided below.

Purpose: The study aims to investigate the practical aspects of designing Enquiry Based Learning (EBL) materials for students.
Participants: The volunteer participants will be drawn from staff undertaking the PGcertHE at UoD and at UAD. Participants will be recruited during a session on their course. Participation is entirely voluntary. It is in the nature of the study that participants will be given full information about the study and debriefing after it. We cannot predict how many volunteers we will recruit but can get meaningful information from 10 individuals.
Procedure: First, participants will be asked for their opinions on general principles of EBL as a technique. This part of the study involves an informal whole group discussion and a secretary will take written notes. At the close of discussion participants will be encouraged to write any thoughts that they have not had the opportunity or have been unable to offer during the discussion. All notes and individual written comments will be compiled without identifying the participants other than listing their disciplines. A full transcript of our discussions will be provided to all participants as a resource for their future reference.
Next participants will devise an EBL task for use in their own teaching. They will be asked to write notes on their reflections as they work. These data will be subject to a content analysis. Again, participants will not be identified except for noting their disciplines. Finally participants will be asked to write down a strength, a weakness, an opportunity and a challenge in adopting EBL. The session will be completed with a debriefing and sharing of opinion with notes taken by a secretary.
Data security: The opinions gathered during discussion will be summarised without attribution save for discipline. A copy of the summarised opinions will be give to all participants. The reflective notes will be copied for use in the report and returned to the participants for their own later use. These data will be kept secure for 3 years and then destroyed.
The tasks that participants devise will not be examined and will be retained for use by the participants.
Possible benefits: Participating staff may benefit in developing their teaching. Staff will have opportunity to talk to colleagues and share experiences.
The findings will be published as a report to the funding body, Academy Scotland. The findings will also be shared in the Educational Developers' community and the Academy subject groups of Psychology and GEES (Geography,
Earth and Environmental Sciences). Although the participants are anonymous their contribution will be acknowledged in the final report.

TIME COMMITMENT
The study will involve one morning session ending at 12.30 after which lunch will be provided.

TERMINATION OF PARTICIPATION
You may decide to stop being a part of the research study at any time without explanation.

RISKS
There are no known risks for you in this study

COST, REIMBURSEMENT AND COMPENSATION
Your participation in this study is voluntary.

CONFIDENTIALITY/ANONYMITY
The data we collect do not contain any personal information about you except the name of your discipline
No one will link the data you provided to your identity and name. **Because of the nature of the study we cannot unequivocally guarantee that your identity is impossible to discover. The data provided are not controversial but if you require unequivocal anonymity you should not participate.**

FOR FURTHER INFORMATION ABOUT THIS RESEARCH STUDY
Siobhan MacAndrew will be glad to answer your questions about this study at any time. If you want to find out about the final results of this study you should contact:

Dr Siobhan MacAndrew
Reader in Psychology
University of Abertay Dundee
s.macandrew@abertay.ac.uk
01382 308582 (voicemail)

CONSENT FORM
SHEER2* 'WHITE SPACE IN PRACTICE'

*SHEER2 'Scottish Higher Education Enhancement Research phase 2' is the name of an initiative funded by the Scottish Funding Council. This body provided the funding for this study.

This document is to be read in conjunction with the participant's information sheet entitled 'PIS version 2 19/05/08'.

Please read the description of this study in the participants' information sheet and ask the study team questions if there is anything you do not understand.

Data security: The opinions gathered during discussion will be summarised without attribution save for discipline. A copy of the summarised opinions will be give to all participants. The reflective notes will be copied for use in the report and returned to the participants for their own later use. These data will be kept secure for 3 years and then destroyed.

The tasks that participants devise will not be examined and will be retained for use by the participants.

The findings will be published as a report to the funding body, Academy Scotland. The findings will also be shared in the Educational Developers' community and the Academy subject groups of Psychology and GEES (Geography, Earth and Environmental Sciences). Although the participants are anonymous their contribution will be acknowledged in the final report.

By signing below you are agreeing that you have read and understood the Participant Information Sheet and that you agree to take part in this research study.
Date
Participant's signature
Signature of person obtaining consent

Appendix 3
Methodological issues

This project is focused on service development using an action research technique. Clearly, the nature of our data is such that formal statistical analysis is inappropriate and some of the reasons for this are detailed below. Nevertheless our findings are valuable to practitioners to generate ideas and reflection. We hope that our project will inspire others to undertake more empirically based experimental investigation.

The responses discussed in this report were collated using informal means. We used a set of guiding questions but our respondents ranged freely across and between issues. In particular participants responded to and were influenced by each other's comments.

In this section we detail operational difficulties we encountered while carrying out the study. As a result of these difficulties we are cautious in claiming generality for these results.

Problem: The original design for the study was too ambitious in scale given the seven month duration of the project. As participants were full time members of staff their availability was understandably restricted to out of term time when they were not teaching. This time also coincided with annual leave. A large number of staff volunteered but could not undertake their sessions before the end of the project in August. The resulting disappointment of the volunteers shows their high motivation and the value they put on our project. Only a small number of participants were available on the main three hour session in June. This necessitated further data collection in groups of two or three over the next several weeks. These sessions ranged from one and a half to two hours. The principal investigator carried out all of the data collection sessions and this amounted to approximately 16 hours of interviewing. Clearly, group data collection would have been much easier, but our participants were simply not available in large numbers on one day.

The nature, size and availability of the participant group restricted the focus of the project to PBL rather than a wider and deeper investigation of EBL, as initially intended, leaving further scope for work in this area.

Problem: The low number of participants and the range of their disciplines are not representative and suitable for statistical analysis. This means that we must interpret the findings with caution. The general findings in the report may not be accurately representative of any single individual's beliefs and behaviours. The small range of disciplines also raises the question of why some disciplines participated more readily than others.

Implications: Our experience shows difficulty of getting small-scale research carried out quickly. The most interesting questions take time to investigate properly. The overwhelmingly positive response to participation shows us that although there are many volunteers their availability is restricted so studies with participant staff are relatively difficult to plan.

Appendix 4
Examples of problem based learning tasks

Examples facilitating understanding of the nature of learning and education

'Lecturer for a day' (MacAndrew has employed these tasks for many years and further details are available from her)

These tasks involve a student undertaking activities normally carried out by a lecturer

Devising assessment criteria.
There is no pre-briefing for this task. The lecturer explains the difficulties of marking work that is not an essay or an exam. Students are given examples of presentations and information packs (see below). They are asked to review and evaluate them and to devise some fair and valid assessment criteria. The class then debate the criteria with the facilitation and guidance of the lecturer. The resulting criteria are then used by the lecturer to mark their own work.

Outcome: Students understand the marking process and have ownership of the criteria by which they are judged. Students understand that it is possible to evaluate the quality of material that is not in a question-and-answer format or a discursive piece of extended writing.

Marking anonymised work
There is no pre-briefing for this task. In this task students are given a 'surprise' task of writing an essay in 10 minutes. The students identify their essay with a 'nickname'. The piles of essays are then taken to the front and each student chooses a random essay. The next task is to mark the essay using a set of criteria. These criteria were devised by the lecturer in conjunction with previous students (see above). The students mark the work and give feedback to the writer. The essays are then passed to the front again and students retrieve their own work.

Outcome: The surprise nature of the essay request shows students that it is possible to work under pressure and that they have knowledge of the module content even without revising specific material. When students mark they discover the many judgements that are required and that often the work is neither 'right' nor 'wrong'. Much of the essay does not fit easily into the criteria and they must take a view as to whether the essay meets the criterion or not. They also have to make judgements of quality and match these to grades. Here they realise that there is not a one-to-one relationship between the content and a specific grade, but that they must justify their mark nevertheless. Finally when they give feedback they realise that this is not an easy job. It is difficult to devise feedback based on 'what you should do to make this better' and also to justify the grade. In practice students give harsh grades and very little feedback.

In the debriefing part of the session there is a discussion on the students' experiences as 'lecturers' including; how they assigned marks to others and how did they feel about the marks assigned to them, did they give sufficient feedback to others and was it helpful, how did they feel about the feedback given to them, and did they agree with the criteria? This discussion gives insight into writing and evaluating essays and makes assessment criteria and the judgement of quality explicit to them.

Examples facilitating understanding of professional skills and graduate attributes

'Dragon's Den'
In this task students form groups to create a commercial product in response to a brief. As far as possible the context is made 'real' with respect to funds, employees, and company resources. The students must create a professional presentation to their class, lecturers and employers from outside the university.

The process of evaluation resembles the 'Dragon's Den' television programme.

Outcome: Students realise the constraints of working on time and within budget. They understand they must show evidence of the superiority of their brand. They also have to think about how best to communicate their message.

The speech and language therapist exercise
There is no pre-briefing for this task. Students are presented with a picture. A volunteer is asked to describe what they see as fully as they can. The class is then asked to comment on what they have heard. This is baffling for students since they do not yet know the lecture topic and have no knowledge of the psychology of language, neurposychology or speech pathology. They are thus thrown on their own resources. After the student's verbal output is analysed, the lecturer then shows a film of a speech disordered patient describing the same scene. They are then asked to compare the student's output with that of the patient's. This process encourages them to discover criteria for judging speech, such as number of words, completeness of description, and sophistication of vocabulary. By comparing the speech errors of the patient with the speech of the student they can determine the ways in which a word breaks down in a structured way that is related to normal speech.

Outcome: Students discover from first principles the discipline of neuropsychology and speech pathology. They are given no direct instruction. This engenders engagement and excitement and gives them confidence since they have 'worked it out' for themselves.

Variations on this task are seen in nurses analysing patient scenarios and suggesting treatments and medical students role playing patients. In those cases, however, the aim is directly concerned with the professional skill and not discovering discipline content.

The clinical ethics committee exercise
Students of disciplines involving research with human subjects must understand research ethics. In this exercise students are given anonymised real ethics applications for medical research and are asked to undertake ethical review. The applications range from relatively uncontroversial research on blood pressure to highly sensitive work researching the impact of parental drug abuse on children.

Outcome: Students learn the complexity of ethical judgement and also that the evaluation of ethics is revealing about themselves. Students often reject some applications that received ethical approval in reality. This provokes discussion about the role of science in society. Clearly this experience is helpful when students submit their own undergraduate project research proposals. Finally, the students must undertake the committee paper work efficiently, get through their agenda, and manage differences of opinion. These are all useful graduate attributes.

An example of problem based assessment (See MacAndrew, 2003)
In this task students learn how to write for a general audience and make themselves understood. Instead of, for example, writing an essay about dementia, they are asked to publish an information pack for carers of people with dementia. The topic is any one of their own choosing relevant to the module. The pack must contain the equivalent level of scientific material and depth as an essay or exam question but with the additional constraint of explaining the science to the layperson and suggesting why the research can help in everyday life.

This is a problem based assessment in that the student chooses the topic, decides on the relevant material, devises the best way to communicate with the reader and must of course have command of their subject. The lecturer is not involved at any point in the process.

Outcome: Students report great enjoyment in the assessment and that it makes clear what it means to be a graduate. They comment that in order to make themselves understood to a non-specialist audience they must first understand their topic deeply. They note that in an essay you can give the impression that you understand but it is not until you try to explain to someone else that you see the gaps in your understanding. The assessment has clear benefits for employability and has been taken to job interviews by students.