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Learning and Teaching Support Network

LTSN Physical Sciences Practice Guide

Designing Assessment to Improve Physical Sciences Learning

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Putting assessment into perspective

Whether we think of ourselves as lecturers, or teachers, or facilitators of learning, the most important thing we do for our students is to assess their work. It is in the final analysis the assessment we do that determines their diplomas, degrees, and future careers. Over the last decade, many of us have seen our assessment workload grow dramatically, as we work with increasing numbers of students, who are ever more diverse. Consequently, the time we have available to devote to assessing each student has fallen. It is therefore more important than ever to review the way we design and implement our assessment.

Let's be clear about one thing at the outset – in my opinion, physical sciences assessment is on the whole a picture of good practice, and is generally considerably better designed than in many other disciplines. Assessment in physical sciences subjects is usually high on validity, sound on reliability, and exemplary on transparency. Nevertheless, the overall aim of this booklet is to challenge your thinking on how best to assess students learning physical science subjects such as physics, chemistry, astronomy, and sometimes engineering or mathematical topics related to these discipline areas. I hope too to provide food for though to enable you to confront the difficulties in order to move towards making physical sciences assessment even more fair, valid and reliable. As a prelude to this booklet, I would like to share some overarching thoughts and questions about teaching, learning and assessment, and the relationships between these processes. Then I will outline some 'concerns' about unseen written examinations, and about continuous assessment. The remainder of this booklet is intended to offer some thoughts about fourteen particular forms of assessment, each with its pros and cons, and with some suggestions for making each work better, to improve student learning of physical sciences.

What are our intentions?

- to turn out students who know a lot of physical sciences information?
- to turn out students who can do a lot, regarding applying information and data to solve problems?
- to turn out students who can make sense of their particular subject in the field of physical sciences?
- to turn out students who can make sense of all the other things that they will encounter in their careers?
- to turn out students who can make sense of themselves?

These questions lead into enquiring about what the assessment processes, practices and instruments used in higher education are intending to measure. The questions below set an agenda against which to interrogate our assessment culture, particularly as it relates to assessing students physical sciences knowledge, skills and competences, in higher education.

What are we trying to measure?

- how much data and information our students can remember?
- how much relevant knowledge our students have actually acquired from the data and information they've been handling as they studied?
- how well students can write about the data and information they have processed?
- how well students can apply the physical sciences they have mastered?
- how well students can handle, in the broad fields of physical sciences and related disciplines, things that they don't yet know? (This links to measures of their potential research skills).

How important is expertise in the design of assessment?

Just as it seems to be assumed that anyone appointed to a teaching post in higher education can automatically teach, it is also implicit that they should be able to assess students' work. More than a few physical sciences teachers in higher education have had to wield their red pens for the first time without ever having had any real training in how to assess. Some are embarrassed at the notion of even asking for any guidance, yet are quite intimidated at the responsibility attached to assessing.

Teaching is a public affair, and we get all sorts of feedback regarding how well or how badly we teach – even without deliberately seeking feedback. The expression on students' faces, the attendance at our classes, and the level of students' performance in practical work and in tutorials all help us to adjust our teaching techniques. External review provides further feedback, if in a more threatening environment. Assessment, however, tends to be a private and intimate affair, and there is seldom anyone looking over our shoulders as we go about designing and implementing assessment. Given the importance of assessment, it is probably an aspect of our profession that should be scrutinised most carefully. Even with the best of intentions, external examiners and moderators can only contribute a limited amount to the processes of assessment, and the primary responsibility for assessment continues to rest with teachers, as individuals and as course teams.

An assessment charter?

Let's begin by identifying some values as a starting point on our mission to optimise physical sciences assessment in terms of validity, reliability and transparency. For a start, let's try to define these terms, and add some more values to work towards in our assessment.

1. **Assessment should be valid.** It should assess what it is that you really want to measure. For example, when attempting to assess problem-solving skills, the assessment should not be dependent on the quality and style of the production of written reports, but on the quality of the solutions devised.

2. **Assessment should be reliable.** If we can get the task briefings, assessment criteria and marking schemes right, there should be good inter-tutor reliability when more than one lecturer marks the work, as well as good intra-lecturer reliability (lecturers should come up with the same results when marking the same work on different occasions). All assignments in a batch should be marked to the same standard. (This isn't the same as the strange notion of benchmarking, which implies that assignments should hit the same standards in every comparable course in existence – an interesting but quite unachievable idea).

3. **Assessment should be transparent.** There should be no hidden agendas. There should be no nasty surprises for students. Assessment should be in line with the intended learning outcomes as published in student handbooks and syllabus documentation, and the links between these outcomes and the assessment criteria we use should be plain to see (not just by external scrutineers such as QAA subject reviewers, but by students themselves.

4. **Assessment should be fair.** Students should have equivalence of opportunities to succeed even if their experiences are not identical. This is particularly important when assessing work based in individual learning contracts. It is also important that all assessment instruments and processes should be seen to be fair by all students.

5. **Assessment should be equitable.** Assessment practices should not discriminate between students, and should disadvantage no individual or group. Obviously, students may prefer and do better at different kinds of assessment (some love exams and do well in them, while others are better at giving presentations for example) so a balanced diet of different means of assessment within a course will set out to ensure that no particular group is favoured over any other group.

6. **Assessment should be formative - even when it is also intended to be summative.** Assessment is a time-consuming process for all concerned, so it seems like a wasted opportunity if it is not used as a means of letting students know how they are doing, and how they can improve. Assessment that is primarily summative in its function (for example when only a number or grade is given) gives students very little information, other than frequently confirming their own prejudices about themselves.

7. **Assessment should be timely.** Assessment that occurs only at the end of a learning programme is not much use in providing feedback, and also leads to the 'sudden death' syndrome, where students have no chance to practise before they pass or fail. Even where there is only end-point formal assessment, earlier opportunities should be provided for rehearsal and feedback.

8. **Assessment should be incremental.** Ideally, feedback to students should be continuous. There is sense therefore in enabling small units of assessment to build up into a final mark or grade. This avoids surprises, and can be much less stressful than systems when the whole programme rests on performance during a single time-constrained occasion.

9. **Assessment should be redeemable.** Most universities insist that all assessment systems contain within them opportunities for the redemption of failure when things go wrong. This not only is just, but also avoids high attrition rates.

10. **Assessment should be demanding.** Assessment systems should not be a pushover, and the assurance of quality is impossible when students are not stretched by assessment methods. That is not to say that systems should only permit a fixed proportion of students to achieve each grade: a good assessment system should permit all students considered capable of undertaking a course of study to have a chance of succeeding in the assessment, provided they learn effectively and work hard.

11. **Assessment should be efficient and manageable.** Brilliant systems of assessment can be designed, but which are unmanageable because of ineffective use of staff time and resources. The burden on staff should not be excessive, nor should be the demands on students undertaking the assessment tasks.

Why should we assess?

There are many reasons for assessing students performance. Not all are good reasons. Some are:

- we live in a society where people are appointed and employed on the basis of their qualifications.
- students themselves need feedback to help them to find out how their learning is going.
- we need feedback on how well students' learning is going, so that we can adjust and develop our teaching.
- assessment is often the major driving force which gets students down to serious studying.
- in a field such as physical sciences, it is important to strike an appropriate balance between the energy that students put into quite diverse kinds of activities, ranging from laboratory work, problem-solving, to understanding concepts, theories and models.

If we think clearly about our reasons for assessment, it helps to clarify which particular methods are best suited for our purposes, as well as helping to identify who is best placed to carry out the assessment, and when and where to do it.
Some of the most common reasons for assessing students are listed below.

- **To classify or grade students.** There are frequently good reasons for us to classify the level of achievements of students both individually and comparatively within a cohort. Assessment methods to achieve this will normally be summative and involve working out numerical marks or letter grades for students' work of one kind or another.
- **To enable student progression.** Students often cannot undertake a course of study unless they have a sound foundation of prior knowledge or skills. Assessment methods to enable student progression therefore need to give a clear idea of students' current levels of achievement, so they – and we – can know if they are ready to move onwards.
- **To guide improvement.** The feedback students receive helps them to improve. Assessment that is primarily formative need not necessarily count towards any final award and can therefore be ungraded in some instances. The more detailed the feedback we provide, the greater is the likelihood that students will have opportunities for further development.
- **To facilitate students' choice of options.** If students have to select electives within a programme, an understanding of how well (or otherwise) they are doing in foundation studies will enable them to have a firmer understanding of their current abilities in different subject areas. This can provide them with guidance on which options to select next.
- **To diagnose faults and enable students to rectify mistakes.** Nothing is more demotivating than struggling on getting bad marks and not knowing what is going wrong. Effective assessment lets students know where their problems lie, and provides them with information to help them to put things right.
- **To give us feedback on how our teaching is going.** If there are generally significant gaps in student knowledge, this often indicates faults in the teaching of the areas concerned. Excellent achievement by a high proportion of students is often due to high quality facilitation of student learning.
- **To motivate students.** As students find themselves under increasing pressure, they tend to become more and more strategic in their approaches to learning, only putting their energies into work that counts. Assessment methods can be designed to maximise student motivation, and prompt their efforts towards important achievements.
- **To provide statistics for the course, or for the institution.** Universities need to provide funding bodies and quality assurance agencies with data about student performance, and assessment systems need to take account of the need for appropriate statistical information.
- **To enable grading and final degree classification.** Unlike some overseas universities, UK universities still maintain the degree classification system. However, some universities are continuing to ponder the introduction of a no-classifications system coupled with the production of student portfolios.
- **To add variety to students' learning experience, and add direction to our teaching.** Utilising a range of different assessment methods spurs students to develop different skills and processes. This can provide more effective and enjoyable teaching and learning.

In this booklet, I offer various practical suggestions regarding how assessment can be improved, particularly so that assessment can be:

- more valid, measuring that which we really intend to measure, rather than 'ghosts' of students' real learning;
- more reliable, moving away from the subjectivity that can cause assessment to be unfair;
- more diverse, so that individual students are not disadvantaged unduly by particular forms of assessment;
- more transparent, so that students know where the goalposts are, and so that external reviewers can see clear links between intended learning outcomes as spelled out in course documentation, and assessment criteria applied to students' work;
- more useful in terms of feedback, so that students learning is enhanced;
- more successful in promoting deep learning, so that students get a firmer grasp of the important theories and concepts underpinning physical sciences.

What are you trying to assess?

The range of assessment methods to choose from is much wider than is often realised. Yet it is estimated that more than 80% of assessment in universities comprises essays, reports, and traditional time-constrained unseen written exams. Assessment that is 'fit for purpose' should use the best method of assessment appropriate to the context, the students, the level, the subject and the institution. To help you choose the most appropriate methods, here are some questions to stimulate your thinking.

- **Which, if any, of the following written elements should you choose from?** Consider the best uses of essays, reports, reviews, summaries, dissertations, theses, annotated bibliographies, case studies, journal articles, presentations, and exams.
- **Should the method be time-constrained?** Time constrained tests put students under pressure, but are usually fairly good at preventing cheating.
- **Is it important that the method you choose includes cooperative activity?** If it is important, you might choose to assess students in groups, perhaps on group projects, poster displays, or presentations.
- **Is a visual component important?** When it is important, you might choose portfolios, poster displays, 'critique' sessions or exhibitions.
- **Is it important that students use information technology?** When it is important, computer-based assessments may be best, either getting students to answer multiple-choice questions, or write their own programmes, or prepare databases, or CD-roms or Web pages.
- **Do you wish to try to assess innovation or creativity?** Some assessment methods that allow students to demonstrate these include exhibitions, poster displays, presentations, projects, student-led assessed seminars, simulations and games.
- **Are you keen to encourage students to develop oral skills?** If so, you might choose to assess vivas, presentations, recorded elements of audio and videotapes made by students, assessed discussions or seminars, interviews or simulations.
- **Do you want to assess the ways in which students interact together?** You might then assess negotiations, debates, rôle plays, interviews, selection panels, and case studies.
- **Is the assessment of learning done away from the institution important?** For example you may wish to assess learning done in the workplace, in professional contexts or on field courses. You may choose to assess logs, reflective journals, field studies, case studies or portfolios.
- **Is your aim to establish what students are able to do already?** Then you could try diagnostic tests (paper-based or technology-based), profiles, records of achievement, portfolios, interviews, and vivas.

Keeping tabs on assessment

However good we are at assessing students, we do well to monitor our effectiveness, and keep a watching brief on what works well and what does not, so that we too can learn from our triumphs and mistakes, and can address problems. Quality reviewers, both internal and external, also look for evidence of how assessment quality is monitored. The following tactics may help you to build up a strategy for monitoring your own assessment practices.

- **Keep an overview of the marks you are giving.** In a small sample it won't be possible to get a set of results which plot into a normal distribution curve on a graph. However, if you notice that all of your marks are bunching too tightly at the median point, or that everyone is getting top marks, this may indicate that something is awry. It may help you to use a spreadsheet or other visual means to keep an eye on what's going on.
- **Get students to give you feedback on how well they feel you are assessing them.** You may not always want to hear their answers, but you could ask questions including "Am I giving you enough feedback?", "Do you find it helps you to improve?", "Is the turn around fast enough for you?", "Is there any way in which I can improve my assessment?", "How useful are the questions I am setting?", and so on.
- **Get help from colleagues.** Especially when work is not double-marked, sampled or moderated, it is useful to get colleagues to look at some of your grades, particularly when you are inexperienced regarding assessment. Pick scripts including a strong one, a weak one and an average one, and ask an experienced colleague or two to confirm that they agree with your evaluation.
- **Keep notes from year to year.** As you assess sets of work, note any difficulties you experience which may have arisen from the timing of the assessment or how you briefed the students. Note also difficulties of interpretation. Use these notes to help you design better assessments in future years. The best time to revise the briefing of an assessment task is just after you've finished marking the results of the present edition.
- **Beware of upward-creeping standards.** The more experienced you become in teaching and assessing a subject, the greater the risk is that you gradually expect or demand higher levels of performance from successive groups of students.
- **Tune in to other universities.** Build up your list of friends and colleagues in other colleges, and exchange with them past exam papers, assignment briefings and marking schemes. This can help you to design new tasks more easily for your own students, and also gives you the chance to seek feedback from such people on your own assessment practices.
- **Stand back and ask "what did that really measure?"** When reflecting on data from assignment performances or exam results, check that you did in fact succeed in measuring those aspects of student performance that you intended to assess. Also, however, ask "what <u>else</u> did I measure?". Decide whether next time to make such additional agendas more explicit when they are valuable (or when not valuable, how to steer assessment tasks away from such agendas).
- **Use comments from external assessors.** Quality reviewers, external examiners and others may well provide you with comments on how effectively they perceive your assessment methods to be. Use such feedback to help you to improve continuously, rather than seeing it as a personal attack. Make sure that you continue to include those elements that they praise or commend, and develop such elements further when appropriate.
- **Become an external assessor yourself.** Once you have developed expertise in your own university, an excellent way to learn from the experiences of other institutions is to become involved in external examining or quality reviewing yourself. What you learn about the excellence (or otherwise) of others means of assessment can then be transferred to your own context.

Concerns about assessment

Before it is possible to persuade people to review what they are presently doing, and to consider implementing changes, it is useful to take a critical look at whether current practices actually work as well as we think they do. Therefore, I continue this booklet with a critical review of two of the principal areas of assessment that physical sciences students encounter: traditional unseen written exams, and assessed coursework. In each case, I will list ten concerns, and in many cases provide hints at how the effects described by these concerns can be ameliorated. Later in the booklet I offer a range of practical pointers towards how even the traditional methods of assessment can be put to good use.

Concerns about exams

Much has been written about the weaknesses of traditional examinations – in particular time-constrained unseen written exams. In physical sciences in particular, this assessment format seems to be at odds with the most important factors underpinning successful learning. Moreover, there is abundant evidence that even in areas of physical sciences where the subject matter is well defined, and answers to questions are either correct or incorrect, assessors still struggle sometimes to make exams valid, reliable, or transparent to students.

However, with larger numbers of students, and staff-time under more pressure, there is evidence of a drift back to reliance on exams. They can be argued to be one of the more efficient methods of assessment, where it is fairly easy to achieve fairness and reliability, and with the added bonus that plagiarism or cheating cause less headaches to markers than in many other forms of assessment.

Some of the principal concerns that can be expressed about unseen written exams in physical sciences are summarised below.

1. **Exams don't do much to increase students' desire to learn physical sciences.** Students often make choices in modular schemes so that they avoid this kind of assessment if they can. This can lead them to choose subjects in which they are less interested than those that they fear to select because they will be subjected to exams. Physical sciences are not the most popular of subjects in many students' eyes, not least because many parts of physical sciences are perceived to be somewhat harder to learn than is the case with some other disciplines. Therefore, if our assessment strategies deter students from choosing physical sciences options, it is even more important to address the situation.

2. **Exams are not ideal occasions for learning by doing.** Although students may do a lot of learning before formal unseen written examinations in physical sciences, their actual experiences of learning physical sciences in such situations is very limited. It is therefore worth our while revisiting our testing processes to search for forms of physical sciences assessment which are in themselves better learning experiences.

3. **The amount of feedback that students receive about physical sciences exams is not optimal.** Most systems require marked exam scripts to be regarded as secret documents, not to be shown to students on any account! It is worth asking what reasons underlie this philosophy? It is useful to reconsider the value that students can derive from seeing their marked examinations papers, particularly in a field like physical sciences, where it should be possible to be able to demonstrate to students that the examination marking has indeed been reliable, fair, and valid.

4. **Exams tend not to do much to help students make sense of what they have learned.** While there may be a significant amount of 'digesting' concepts and theories during the time leading up to exams, the assessment experience itself does little to help students to gain any further deepening of their grasp of these.

5. **We mark exam scripts in a rush.** Most staff who mark exams agree that the task usually has to be completed in haste, in preparation for timetabled exam boards. The situation has been worsened by modularisation and semesterisation developments in some institutions, which give tighter turn-round intervals between examinations and progression to the next element of study. While our marking may still be fair and reliable, it can seem unrealistic to students who have spent a great deal of time preparing for physical sciences exams to find out that their scripts are marked so quickly.

6. **We're often tired and bored when we mark them.** With the speed which exam scripts need to be marked, and the pressure to mark well, staff are not functioning at their best while undertaking the task.

7. **We're not good at marking some areas of physical sciences objectively.** There is abundant data on the problems both of inter-assessor reliability and intra-assessor reliability, particularly with the more-qualitative or discursive kinds of exam question. Fortunately, in physical science subjects, these questions are relatively rare.

8. **Exams tend to favour candidates who happen to be skilled at doing exams!** If we look at exactly what skills are measured by unseen written exams, the most important of these from students' point of view turns out unsurprisingly to be the techniques needed to do unseen written exams, and the same students can get rewarded time after time! This skill may have little to do with the competences we need to help students to develop to become professionals in physical sciences fields.

9. **Unseen written exams force students into surface learning, and into rapidly clearing their minds of previous knowledge when preparing for the next exam.** Students are encouraged to clear their brains of the knowledge they have stored for each exam in turn. This of course is quite contrary to our real intentions to help students to achieve deep learning.

10. **There are many important qualities which are not tested well by traditional exams.** For example, unseen written exams are limited or useless for measuring teamwork, leadership, and even creativity and lateral thinking, all of which are have their parts to play in a field such as physical sciences.

Concerns about continuous assessment

Having made a broadside about the limitations of unseen written exams in physical sciences, I have to admit that such exams have advantages as well. These are particularly; they are fair to candidates, and they are not subject to most of the problems of plagiarism, unwanted collaboration, and so on which can affect the assessment of coursework. Let me proceed to further balance the picture by expressing an equal number of concerns about continuous assessment in physical sciences.

1. **If students are under too much pressure, their desire to learn is damaged.** When almost everything that students do as part of their physical sciences learning is measured, they naturally adopt strategic approaches to their learning, and only concentrate on those things that are going to be assessed. In particular, we need to ensure that students' practical work is focused on quality learning, and is not unnecessarily burdensome regarding quantity.

2. **The range of learning-by-doing may be too narrow.** For example, reports and calculations make up the majority of students' continuous assessment formats in many parts of physical sciences, and the skills tested are primarily those associated with preparing reports and performing calculations, rather than the deeper knowledge or understanding that may be intended.

3. **Feedback may be eclipsed by marks or grades.** Students pay most attention to their scores or grades when they get back marked work, and often are quite blind to valuable feedback which may accompany their returned work. A way out of this problem is to return students' work with feedback but without grades in the first instance, then get them to self-assess their own grades. Most students are within 5% or one grade point, and it is possible to allow their grade to count. It is well worth talking to the few students whose self-assessment is at odds with our own assessment, and alerting them to the blind spots which could have caused them to overestimate the worth of their work, or (as happens more often) to reassure them that their work was worth more than they thought it was.
4. **Students may not have the opportunity to make sense of the feedback they receive.** Particularly when there is a delay in getting feedback to students, they may already have moved on to learning other topics, and they don't then make learning from the feedback available to them a priority.

5. **It may be hard to detect unwanted collaboration.** Particularly with assignments submitted in word-processed formats, it is hard if not impossible to detect every instance of plagiarism or copying. Even when marking laboratory reports, if there are several lecturers or demonstrators involved in marking them, students who have copied can be quite skilled at making sure that different people mark their respective work, minimising the chance that the collaboration is detected. The most skilful plagiarists will always evade detection!

6. **Too much of our time may be involved in marking.** In many physical sciences courses, lecturers continue to try to use the same continuous assessment processes that worked quite well when student numbers were much smaller. With large numbers of students, it is essential that human assessment and feedback should be reserved for higher-level agendas, and that computer-delivered assessment formats should be exploited to provide assessment and feedback on relatively routine matters. There has already been a significant growth in the use of computer-aided assessment in physical sciences, and it is probably

one of the subject fields that is leading the way in this respect.

7. **Students may not be aware of the criteria used to assess their work.** When students are practised in interpreting and making use of assessment criteria, the standard of their assessed work rises dramatically. Alerting students to the detail of the assessment agenda is regarded by some staff as a move towards 'spoonfeeding'. However, it can be argued that enabling students to demonstrate their full potential is a desirable goal. Involving students in self-assessment of suitable elements of their own work, and in peer-assessment of appropriate assignments, can help students to gain a substantial understanding of the way that tutors assess their work.

8. **Students may get the balance wrong between continuous assessment and exams.** Students feel the pressure to submit coursework by stated deadlines, and may still be working on such work at a late stage in their studies on a particular module, when they would be better advised to cut their losses regarding coursework and prepare for important exams. This particularly happens when students who fall behind in writing up laboratory work, continue to try to get this work finished and handed in, when they may be better advised to spend their remaining time making sure that they are well prepared for forthcoming formal exams.

9. **Learning may become driven by assessment, and students may only do those things that are assessed.** Earlier in these concerns, it was mentioned that students tend to adopt strategic approaches to their learning. Such approaches can be made beneficial if the nature and range of the assessed tasks are adjusted to make all the learning that students do in their assessed work as relevant as possible to the intended learning outcomes.

10. **Too little use may be made of the learning that can be achieved when students assess their own, and each others', work.** Involving students in self-assessment and peer-assessment (when well facilitated) can deepen students' learning, and help them to develop awareness of the nature of assessment criteria, and of the overall assessment culture surrounding their studies.

Pros and cons of fourteen assessment techniques

Assessment can take many forms, and it can be argued that the greater the diversity in the methods of assessment, the fairer assessment is to students. Each one of the forms of assessment I consider in this booklet can be claimed to disadvantage those students who do not give of their best in the particular circumstances in which it is used. Therefore, diversifying assessment so that students experience a range of assessment methods evens out the situation, and increases the chance that they will be able to demonstrate their best performance in at least some of the formats. The art of assessing therefore needs to embrace several different kinds of activity. In this booklet, I would like to encourage colleagues to broaden the range of assessment processes, and I have tried to provide practical suggestions about how to maximise the benefits of each of a number of methods I have addressed below. In each case, I have also listed a few of the advantages of using the method, as well as some of the corresponding drawbacks.

In the next part of this booklet, I will look systematically at each of fourteen forms of assessment, listing a few advantages, some disadvantages, and I will offer some suggestions (sometimes a few, sometimes a lot) for making the particular assessment device work better in the context of learning physical sciences. None of these lists should be considered as anything more than a starting point. Nor should the kinds of assessment I happen to have chosen be taken as representative of a sufficiently diverse range of assessment processes.

1 Traditional exams

Traditional unseen written exams still make up the lion's share of assessment in higher education, though in physical sciences courses this situation is considerably balanced by the inclusion of practical work, projects and other contributions to the evidence on the basis of which we grade and classify students. Despite growing concern about the validity and fairness of traditional exams, for all sorts of reasons they will continue to play a large part in the overall assessment picture. Despite many concerns about exams, I have tried in the following discussion to suggest a number of ways that the use of exams can be improved. I have given more suggestions about setting exam questions than for setting any of the other types of assessment explored in this booklet, as in general, good practice in writing exam questions overlaps with, or extends across, many of the other types.

Advantages

- **Relatively economical.** Exams can be more cost-effective than many of the alternatives (though this depends on economies of scale when large numbers of students are examined, and also on how much time and money needs to be spent to ensure appropriate moderation of students' performance). However, any form of assessment can only be truly said to be cost-effective if it is actually *effective* in its contribution to students' learning.
- **Equality of opportunity.** Exams are demonstrably fair in that students have all the same tasks to do in the same way and within the same timescale. (However, not all things are equal in exams – ask any hay-fever sufferer, or candidate with menstrual problems).
- **We know whose work it is.** It is easier to be sure that the work being assessed was done by the candidates, and not by other people. For this reason, exams can be considered to be an 'anti-plagiarism assessment' device.
- **Teaching staff are familiar with exams.** Familiarity does not always equate with validity, but the base of experience that teaching staff already have with traditional unseen exams means that at least some of the problems arising from them are well known, and sometimes well-addressed.
- **Exams cause students to get down to learning.** Even if the assessment method has problems, it certainly causes students to engage deliberately with the subject matter being covered by exams, and this can be worthwhile particularly for those areas of physical sciences (to name but one: thermodynamics) where students may not otherwise spend the time and energy that is needed to make sense of the subject matter.

Disadvantages

- **Students get little or no feedback** about the detail of their performance, which is therefore a wasted as far as feedback is concerned. Though it can be argued that the purpose of such exams is measurement rather than feedback, the counter-argument is that most exams represent lost learning opportunities because of this lack of feedback. Where students are given the opportunity to see their marked scripts (even with no more feedback than seeing the sub-totals and total marks awarded along the way), they learn a great deal about exactly what went wrong with some of their answers, as well as having the chance to receive confirmation regarding the questions they answered well.
- **Badly set exams encourage surface learning,** with students consciously clearing their minds of one subject as they prepare for exams in the next subject. In a discipline such as physical sciences, it is inappropriate to encourage students to put out of their minds important subject areas, where they will need to retain their mastery for later stages in their studies.
- **Technique is too important.** Exams tend to measure how good students are at answering exam questions, rather than how well they have learned. In physical sciences exams lending themselves to problems and calculations, students may miss out on the need to develop other important skills, such as writing effectively and expressing themselves coherently.
- **Exams only represent a snapshot of student performance, rather than a reliable indicator of it.** How students perform in traditional exams depends on so many other factors than their grasp of the subject being tested. Students' state of mind on the day, their luck or otherwise in tackling a good question first, their state of health, and many other irrelevant factors creep in.

Tips on setting physical sciences exam questions

- **Don't do it on your own!** Make sure you get feedback on each of your questions from colleagues. They can spot whether your question is at the right level more easily than you can. Having someone else look at one's draft exam questions is extremely useful. It is better still when all questions are discussed and moderated by teams of staff. Where possible, draft questions with your colleagues. This allows the team to pick the best questions from a range of possibilities, rather than use every idea each member has.
- **Ask colleagues: 'what would you say this question really means?'.** If they tell you anything you hadn't thought of, you may need to adjust your wording a little.
- **Get colleagues to do your questions!** Sometimes even sketch answers can be helpful. This may be asking a lot of busy colleagues, but the rewards can be significant. You will often find that they answered a particular question in a rather different way than you had in mind when you designed the question. Being alerted to the ways that students might approach a question gives you the opportunity to accommodate different approaches in your marking scheme, or to adjust the wording of your question so that your preferred approach is made clear to students.
- **Keep your sentences short.** You're less likely to write something that can be interpreted in more than one way if you write plain English in short sentences. This also helps reduce any discrimination against those students whose second or third language is English.
- **Work out what you're really testing.** Is each question measuring decision-making, strategic planning, problem solving, data processing (and so on), or is it just too much dependent on memory? Most exam questions measure a number of things at the same time. Be up-front about all the things each question is likely to measure.
- **Don't measure the same things again and again.** For example, it is all too easy in essay-type exam questions to repeatedly measure students' skills at writing good introductions, firm conclusions, and well-structured arguments. Valuable as such skills are, we need to be measuring other important things too.
- **Include data or information in questions to reduce the emphasis on memory.** In some subjects, case-study information is a good way of doing this. Science exams often tend to be much better than other subjects in this respect, and it is appropriate to be testing what candidates can do with data rather than how well they remember facts and figures.
- **Make the question layout easy to follow.** A question with bullet points or separate parts can be much easier for (tense) candidates to interpret correctly than one which is just several lines of continuous prose.
- **Don't overdo the standards.** When you're close to a subject, it's easily possible that your questions get gradually harder year-by-year. With some areas of physical sciences, there is the danger that numerical problems become more difficult in each successive exam, partly because of the wish to stretch students a little further than did the worked examples they may have seen in lectures, or the problems students tackled in tutorials.
- **Write out an answer to your own question.** This will be handy when you come to mark answers, but also you'll sometimes find that it takes you an hour to answer a question for which candidates have only half-an-hour. Lecturers setting problem-type questions for students often forget that familiarity with the type of problem profoundly influences the time it takes to solve it. Students who get stuck on such a question may end up failing the exam more through time mis-management than through lack of subject-related competence.
- **Decide what the assessment criteria will be.** Check that these criteria relate clearly to the syllabus objectives or the intended learning outcomes. Make it your business to ensure that students themselves are clear about these objectives or intended outcomes, and emphasise the links between these and assessment. When students are aware that the expressed learning outcomes are a template for the design of assessment tasks, it is possible for them to make their learning much more focused.
- **Work out a tight marking scheme.** Imagine that you are going to delegate the marking to a new colleague. Write it all down. You will find such schemes an invaluable aid to share with future classes of students, as well as colleagues actually co-marking with us, helping them to see how assessment works.
- **Use the question itself to show how marks are to be allocated.** For example, put numbers in brackets to show how many marks are attached to various parts of the question (or alternatively, give suggested timings such as 'spend about ten minutes on Part 2').
- **Try your questions out.** Use coursework and student assignments to do pilot runs of potential components of your future exam questions, and use or adapt the ones that work best for exams.

Tips on designing marking schemes

Making a good marking scheme can save you hours when it comes to marking a pile of scripts. It can also help you to know that you are doing everything possible to be uniformly fair to all students. In addition, as your marking schemes will normally be shown to people including external examiners and quality reviewers, it's important to design schemes in the first place so that they will stand up to such scrutiny. The following suggestions should help.

- **Write a model answer for each question.** This can be a useful first-step towards identifying the mark-bearing ingredients of a good answer. It also helps you see when what you thought was going to be a 30-minute question turns out to take an hour! If you have difficulties answering the questions, the chances are that your students will too! Making model answers and marking schemes for coursework assignments can give you good practice for writing exam schemes.
- **Make each decision as straightforward as possible.** Try to allocate each mark so that it is associated with something that is either there or absent, or right or wrong, in students' answers.
- **Aim to make the scheme usable by a non-expert in the subject.** This can help your marking schemes be useful resources for students themselves, perhaps in next year's course.
- **Aim to make it so that anyone can mark answers, and agree on the scores within a mark or two.** It is best to involve colleagues in your piloting of first-draft marking schemes. They will soon help you to identify areas where the marking criteria may need clarifying or tightening up.
- **Allow for 'consequential' marks.** For example, when a candidate makes an early mistake, but then proceeds correctly thereafter (especially in problems and calculations), allow for some marks to be given for the ensuing correct steps even when the final answer is quite wrong.
- **Pilot a marking scheme by showing it to others.** It's worth even showing marking schemes to people who are not closely associated with your subject area. If they can't see exactly what you're looking for, it may be that the scheme is not yet sufficiently self-explanatory. Extra detail you then add at this stage may help you to clarify your own thinking, and will certainly assist fellow markers.
- **Make yourself think about honourable exceptions.** Ask yourself whether your marking scheme is sufficiently flexible to accommodate a brilliant student who hasn't strictly conformed to your original idea of what should be achieved. There are sometimes candidates who write exceptionally good answers which are off-beam and idiosyncratic, and they deserve credit for these.
- **Consider having more than 20 marks for a 20-mark question.** Especially in essay-type answers, you can't expect students to include all the things you may think of yourself. It may be worth having up to 30 or more 'available' marks, so that students approaching the question in different ways still have the opportunity to score well.
- **Look at what others have done in the past.** If it's your first time writing a marking scheme, looking at other people's ways of doing them will help you to focus your efforts. Choose to look at marking schemes from other subjects that your students may be studying, to help you tune in to the assessment culture of the overall course.
- **Learn from your own mistakes.** No marking scheme is perfect. When you start applying it to a pile of scripts, you will soon start adjusting it. Keep a note of any difficulties you experience in adhering to your scheme, and take account of these next time you have to make one.

Tips on marking examination scripts

The following suggestions may help you approach the task of marking exam scripts efficiently, while still being fair and helpful to students.

- **Be realistic about what you can do.** Marking scripts can be boring, exhausting and stressful. As far as constraints allow, don't attempt to mark large numbers of scripts in short periods of time. Put scripts for marking into manageable bundles. It is less awesome to have ten scripts on your desk and the rest out of sight than to have the whole pile threatening you as you work.
- **Avoid halo effects.** If you've just marked a brilliant answer on a script, it can be easy to go into the same student's next answer seeing only the good points and passing over the weaknesses. Try to ensure that you mark each answer dispassionately. Conversely, when you look at the next student's answer, you may be over-critical if you've just marked a brilliant one.
- **Watch out for prejudices.** There will be all sorts of things which you like and dislike about the style and layout of scripts, not to mention handwriting quality. Make sure that each time there is a 'benefit of the doubt' decision to be made, it is not influenced by such factors.
- **Recognise that your mood will change.** Every now and then, check back to scripts you marked

earlier, and see whether your generosity has increased or decreased. Be aware of the middle-mark bunching syndrome. As you get tired, it feels safe and easy to give a middle-range mark. Try as far as possible to look at each script afresh.

- **Remind yourself of the importance of what you're doing.** You may be marking a whole pile of scripts, but each individual script may be a crucial landmark in the life of the student concerned. Your verdict may affect students for the rest of their careers.
- **Take account of the needs of second markers.** Many universities use a blind double marking system, in which case you should not make any written comments or numbers on the scripts themselves, to avoid prejudicing the judgement of a second marker (unless of course photocopies have already been made of each script for double marking). You may find it useful to use post-its or assessment proformas for each script, so you are able to justify the marks you give at any later stage. Such aides-memoirs can save you having to read the whole scripts again, rethinking how you arrived at your numbers or grades.
- **Write feedback for students.** In most exams, the system may not allow you to write on the scripts the sort of feedback you would have given if the questions had been set as assessed coursework. However, students still need feedback, and making notes for yourself of the things you would have explained about common mistakes can help you prepare some discussion notes to issue to students after the exam, or can remind you of things to mention next time you teach the same subjects.
- **Devise your own system of tackling the marking load.** You may prefer to mark a whole script or just Question 1 of every script first. Do what you feel comfortable with, and see what works best for you.
- **Provide feedback for yourself and for the course team.** As you work through the scripts, note how many students answered each question, and how well they performed. You may begin to realise that some questions turned out to have been very well written, while others could have been framed better. You will find out which questions proved to be the hardest for students to answer well, even when all questions were intended to be of an equal standard. Such feedback and reflection should prove very useful when designing questions for next time round.
- **Set aside time for a review.** Having marked all the scripts, you may wish to capture your thoughts, such as suggestions about changes for part of the course or module, or the processes used to teach it. It is really useful, however tired you feel, to write a short draft report on the marking as soon as you have completed it. Otherwise, important things, which are still fresh in your tired mind, will all too quickly evaporate away.

Using exam questions as class exercises

Answering exam questions well is still one of the principal skills which students need to develop to succeed in their studies in physical sciences subjects. In our attempts to increase the learning payoff of taught sessions, we can help students to develop their exam skills by making use of past exam questions. The following suggestions may help you to build related activities into your lectures and tutorials – but don't try to implement more than two or three of these suggestions with any one cohort – you haven't got time!

- **Let a class have a try at an exam question under exam conditions.** Then ask students to exchange their answers, and lead them through marking their work using a typical marking scheme. This helps students to learn quickly how examiners' minds work. It is well worth using the whole of at least one lecture slot for such an exercise; the learning payoff for students is likely to be considerably more than if you'd just spent an extra hour with one small element of their curriculum.
- **Issue two or three old exam questions for students to try in preparation for a tutorial.** Then lead them through assessing their work using a marking scheme during the tutorial. Ask them to prepare lists of questions on matters arising from the exercise, both on subject content and requirements for exams, and use their questions to focus tutorial discussion.
- **Display an exam question on-screen in a large group lecture.** Ask students in groups to brainstorm the principal steps they would take in the way they would approach answering the question. Then give out a model answer to the question as a handout, and talk the class through the points in the model answer where marks were earned. All this can be achieved in less than half of the overall time of a typical lecture.
- **In a lecture or a tutorial, get students in groups to think up exam questions themselves.** You can base this on work they have already covered, or on work currently in progress. Ask the groups to transcribe their questions onto overhead transparencies. Display each of these in turn, giving feedback on how appropriate or otherwise each question is in terms of standard, wording, length and structure. (You will get many questions this way that you can later use or adapt for next year's exams or future coursework assignments!).

- **Use exam questions to help students to create an agenda.** In a lecture or tutorial, give out two or three related exam questions as a handout. Ask students in groups to make lists of short questions that they don't yet know the answers to. Then allow the groups to use you as a resource, quizzing you with these questions. You don't have to answer them all at once – for some your reply will be along the lines "We'll come to this in a week or two", and for others "You won't actually be required to know this".
- **Get students to make marking schemes.** Give them a typical exam question, and ask groups of students to prepare a breakdown of how they think the marks should be allocated. Ask them to transcribe the marking schemes to overhead transparencies. Discuss each of these in turn with the whole group, and give guidance to how closely the marking schemes resemble those used in practice.
- **Get students to surf the net.** Ask them to access the Internet to see if they can find appropriate exam questions on the subjects they are studying. Suggest that they work in twos or threes, and bring the questions they find to the next class session. You can encourage them to download the questions they find, and make an electronic question bank.
- **Ask students in groups to think up a 'dream' question.** Ask the groups to make bullet-point lists of the ten most important things that they would include in answers to these questions. These questions will give you useful information about their favourite topics.
- **Ask students in groups to think up 'nightmare' questions.** With these, you can open up a discussion of the causes of their anxieties and traumas, and can probably do a lot to allay their fears, and point them in the right direction regarding how they might tackle such questions.
- **Ask students to think of way-out, alternative questions.** Suggest that they think of questions which are not just testing of their knowledge and skills, but which get them to think laterally and creatively. This encourages deeper reflection about the material they are learning, and will probably give you some interesting ideas to use in future exams.

2 Open-book exams

In many ways these are similar to traditional exams, but with the major difference that students are allowed to take in with them sources of reference material. Alternatively, candidates may be issued with a standard set of resource materials that they can consult during the exam, and are informed in advance about what will be available to them, so that they can prepare themselves by practising to apply the resource materials. Sometimes, in addition the 'timed' element is relaxed or abandoned, allowing students to answer questions with the aid of their chosen materials, and at their own pace.

Advantages

These have many of the advantages of traditional exams, with the addition of:

- **Less stress on memories!** The emphasis is taken away from students being required to remember facts, figures, maybe formulae, and other such information.
- **Measuring retrieval skills.** It is possible to set questions which measure how well students can use and apply information, and how well they can find their way round the contents of books and even databases.
- **Slower writers helped?** If coupled with a relaxation in the timed dimension (e.g. a nominal '2-hour' paper where students are allowed to spend up to three hours if they wish) some of the pressure is taken away from those students who happen to be slower at writing down their answers (and also students who happen to think more slowly).

Disadvantages

- **Not enough books or resources!** It is hard to ensure that all students are equally equipped regarding the books they bring into the exam with them. A limited stock of library books (and the impossibility of students purchasing their own copies of expensive books) means that some students may be disadvantaged.
- **Need bigger desks?** Students necessarily require more desk-space for open-book exams if they are to be able to use several sources of reference as they compose their answers to exam questions. This means fewer students can be accommodated in a given exam room than with traditional unseen exams, and therefore open book exams are rather less cost-effective in terms of accommodation and invigilation.

Tips on setting open-book exam questions

All of the suggestions regarding traditional exam questions still apply. In addition.....

- **Decide whether to prescribe the books students may employ.** This is one way round the problem of availability of books. It may even be possible to arrange supplies of the required books to be available in the exam room.
- **Consider compiling a source-collection for the particular exam.** Check on copyright issues, and see if it is cost-effective to put together a set of papers, extracts, data, and other information from which students can find what they need to address the questions in the particular exam.
- **Set questions which require students to do things with the information available to them,** rather than merely summarising it and giving it back.
- **Make the actual questions particularly clear and straightforward to understand.** The fact that students will be reading a lot during the exam means that care has to be taken that they don't read the actual instructions too rapidly.
- **Focus the assessment criteria on what students have done with the information,** and not just on them having located the correct information.
- **Plan for shorter answers.** Students doing open book exams will be spending quite a lot of their time searching for, and making sense of, information and data. They will therefore write less per hour than students who are answering traditional exam questions 'out of their heads'.

3 Open-notes exams

These are similar to open-book exams described above, but this time students are allowed to bring into the examination room any notes that they have prepared for the purpose. In other words, we are talking about a situation of 'legitimised crib-notes'! Your first thought may be that this is all very strange, but in fact such exams can work surprisingly well.

Advantages

- **Students can achieve a very significant learning payoff simply making the notes in the first place.** It is best not to place stringent limits on the amount of materials which students can bring in. Those who bring in everything they have ever written about your topic will be disadvantaging themselves in that it will take them much longer to search for the relevant parts of their notes, compared to students who have been really selective in summarising the important parts of your topic.
- **The emphasis on memory is reduced, allowing competence to be tested more effectively.** Open-notes exams can also spread candidates' abilities out more fairly, as the better candidates will have made better notes in the first place.
- **You can write shorter questions.** When it is up to the students to ensure that they have with them important information or data, you don't have to put so much into the questions themselves.

Disadvantages

- **Students need rehearsal at preparing for open-notes exams.** They may take two or three practice runs to develop the art of making comprehensive but manageable summaries of the important data or information you intend them to make available to themselves.
- **Candidates whose open notes were not very suitable are penalised quite severely.** Some of these candidates may have been better at answering traditional exam questions with no notes.
- **Extra desk-space is needed, just as for open book exams.**

Tips on designing open-notes exams

- **Think of giving a topic menu in advance.** This can save candidates from trying to prepare open notes on everything they have learned about your topic. It does, of course, also mean that you are letting them off the hook regarding trying to learn some of the things than you don't include in your menu.
- **Consider having an inspection process.** For example, let it be known that yourself or your colleagues will be keeping an eye on the range and content of the open notes, or even that they may be temporarily retained after the exam.

4 Structured exams

These include multiple-choice exams, and several other types of formats where students are not required to write 'full' answers, but are involved in making true/false decisions, or identifying reasons to support assertions, or fill in blanks or complete statements, and so on. It is of course possible to design mixed exams, combining free-response traditional questions with structured ones. In the following discussion, I will concentrate on the benefits and drawbacks of multiple choice questions. Many of the same points also apply at least in part to other types of structured exam questions, such as true-false, short-answer, and sequencing questions.

Advantages

- **Greater syllabus coverage:** it is possible, in a limited time, to test students' understanding of a much greater cross-section of a syllabus than could be done in the same time by getting students to write in detail about a few parts of the syllabus.
- **Multiple choice exams test how fast students think,** rather than how fast they write. The level of their thinking depends on how skilled the question-setters are
- **Students waste less time.** For example, questions can already show structural formulae (correct and wrong) and students can be asked to select the correct one, without having to draw it for themselves.
- **Saving staff time and energy.** With optical mark readers, it is possible to mark multiple choice exams very cost-effectively, and avoid the tedium and subjectivity which affect the marking of traditional exams.
- **Computer-based tests can save even more time.** As well as processing all of the scores, computer software can work out how each question performs, calculating the discrimination index and facility value of each question. This allows the questions which work well as testing devices to be identified, and selected for future exams.
- **Testing higher-level skills?** Multiple choice exams can move the emphasis away from memory, and towards the ability to interpret information and make good decisions. However, the accusation is often made that such exams seem only to test lower cognitive skills, and there are numerous examples which seem to support this argument. There are, however, examples where high level skills are being tested effectively, and more attention needs to be given to the design of such testing to build on these.

Disadvantages

- **The guess factor.** Students can often gain marks by lucky guesses rather than correct decisions.
- **Designing structured questions takes time and skill.** It is harder to design good multiple-choice questions than it is to write traditional open-ended questions.
- **Black and white or shades of grey?** While it is straightforward enough to reward students with marks for correct choices (with zero marks for choosing distractors), it is more difficult to handle subjects where there is a 'best' option, and a 'next-best' one, and so on.
- **Where multiple-choice exams are being set on computers, check that the tests are secure.** Students can be ingenious at getting into computer files that are intended to be secret!
- **The danger of impersonators?** The fact that exams composed entirely of multiple-choice questions do not require students to give any evidence of their handwriting increases the risk of substitution of candidates.

Tips for designing multiple-choice exams in physical sciences

- **Try out questions with colleagues and with large groups of students.** Make sure that people are, on the whole, selecting correct options for the right reasons – and not because in one way or another the question gives away which is the correct option.
- **Make sure that distractors are plausible.** If no-one is selecting a given distractor, it is serving no useful purpose. Distractors need to represent anticipated errors in students' knowledge or understanding.
- **Try to avoid overlap between questions.** If one question helps students successfully to answer further questions, the possibility increases of students picking the right options for the wrong reasons.

- **Avoid options such as 'none of the above' or 'all of the above'.** These options are a let-out for students who find it hard to decide between the other alternatives, and are often chosen by students in surface-thinking mode. Also, it is surprisingly rare for such options to be in fact the correct one, and test-wise candidates will already have guessed this.
- **Pilot questions in formative-tests before using them in summative exams.** Ideally, multiple-choice questions that appear in formal exams should be tried-and-tested ones. It is worth consulting the literature on multiple-choice question design and finding out how to assess the discrimination index and facility value of each question from statistical analysis of the performance of substantial groups of students.
- **Remember that students can still guess.** The marking scheme needs to take into account the fact that students will score some marks by pure luck! If most of the questions were, for example, four-option ones, the average mark which would be scored by a monkey would be 25%, so the real range lies between this and 100%. It is important that people are indeed allowed to get 100% in such structured exams, and that this does not cause any problems when the marks are blended with more-traditional exam formats where written answers in some subjects still attract marks only in the 70s even when they're reckoned to be first-class answers.
- **Write feedback responses to each option.** Where possible, it is useful to be able to explain to students selecting the correct (or best) option exactly why their selection is right. It is even more useful to be able to explain to students selecting the wrong (or less-good) options exactly what may be wrong with their understanding. When multiple-choice questions are computer-marked, it is a simple further step to get the computer to print out feedback responses to each student. This practice can equally be applied to formative multiple-choice tests, and to formal multiple-choice exams. Furthermore, the availability of feedback responses to each decision students make lends itself to extending the use of such questions in computer-based learning packages, and even computer-managed exams.
- **Ensure that students are well practised at handling multiple-choice questions.** Answering such questions well is a skill in its own right, just as is writing open answers well. We need to ensure that students are sufficiently practised, so that multiple-choice exams measure their understanding and not just their technique.
- **Look at a range of published multiple-choice questions.** For example, several Open University courses have multiple-choice assignment questions, as well as multiple-choice exams. You may be surprised how sophisticated such questions can be, and may gain many ideas that you can build into your own question-design.
- **Gradually build up a large bank of questions.** This is best done by collaborating with colleagues, and pooling questions that are found to be working well. It then becomes possible to compose a multiple-choice exam by selecting from the bank of questions. If the bank becomes large enough, it can even be good practice to publish the whole collection, and allow students to practise with it.
- **When you've got a large bank of questions, there is the possibility of on-demand exams.** Students can then take a multiple-choice test with a random selection of questions from the bank, at any time during their studies, and 'pass' the component involved as soon as they are able to demonstrate their competence with the questions.

5 Essays

In some subjects, assessment is dominated by essay writing. Traditional (and open-book) exams often require students to write essays. Assessed coursework often takes the form of essays. In physical sciences, however, the essay is less dominating, and it is well known that essay-answers tend to be harder to mark, and more time-consuming to assess. There are still some useful functions to be served by including some essay questions however.

Advantages

- **Essays allow for student individuality and expression.** They are a medium in which the 'best' students can distinguish themselves. This means, however, that the marking criteria for essays must be flexible enough to be able to reward student individuality fairly.
- **Essays can reflect the depth of student learning.** Writing freely about a topic is a process which demonstrates understanding and grasp of the material involved.
- **Essay-writing is a measure of students' written style.** It is useful to include good written communication somewhere in the overall assessment strategy. The danger of students in science disciplines missing out on the development of such skills is becoming increasingly recognised.

Disadvantages

- **Essay-writing is very much an art in itself.** Students from some backgrounds are disadvantaged regarding essay-writing skills as they have simply never been coached in how to write essays well. For example, a strong beginning, a coherent and logical middle, and a firm and decisive conclusion combine to make up the hallmarks of a good essay. The danger becomes that when essays are over-used in assessment strategies, the presence of these hallmarks is measured time and time again, and students who happen to have perfected the art of delivering these hallmarks are repeatedly rewarded irrespective of any other strengths and weaknesses they may have.
- **Essays take a great deal of time to mark objectively.** Even with well-thought-out assessment criteria, it is not unusual for markers to need to work back through the first dozen or so of the essays they have already marked, as they become aware of the things that the best students are doing with the questions, and the difficulties experienced by other students.
- **Essays take time to write (whether as coursework or in exams).** This means that assessment based on essay-writing necessarily is restricted regarding the amount of the syllabus that is covered directly. There may remain large untested tracts of syllabus.
- **'Write down the number we first thought of'!** Essays are demonstrably the form of assessment where the dangers of subjective marking are greatest. Essay-marking exercises at workshops on assessment show marked differences between the mark or grade that different assessors award the same essay – even when equipped with clear sets of assessment criteria.

Tips on setting and using essay-type questions

Most of the suggestions given earlier in this booklet about writing traditional exam questions continue to apply – whether essays are to be used as assessed coursework or as exam questions. Some further suggestions are given below.

- **Help students to see exactly how essays are marked.** Alert students to the credit they gain from good structure and style. One of the best ways of doing this is to involve classes of students in looking at examples of past (good, bad and indifferent) essays, and applying assessment criteria. This can be followed by involving students in peer-assessment of each other's essays.
- **Subdivide essay questions into several parts, each with marks publicly allocated.** This helps to prevent students from straying so far off the point that they lose too many of the marks that they could have scored.

- **Give word limits.** Even in exams, it can be useful to suggest to students that an essay-answer should lie between (for example) 800 and 1200 words (essay answers in physical sciences are normally much shorter than in most other non-scientific disciplines, and the one-hour question is rare). This avoids the quantity-versus-quality issue, which leads some students into simply trying to write a lot, rather than thinking deeply about what they are writing - and also helps reduce the time it takes to mark the essays.

- **Help students develop the skills required to assemble the 'content' for essays.** This is particularly important in areas of physical sciences, where students will be more accustomed to handling structured questions and problems. The danger then is that students tackling essay questions in exams spend far too long on them, and penalise themselves regarding time for the rest of the examination. One of the best – and most time-effective – ways of helping physical sciences students become better at handling essay questions is to set class or coursework tasks which require students to prepare essay-plans rather than fully-finished masterpieces. A concept-map or diagram can show a great deal about the eventual 'worth' of students' essays, and can avoid distraction from the elements of style and structure. Students can put together maybe half-a-dozen essay plans in the time it would take them to complete one essay, and perhaps making the plans involves far more thinking and learning.
- **Don't assess essays too often.** Any assessment form advantages those students who happen to be skilled at delivering what is being measured. This applies to essays too, and there is a significant danger that those students who happen to become good at planning and writing essays continue to be advantaged time and time again.
- **Have a clear, well-structured marking scheme for each essay question.** This can save a lot of time when marking, and can help guarantee that students' answers are assessed fairly and consistently.
- **Don't assume that longer equals better.** It is often harder for students to write succinctly than to just ramble on. However, students need to be briefed on how best we want them to develop their art in writing briefly.
- **Consider involving students in peer-assessing some essays or essay plans.** This helps them to put their own efforts into perspective, and to learn things to emulate (and things to avoid!) by seeing how other students go about devising essays.
- **Help students to improve their technique through feedback.** Consider the range of approaches you can use to give students useful feedback on their essays, including statement banks, assignment return sheets, email messages, and try to minimise the time you spend writing similar feedback comments onto different students' essays.
- **Use some class time to get students to brainstorm titles for essays.** This helps them to think about the standard they could anticipate for essay questions in forthcoming exams, and gives them topic areas to base their practice on.

6 Reviews and annotated bibliographies

Anyone who reviews books for journals or magazines will confirm that there's no better way of making oneself look deeply into a book than to be charged with the task of writing a review of it! Getting students to write reviews is therefore a logical way of causing them to interact in depth with the information they review. One way of getting students to review a lot of material at once is to ask them to produce annotated bibliographies on a topic area, and to assess these.

Advantages

- **Reviewing is an active process.** Reviewing material gives students a task to do which focuses their thinking, and helps them avoid reading passively.
- **Reviews are useful for revision.** When students have reviewed material, the reviews are useful learning tools in their own right, and may spare students from having to wade through the material on subsequent revision.
- **Reviewing involves important mental processes.** When students are required to review material from different sources critically, they are necessarily engaged in higher-level skills of comparing, contrasting and evaluating – far beyond passive reading.
- **Reviewing other papers and articles is useful practice for research writing.** Students who will move on to research can benefit from the training involved in writing reviews, and gain skills in communicating their conclusions coherently.
- **Reviewing helps students develop critical skills.** Getting students to compare and contrast chosen sources helps them think more deeply about the subject matter involved.
- **Compiling annotated bibliographies is a way of requiring students to survey a considerable amount of material.** It also helps them to reduce a large field to a manageable body of notes and references.

Disadvantages

- **Reviews are necessarily quite individual.** For reviews to lend themselves to assessment, it is important that the task should be delineated quite firmly. This may go against the open-ended approach to reviewing which we may wish students to develop.
- **There aren't enough books!** With large numbers of students and limited library resources, students may find it difficult or impossible to get adequate access to the materials we want them to review.
- **Reviewing individually can be lonely.** Reviewing a range of resources is often best done as a group task rather than an individual one, maximising the benefits that students derive from discussion and debate. It then becomes more difficult to assess individual contributions to such reviews.

Tips on setting assessed review tasks

- **Promote variety.** Ask students to select their own subject for research, and give them a wide range of topics to choose from.
- **Prompt awareness of audience.** Ask students to write reviews of different kinds of publication, so that they become aware of the differences in tone and style of writing which are appropriate for different audiences.
- **Get students to assess existing reviews.** For example, issue students with a selection of existing reviews, and ask them to identify features of the best reviews, and faults of the worst ones.

- **Help students to see that reviewing is not just a matter of summarising what everyone has said.** You only have to look at book reviews in journals to see how some reviewers make up their contributions by summarising the 'contents' pages of the material that they are reviewing. This is not a high-level intellectual activity.
- **Decide about credit to be awarded to 'search' tasks.** It is useful to get students both to locate all relevant major resources addressing a field, and to prioritise (for example) the most-important or most-relevant half-dozen sources.
- **Consider limiting the parameters.** Getting students to do a short comparative review of two or three important sources can be easier (and fairer) to assess than when the reviews are done without any restrictions. When such focused review tasks are coupled with a general search, it is possible to

measure information retrieval skills as well as the higher-level 'compare and contrast' skills, without the agenda for the latter remaining too wide for objective assessment.

- **Set a tight word-limit for the review.** The art of writing a good, short review is more demanding than writing long reviews. When students' reviews are of equal length, it becomes easier to distinguish the relative quality of their work. However, brief students on how to draft and re-draft their work, to ensure the quality of short reviews.
- **Think about combining collaborative and individual work.** For example, suggest that groups of students do a search collaboratively, and identify the most relevant sources together. Then suggest they write individual reviews of different sources. Finally, consider asking them to share their reviews, and then write individual comments comparing and contrasting the sources.
- **Ask students to look at the same texts, but give them different focuses.** For example, students could look at a series of articles on pollution, and write different reviews of them aimed to be separately useful to conservationists, parents, individualists, and general consumers.
- **Emphasise the importance of brevity.** It is much more difficult to write a concise pithy review than to ramble on with opinion and narrative at unspecified length. Short reviews are also quicker to mark (but make sure that students don't adopt the 'stop when you've written a thousand words' approach).
- **Encourage qualitative judgement.** Prompt students to write on not only what a book or article is about, but also about how effective it is in providing convincing arguments, and how well it is expressed.
- **Involve your library or information services staff.** It's a mean trick to send off groups of students to rampage through the library, without giving notice to the staff there of what you are doing. Discussing your plans with your faculty librarians, for example, gives them a chance to be prepared, and gives opportunities for them to make suggestions and give advice to you on the nature of the task, before you give it to students.
- **Think hard about resource availability.** Make sure that there won't be severe log-jams with lots of students chasing particular library resources. Widen the range of suggested resources. Consider arranging with library staff that any books which will be in heavy demand are classified as 'reference only' stock for a specified period, so that they can remain in the library rather than disappearing on loan.
- **Consider setting annotated bibliographies as group tasks.** This can encourage students to collaborate productively in future information-seeking tasks, and can reduce the drudgery sometimes experienced in tasks such as literature searching.
- **Make the final product 'publishable'.** Aim to compile collections of the best reviews and annotated bibliographies, for example to use in next year's Course Handbook, or as the basis of an assessed task for next year's students.
- **Consider delegating assessment to library staff (with their agreement!).** Library staff may be willing and able to assess annotated bibliographies and reviews in parallel with yourself, or may be willing to provide additional feedback comments to students.

7 Reports

Assessed reports make up at least part of the coursework component of many courses. Report-writing is one of the hardest things when it comes to providing students with general advice, as (for example) the nature of a report in physical sciences may be quite different from the kinds of reports students may be required to do in other disciplines. The most common kinds of report that physical sciences students write are those associated with their practical, laboratory or field work.

Advantages

- **Report writing is a skill relevant to many jobs.** In many careers and professional areas that physical sciences students are likely to meet, the ability to put together a convincing and precise report is useful. Report writing can therefore provide a medium where specific skills relevant to professional activity can be addressed.
- **Reports can be the end product of useful learning activities.** For example, the task of writing reports can involve students in research, practical work, analysis of data, comparing measured findings with literature values, prioritising, and many other useful processes. Sometimes these processes are hard or impossible to assess directly, and reports provide secondary evidence that these processes have been involved successfully (or not).
- **Report-writing can allow students to display their talents.** The fact that students can have more control when they write reports than when they answer exam questions or set coursework, allows students to display their individual strengths.

Disadvantages

- **Collaboration can be difficult to detect.** For example with laboratory work, there may be a black market in old reports! Also, when students are working in pairs or groups in practical work, it can be difficult to set the boundaries between collaborative work and individual interpretation of results.
- **Report-writing can take a lot of student time.** When reports are assessed and count towards final grades, there is the danger that students spend too much time writing reports at the expense of getting to grips with their subject matter in a way which will ensure that they succeed in other forms of assessment such as exams.
- **Report marking can take a lot of staff time.** With increased numbers of students, it becomes increasingly difficult to find the time to mark piles of reports and maintain the quality and quantity of feedback given to students about their work.

Tips on setting assessed report writing

- **Give clear guidance regarding the format of reports.** For example, issue a sheet listing principal generic section headings, with a short description of the purpose and nature of each main section in a typical report.
- **Get students to assess subjectively some past reports.** Issue students with copies of some good, bad and indifferent reports, and ask them to mark them independently, simply giving each example an impression mark. Then facilitate a discussion where students explain why they allocated the marks in the ways they did.
- **Get students to assess objectively some past reports.** Issue groups of students with good, bad and indifferent reports, along with a sheet listing assessment criteria and a mark scheme. Ask each group to assess the reports. Then initiate discussions and comparisons between groups.
- **Make explicit the assessment criteria for reports.** Help students to see the balance between the marks associated with the structure of their reports, and those given to the content and the level of critical thinking and analysis.
- **Ask students for full reports less often.** For example, if during a course students tackle eight pieces of work involving report writing, ask students to write full reports for only two of these, and ask for summary or ‘short-form’ or ‘memorandum’ reports for the remaining assignments. These shorter reports can be structured in note-form or bullet-points, and can still show much of the evidence of the thinking and analysis that students have done.
- **Accommodate collaboration.** One way round the problems of collaboration is to develop approaches where students are required to prepare reports in groups – often closer to real-life than preparing them individually.

- **Involve students in assessing each other's reports.** When marks for reports 'count' significantly, it may be desirable to moderate student peer-assessment in one way or another, but probably the greatest benefit to derive is that students get a good deal more feedback about their work than hard-pressed staff are able to provide. It is far quicker to moderate student peer-assessment than to mark all the reports from scratch.
- **Consider asking students to write (or word-process) reports onto pre-prepared pro-formas.** This can help where there are significant 'given' elements such as equipment and methodology. You can then concentrate on assessing the important parts of their writing, for example interpretation of data.
- **Publish clear deadlines for the submission of successive reports.** In the case of practical work, allow only one or two weeks after the laboratory session. It is kinder to students to get them to write-up early, rather than to allow them to accumulate a backlog of report writing, which can interfere (for example) with their revision for exams.
- **Prepare a standard assessment/feedback grid, to return to students with marked reports.** Include criteria and marks associated with (for example) the quality of data, observations, calculations, conclusions, references and verdicts.
- **Allocate practical work in advance of the sessions, and include some assessed pre-laboratory preparation.** For example, pose half-a-dozen short-answer questions for students to complete before starting a piece of laboratory work. This helps students know what they are doing, rather than follow instructions blindly. It also avoids wasting time at the start of a laboratory session working out only then which students are to undertake each experiment.
- **Include some questions linked closely to practical or fieldwork in examinations.** For example, tell students that two exam questions will be based on work they will have done in the outside the lecture room. This helps to ensure that practical work isn't forgotten when students start revising for exams.
- **Get students to design exam questions based on practical work.** Set groups of students this task. Allocate some marks for the creativity of their questions. When done over several years, the products could be turned into a bank of questions that could be placed on computer for students to consult as they prepared for exams.
- **Consider the use of computers in the laboratories and other practical work situations.** Where facilities are available, arrange that students can input their experimental data directly onto a computer or network. Many universities now enable students to write up their reports straight into a word processor alongside the laboratory bench, using a report template on disk. Such reports can be handed in immediately at the end of the laboratory session, and marked and returned promptly.

8 Practical work

Many areas of study involve practical work, but it is often much more difficult to assess such work in its own right; assessing reports of practical work may only involve measuring the quality of the end-product of the practical work, and not the work itself. The following discussion attempts to help you to think of ways of addressing the assessment of the practical work itself.

Advantages

- **Practical work is really important.** In many areas of physical sciences, practical skills are just as important as theoretical competences. Students proceeding to research or industry will be expected to have acquired a wide range of practical skills.
- **Employers may need to know how good students' practical skills are (and not just how good their reports are).** It is therefore useful to reserve part of our overall assessment for practical skills themselves, and not just the final written products of practical work.
- **Practical work is learning-by-doing.** Increasing the significance of practical work by attaching assessment to it helps students approach such work more earnestly and critically.

Disadvantages

- **It is often difficult to assess practical work in its own right.** It is usually much easier to assess the end-point of practical work, rather than the processes and skills involved in their own right.
- **It can be difficult to agree on assessment criteria for practical skills.** There may be several ways of performing a task well, requiring a range of alternative assessment criteria.
- **Students may be inhibited when someone is observing their performance.** When doing laboratory work, for example, it can be very distracting to be watched!

Questions and tips for assessing practical work

It is important to address a number of questions about the nature and context of practical work, the answers to which help to clarify how best to got about assessing such work. First the questions, then some tips.

- **What exactly are the practical skills we wish to assess?** These may include a vast range of important skills, from deftness in assembling complex glassware in a chemistry laboratory to precision and speed in using a scalpel on the operating table. It is important that students know the relative importance of each skill.
- **Why do we need to measure practical skills?** The credibility of our courses often depends on what students can do when they enter employment. It is often said by employers that students are very knowledgeable, but not necessarily competent in practical tasks.
- **Where is the best place to try to measure these skills?** Sometimes practical skills can be measured in places such as laboratories or workshops. For other skills, students may need to be working in real-life situations.
- **When is the best time to measure practical skills?** When practical skills are vitally important, it is probably best to start measuring them very early on in a course, so that any students showing alarming problems with them can be appropriately advised or redirected.
- **Who is in the best position to measure practical skills?** For many practical skills, the only valid way of measuring them involved someone doing detailed observations while students demonstrate the skills involved. This can be very time-consuming if it has to be done by staff, and also can feel very threatening to students.
- **Is it necessary to establish minimum acceptable standards?** In many jobs, it is quite essential that everyone practising does so with a high level of skill (for example surgery!). In other situations, it is possible to agree on a reasonable level of skills, and for this to be safe enough (for example teaching!).
- **How much should practical skills count for?** Students often spend a considerable proportion of their time developing and practising practical skills. It is important to think clearly about what contribution to their overall assessment such skills should make, and to let students know this.
- **May student self-assessment of practical skills be worth using?** Getting students to assess their own practical skills can be one way round the impossible workloads that could be involved if staff were to do all the requisite observations. It is much quicker for staff to moderate student self-assessment of

such skills than to undertake the whole task of assessing them.

- **May student peer-assessment of practical skills be worth using?** Involving students in peer-assessment of practical skills can be much less threatening than using tutor assessment. The act of assessing a peer's practical skills is often very good for peer-assessors, in terms of improving similar skills of their own.
- **Is it necessary to have a practical examination?** In some subjects, some sort of end-point practical test may be deemed essential. Driving tests, for example, could not be wholly replaced by a written examination on the Highway Code.
- **Reserve some marks for the processes.** Help students to see that practical work is not just reaching a defined end point, but is about the processes and skills involved in doing so successfully.
- **Ask students to include in their reports "ways I would do the experiment better next time".** This encourages students to become more self-aware of how well (or otherwise) they are approaching practical tasks.
- **Include some 'supplementary questions'.** Make the questions that students can only answer when they have thought through their own practical work. For example, students can be briefed to compare their findings with a given published source, and comment on any differences in the procedures used in the published work from those used by the students.
- **Design the right end products.** Sometimes it is possible to design final outcomes that can only be reached when the practical work itself is of high quality. For example, in chemistry, the skills demonstrated in the preparation and refinement of a compound can often be reflected in the purity and amount of the final product.

9 Portfolios

Building up portfolios of evidence of achievement is becoming much more common, following on from the use of Records of Achievement at school. Typically, portfolios are compilations of evidence of students' achievements, including major pieces of their work, feedback comments from tutors, and reflective analyses by the students themselves. It seems probable that in due course, degree classifications will no longer be regarded as sufficient evidence of students' knowledge, skills and competences, and that profiles will be used increasingly to augment the indicators of students achievements, with portfolios to provide in-depth evidence. With physical sciences, some of the assessment formats we have already addressed make useful components of portfolios of evidence, particularly good examples of practical reports. Probably the most effective way of leading students to generate portfolios is to build them in as an assessed part of a course. Here, the intention is to alert you to some of the more general features to take into account when assessing student portfolios.

Advantages

- **Portfolios tell much more about students than exam results.** They can contain evidence reflecting a wide range of skills and attributes, and can reflect students' work at its best, rather than just a cross-section on a particular occasion.
- **Portfolios can reflect development.** Most other forms of assessment are more like 'snapshots' of particular levels of development, but portfolios can illustrate progression. This information reflects how fast students can learn from feedback, and is especially relevant to employers of graduates straight from university.
- **Portfolios can reflect attitudes and values as well as skills and knowledge.** This too makes them particularly useful to employers, looking for the 'right kind' of applicants for jobs.

Disadvantages

- **Portfolios take a lot of looking at!** It can take a long time to assess a set of portfolios. The same difficulty extends beyond assessment; even though portfolios may contain material of considerable interest and value to prospective employers, it is still much easier to draw up interview shortlists based on paper qualifications and grades. However, there is increasing recognition that it is not cost-effective to skimp on time spent selecting the best candidate for a post. This is as true for the selection of physical sciences lecturers as for the selection of students for jobs. Lecturers are increasingly expected to produce hard evidence of the quality of their teaching and research, as well as to demonstrate how they teach to those involved in their appointment.
- **Portfolios are much harder to mark objectively.** Because of the individual nature of portfolios, it is harder to decide on a set of assessment criteria that will be equally valid across a diverse set of portfolios. This problem can, however, be overcome by specifying most of the criteria for assessing portfolios in a relatively generic way, while still leaving room for topic-specific assessment.
- **The ownership of the evidence can sometimes be in doubt.** It may be necessary to couple the assessment of portfolios with some kind or oral assessment or interview, to authenticate the origin of the contents of portfolios, particularly when much of the evidence is genuinely based on the outcomes of collaborative work.

Tips on using and assessing portfolios

- **Specify or negotiate intended learning outcomes clearly.** Ensure that students have a shared understanding of the level expected of their work.
- **Propose a general format for the portfolio**. This helps students demonstrate their achievement of the learning outcomes in ways that are more easily assembled.
- **Specify or negotiate the nature of the evidence that students should collect.** This makes it easier to assess portfolios fairly, as well as more straightforward for students.
- **Specify or negotiate the range and extent of the evidence expected from students.** This helps students plan the balance of their work effectively, and helps them avoid spending too much time on one part of their portfolio while missing out important details on other parts.
- **Don't underestimate the time it takes to assess portfolios.** Also don't underestimate their weight and volume if you have a set of them to carry around with you!
- **Prepare a pro-forma to help you assess portfolios.** It is helpful to be able to tick off the

achievement of each learning outcome, and make decisions about the quality of the evidence as you work through a portfolio.

- **Use post-its to identify parts of the portfolio you may want to return to.** This can save a lot of looking backwards and forwards through a portfolio in search of something you know you've seen in it somewhere!
- **Consider using post-its to draft your feedback comments.** You can then compose elements of your feedback as you work through the portfolio, instead of having to try to carry it all forward in your mind till you've completed looking at the portfolio.
- **Put a limit on the physical size of the portfolio.** A single box file is ample for most purposes, or a specified size of ring binder can provide guidance for the overall size.
- **Give guidance on audio or video elements.** Where students are to include video or audiotapes, it is worth limiting the duration of the elements they can include. Insist that they wind the tapes to the point at which they want you to start viewing or listening, otherwise you can spend ages trying to find the bit that they intend you to assess.
- **Provide interim assessment opportunities.** Give candidates the opportunity to receive advice on whether the evidence they are assembling is appropriate.
- **Quality not quantity counts.** Students should be advised not so submit every piece of paper they have collected over the learning period; otherwise the volume of material can be immense.
- **Get students to provide route-maps.** Portfolios are easier to assess if the material is carefully structured, and accompanied by a reflective account which not only outlines the contents but also asserts which of the criteria each piece of evidence contributes towards.
- **Get students to provide a structure.** Portfolio elements should be clearly labelled and numbered for easy reference. If loose-leaf folders are used, dividers should be labelled to enable easy access to material. All supplementary material such as audiotapes, videos, drawings, computer programs, tables, graphs, and so on should be appropriately marked and cross-referenced.
- **Be clear about what you are assessing.** While detailed mark schemes are not really appropriate for portfolios, it is still necessary to have clear and explicit criteria, both for the students' use and to guide assessment.
- **Structure your feedback.** Students may well have spent many hours assembling portfolios and may have a great deal of personal investment in them. To give their work number marks only (or pass/fail) may seem small reward. Consider using an assessment proforma so that your notes and comments can be directly relayed to the students, particularly in cases where required elements are incomplete or missing.
- **Encourage creativity.** For some students, this may be the first time they have been given an opportunity to present their strengths in a different way. Hold a brainstorming session about the possible contents of portfolios, for example, which may include videos, recorded interviews, newspaper articles, and so on.
- **Provide opportunities for self-assessment.** Having completed their portfolios, a valuable learning experience in itself is to let the students assess them. A short exercise is to ask them: "In the light of your experience of producing a portfolio, what do you consider you did especially well, and what would you now do differently?".
- **Assess in a team.** If possible, set aside a day as a team. Write your comments about each portfolio, and then pass them round for others to add to. In this way, students get feedback that is more comprehensive, and assessors get to see a more diverse range of portfolios.
- **Set up an exhibition.** Portfolios take a long time to complete and assess. By displaying them (with students' permission) their valuable experience can be shared.
- **Think about where and when you will mark portfolios.** They are not nearly as portable as scripts, and you may need equipment such as video or audio playback facilities to review evidence. It may be helpful therefore to set aside time when you can book a quiet, well-equipped room where you are able to spread out materials and look at a number of portfolios together. This will help you get an overview, and makes it easier to get a feel for standards.

10 Presentations

Giving presentations to an audience requires substantially different skills from writing answers to exam questions. Also, it can be argued that the communications skills involved in giving good presentations are much more relevant to professional competences needed in the world of work. It is particularly useful to develop physical sciences students' presentations skills if they are likely to go on to research, so that they can give effective presentations at conferences. It is therefore increasingly common to have assessed presentations as part of students' overall assessment diet.

Advantages

- **There is no doubt whose performance is being assessed.** When students give individual presentations, the credit they earn can be duly given to them with confidence.
- **Students take presentations quite seriously.** The fact that they are preparing for a public performance usually ensures that their research and preparation are addressed well, and therefore they are likely to engage in deep learning about the topic concerned.
- **Presentations can also be done as collaborative work.** When it is less important to award to students individual credit for presentations, the benefits of students working together as teams, preparing and giving presentations, can be realised.
- **Where presentations are followed by question-and-answer sessions, students can develop some of the skills they may need in oral examinations or interviews.** Perhaps the most significant advantage of developing these skills in this way is that students can learn a great deal from watching each other's performances.

Disadvantages

- **With large classes, a round of presentations takes a long time.** This can be countered by splitting the large class into groups of (say) 20 students, and facilitating peer-assessment of the presentations within each group on the basis of a set of assessment criteria agreed and weighted by the whole class.
- **Some students find giving presentations very traumatic!** However, it can be argued that the same is true of most forms of assessment, not least traditional exams.
- **The evidence is transient.** Should an appeal be made, unless the presentations have all been recorded, there may be limited evidence available to reconsider the merit of a particular presentation.
- **Presentations cannot be anonymous.** It can prove difficult to eliminate subjective bias.

Tips on using assessed presentations

- **Be clear about the purposes of student presentations.** For example the main purpose could be to develop students' skills at giving presentations, or it could be to cause them to do research and reading and improve their subject knowledge. Usually, several such factors may be involved together.
- **Make the criteria for assessment of presentations clear from the outset.** Students will not then be working in a vacuum and will know what is expected of them.
- **Get students involved in the assessment criteria.** This can be done either by allowing them to negotiate the criteria themselves or by giving them plenty of opportunities to interrogate criteria you share with them.
- **Ensure that students understand the weighting of the criteria.** Help them to know whether the most important aspects of their presentations are to do with they <u>way</u> they deliver their contributions (voice, clarity of expression, articulation, body language, use of audio-visual aids, and so on) or the <u>content</u> of their presentations (evidence of research, originality of ideas, effectiveness of argument, ability to answer questions, and so on).
- **Give students some prior practice at assessing presentations.** It is useful, for example, to give students a dry run at applying the assessment criteria they have devised, to one or two presentations on video. The discussion that this produces usually helps to clarify or improve the assessment criteria.
- **Let the students have a mark-free rehearsal.** This gives students the chance to become more confident and to make some of the more basic mistakes at a point where it doesn't count against them. Constructive feedback is crucial at this point so that students can learn from the experience.

- **Involve students in the assessment of their presentations.** When given the chance to assess each other's presentations they take them more seriously and will learn from the experience. Students merely watching each other's presentations tend to get bored and can switch off mentally. If they are evaluating each presentation using an agreed set of criteria, they tend to engage themselves more fully with the process, and in doing so learn more from the content of each presentation.
- **Ensure that the assessment criteria span presentation processes and the content of the presentations sensibly.** It can be worth reserving some marks for students' abilities to handle questions after their presentations.
- **Make up grids using the criteria that have been agreed.** Allocate each criterion a weighting, and get the entire group to fill in the grids for each presentation. The average peer-assessment mark is likely to be at least as good an estimate of the relative worth of each presentation as would be the view of a single tutor doing the assessment.
- **Be realistic about what can be achieved.** It is not possible to get twelve 5-minute presentations into an hour, and presentations always tend to over-run. It is also difficult to get students to concentrate for more than an hour or two of others' presentations. Where classes are large, consider breaking the audience into groups, for example dividing a class of 100 into four groups, with students presenting concurrently in different rooms, or at different timetabled slots.
- **Think about the venue.** Students do not always give of their best in large, echoing tiered lecture theatres (nor do we!). A more-intimate flat classroom is less threatening particularly for inexperienced presenters.
- **Consider assessing using videotapes.** This can allow the presenters themselves the opportunity to review their performances, and can allow you to assess presentations at a time most suitable to you. Viewing a selection of recorded presentations from earlier rounds can be useful for establishing assessment criteria with students. This sort of evidence of teaching and learning is also useful to show external examiners and quality reviewers.
- **Start small.** Mini-presentations of a few minutes can be almost as valuable as 20-minute presentations for learning the ropes, especially as introductions to the task of standing up and addressing the peer-group.
- **Check what other presentations students may be doing.** Sometimes it can seem that everyone is including presentations in their courses. If students find themselves giving three or four within a month or two, it can be very demanding on their time, and repetitious regarding the processes.

11. Vivas

Viva-voce exams have long been used to add to or consolidate the results of other forms of assessment. They normally take the form of interviews or oral examinations, where students are interrogated about selected parts of work they have had assessed in other ways. Such exams are often used to make decisions about the classification of degree candidates whose work straddles borderlines.

Advantages

- **Vivas are useful checks on the ownership of evidence.** It is relatively easy to use a viva to ensure that students are familiar with things that other forms of assessment seem to indicate they have learned well.
- **Vivas seem useful when searching for particular things.** For example, vivas have long been used to help make decisions about borderline cases in degree classifications, particularly when the written work or exam performance has for some reason fallen below what may have been expected for particular candidates.
- **Candidates may be examined fairly.** With a well-constructed agenda for a viva, a series of candidates may be asked the same questions, and their responses compared and evaluated.
- **Vivas give useful practice for interviews for employment.** Sadly, for most vivas, what is at stake is more serious than a possible appointment, so it is worth considering using vivas more widely but less formally to allow students to develop the appropriate skills without too much depending on their performance.

Disadvantages

- **Some candidates never show themselves well in vivas.** Cultural and individual differences can result in some candidates underperforming when asked questions by experts and figures of authority.
- **The agenda may 'leak'.** When the same series of questions is being posed to a succession of students, it is quite difficult to ensure that candidates who have already been examined aren't able to commune with friends whose turn is still to come.
- **The actual agenda covered by a viva is usually narrow.** Vivas are seldom good as measures of how well students have learned and understood large parts of the syllabus.
- **Vivas cannot be anonymous!** Lecturers assessing viva performance can be influenced by what they already know about the students' work. However, it is possible to use lecturers who don't know the students at all, or to include such lecturers in a viva panel.

Tips on using vivas

- **Remind yourself what the viva is for.** Purposes vary, but it is important to be clear about it at the outset. For example, the agenda could include one or more of the following: confirming that the candidates did indeed do the work represented in their dissertations, or probing whether a poor examination result was an uncharacteristic slip, or proving whether students' understanding of the subject reached acceptable levels.
- **Prepare your students for vivas.** Explain to them what a viva is, and what they will normally be expected to do. It helps to give them opportunities to practise. Much of this they can do on their own, but they will need you to start them off on the right lines, and to check now and then that their practice sessions are realistic.
- **Think about the room layout.** Sitting the candidate on a hard seat while you and your fellow-assessors sit face-on behind a large table is guaranteed to make the candidate tremble! If possible, sit beside or close to the candidate. Where appropriate provide students with a table on which to put any papers they may have with them.
- **Think about the waiting room.** If candidates are queuing together for long, they can make each other even more nervous. If you're asking the same questions of a series of students (in some situations you may be required to do this for fairness), the word can get around about what you're asking.
- **Prepare yourself for vivas!** Normally, if you're a principal player at a viva, you will have read the student's work in detail. It helps if you come to the viva with a list of questions you may ask. You don't have to ask all of them, but it helps to have some ready! Normally, you may need to have a pre-viva discussion with the examining panel, and you need to be seen to have done your homework.

- **Prepare the agenda in advance, and with colleagues.** It is dangerously easy (and unfair to students) for the agenda to develop during a series of interviews with different students. Prepare and use a checklist of pro-forma to keep records. Memory is not sufficient, and can be unreliable, especially when different examiners conducting a viva have different agendas.
- **Do your best to put the candidate at ease.** Students find vivas very stressful, and it improves their confidence and fluency if they are greeted cheerily and made welcome at the start of a viva.
- **When vivas are a formality, indicate this.** When students have done well on the written side of their work, and it's fairly certain that they should pass, it helps to give a strong hint about this straightaway. It puts students at ease, and makes for a more interesting and relaxed viva.
- **Ensure there are no surprises.** Share the agenda with each candidate, and clarify the processes to be used. You are likely to get more out of candidates this way.
- **Ask open questions which enable students to give full and articulate answers.** Try to avoid questions that lead to minimal or 'yes/no' replies.
- **Let students do most of the talking.** The role of an examiner in a viva is to provoke thought and prompt candidates into speaking fluently about the work or topics under discussion, and to spark off an intellectual dialogue. It is not to harangue, carp or demonstrate the examiner's intelligence, or to trick candidates!
- **Prepare to be able to debrief well.** Write your own notes during each viva. If you are dealing with a series of such events, it can become difficult to remember each feedback point that you want to give to each student. Vivas can be very useful learning experiences, but much of the experience can be lost if time is not set aside for debriefing. Such a process is particularly useful when students will encounter vivas again.
- **When debriefing, ask students for their opinions first.** This can spare them the embarrassment of having you telling them about failings they already know they have. You may also find useful food for thought when students tell you about aspects of the vivas that you were unaware of yourself.
- **Be sensitive.** Vivas can be traumatic for students, and they may have put much time and effort into preparing for them. Choose words carefully particularly when giving feedback on aspects that were unsuccessful.
- **Be specific.** Students will naturally want to have feedback on details of things they did particularly well. As far as you can, make sure you can find something positive to say even when overall performance was not good.
- **Consider recording practice vivas on video.** This is particularly worthwhile when one of your main aims is to prepare students for more important vivas to follow. Simply allowing students to borrow the recordings and look at them in the comfort of privacy can provide students with useful deep reflection on their performance. It is sometimes more comfortable to view the recordings in the atmosphere of a supportive student group.
- **Run a role-play afterwards.** Ask students to play both examiners and candidates, and bring to life some of the issues they encountered in their vivas. This can allow other students observing the role-play to think about aspects they did not experience themselves.
- **Plan for the next step.** Get students to discuss strategies for preparing for their next viva, and ask groups of students to make lists of 'do's and don'ts' to bear in mind next time.
- **Get students to produce a guidance booklet about preparing for vivas and taking part in them.** This may be useful for future students, but is equally valuable to the students making it as a way of getting them to consolidate their reflections on their own experience.

12 Student projects

In many courses, one of the most important kinds of work undertaken by physical science students takes the form of individual projects, often relating theory to practice beyond the college environment. Such projects are usually an important element in the overall work of each student, and are individual in nature.

Advantages

- **Project work gives students the opportunity to develop their strategies for tackling research questions and scenarios.** Students' project work often counts significantly in their final-year degree performance, and research opportunities for the most successful students may depend primarily on the skills they demonstrated through project work.
- **Projects can be integrative.** They can help students to link theories to practice, and to bring together different topics (and even different disciplines) into a combined frame of reference.
- **Project work can help assessors to identify the best students.** Because project work necessarily involves a significant degree of student autonomy, it does not favour those students who just happen to be good at tackling traditional assessment formats.

Disadvantages

- **Project work takes a lot of marking!** Each project is different, and needs to be assessed carefully. It is not possible for assessors to 'learn the scheme, and steam ahead' when marking a pile of student projects.
- **Projects are necessarily different.** This means that some will be 'easier', some will be tough, and it becomes difficult to decide how to balance the assessment dividend between students who tackled something straightforward and did it well, as opposed to students who tried something really difficult, and got bogged down in it.
- **Projects are relatively final.** They are usually one-off elements of assessment. When students fail to complete a project, or fail to get a difficult one started at all, it is rarely feasible to set them a replacement one.

Tips on designing student projects

Setting, supporting, and assessing such work can be a significant part of the work of a lecturer, and the following suggestions should help to make these tasks more manageable.

- **Choose the learning-by-doing to be relevant and worthwhile.** Student projects are often the most significant and extended parts of their courses, and it is important that the considerable amount of time they may spend on them is useful to them and relevant to the overall learning outcomes of the courses or modules with which the projects are associated.
- **Work out specific learning outcomes for the projects.** These will be of an individual nature for each project, as well as including general ones relating to the course area in which the project is located.
- **Formulate projects so that they address appropriately higher-level skills.** The aims of project work are often to bring together threads from different course areas or disciplines, and to allow students to demonstrate the integration of their learning.
- **Give students as much opportunity as possible to select their own projects.** When students have a strong sense of ownership of the topics of their projects, they put much more effort into their work, and are more likely to be successful.
- **Include scope for negotiation and adjustment of learning outcomes.** Project work is necessarily more like research than other parts of students' learning. Students need to be able to adjust the range of a project to follow through interesting or important aspects that they discover along the way. Remember that it is still important to set standards, and the scope for negotiation may sometimes be restricted to ways that students will go about accumulating evidence to match set criteria.
- **Make the project briefings clear, and ensure that they will provide a solid foundation for later assessment.** Criteria should be clear and well understood by students at the start of their work on projects.
- **Keep the scope of project work realistic.** Remember that students will usually have other kinds of work competing for their time and attention, and it is tragic when students succeed with project work,

only to fail other parts of their courses to which they should have devoted more time alongside their projects.

- **Liase with library and information services colleagues.** When a number of projects make demands on the availability of particular learning resources or information technology facilities, it is important to arrange this in advance with such colleagues, so that they can be ready to ensure that students are able to gain access to the resources they will need.
- **Ensure that a sensible range of factors will be assessed.** Assessment needs to relate to work that encompasses the whole of the project, and not be unduly skewed towards such skills as writing-up or oral presentation. These are likely to be assessed in any case in other parts of students' work.
- **Collect a library of past projects.** This can be of great help to students starting out on their own projects, and can give them a realistic idea of the scope of the work likely to be involved, as well as ideas on ways to present their work well.
- **Arrange staged deadlines for projects.** It is very useful for students to be able to receive feedback on plans for their project work, so that they can be steered away from going off on tangents, or from spending too much time on particular aspects of a project.
- **Allow sufficient time for project work.** The outcomes of project work may well include that students develop time-management and task-management skills along the way, but they need time and support to do this. Arrange contact windows so that students with problems are not left too long without help.
- **Consider making projects portfolio-based.** Portfolios often represent the most flexible and realistic way of assessing project work, and allow appendices containing a variety of evidence to be presented along with the more important parts showing students' analysis, thinking, argument and conclusions.
- **Encourage students to give each other feedback on their project work.** This can be extended to elements of peer-assessment, but it is more important simply to get students talking to each other about their work in progress. Such feedback can help students sort out many of the problems they encounter during project work, and can improve the overall standard of their work.
- **Think about the spaces and places which students will use to do their project work.** Some of the work may well occur off-campus, but it remains important that students have access to suitable places to write-up and prepare their project work for assessment, as well as facilities and support to help them analyse the data and materials they accumulate.
- **Include a self-evaluation component in each project.** This allows students to reflect on their project work, and think deeper about what went well and where there may have been problems. It can be particularly useful to students to get feedback about the quality of their self-evaluation.

13 Poster-displays and exhibitions

When students are asked to synthesise the outcomes of their learning and/or research into a self-explanatory poster, (individually or in groups), which can be assessed on the spot, it can be an extremely valuable process. More and more conferences are providing poster-display opportunities as an effective way of disseminating findings and ideas. This kind of assessment can provide practise in developing the skills relevant to communicating by such visual means.

Advantages

- **Poster-displays and exhibitions can be a positive step towards diversifying assessment.** Some students are much more at home producing something visual, or something tangible, than at meeting the requirements of traditional assessment formats such as exams, essays, or reports.
- **Poster-displays and exhibitions can provide opportunities for students to engage in peer-assessment.** The act of participating in the assessment process deepens students' learning, and can add variety to their educational experience.
- **Such assessment formats can help students to develop a wide range of useful, transferable skills.** This can pave the way towards the effective communication of research findings, as well as developing communication skills in directions complementary to those involving the written (or printed) word.

Disadvantages

- **However valid the assessment may be, it can be more difficult to make the assessment of posters or exhibitions demonstrably reliable.** It is harder to formulate 'sharp' assessment criteria for diverse assessment artefacts, and a degree of subjectivity may necessarily creep into their assessment.
- **It is harder to bring the normal quality assurance procedures into assessment of this kind.** For example, it can be difficult to bring in external examiners, or to preserve the artefacts upon which assessment decisions have been made so that assessment can be revisited if necessary (for example for candidates who end up on degree classification borderlines).
- **It can take more effort to link assessment of this sort to stated intended learning outcomes.** This is not least because poster-displays and exhibitions are likely to be addressing a range of learning outcomes simultaneously, some of which are subject-based, but others of which will address the development of key transferable skills.

Tips on planning assessed poster-displays and exhibitions

- **Use the assessment process as a showcase.** Students are often rather proud of their achievements and it can be invaluable to invite others in to see what has been achieved. Think about inviting moderators, senior staff, students on parallel course, and employers. Gather their impressions, either using a short questionnaire, or verbally asking them a couple of relevant questions about their experiences of seeing the display.
- **Use posters as a way to help other students to learn.** For example, final year students can produce posters showing the learning they gained during placements. This can be a useful opportunity for students preparing to find their own placements to adjust their approaches and base them on others' experiences.
- **Get students to peer-assess each other's posters.** Having undertaken the task of making posters themselves, they will be well prepared to review critically the work of others. This also provides chances for them to learn from the research undertaken by the whole cohort rather than just from their own work.
- **Consider asking students to produce a one-page handout to supplement their poster.** This will test a further set of skills, and will provide all reviewers with an aide memoire for subsequent use.
- **Give sufficient time for debrief.** Lots of learning takes place in the discussion during and after the display. The tendency is to put poster-display and exhibition sessions on during the last week of the term or semester, and this can give little time to unpack the ideas at the end.
- **Make careful practical arrangements.** Large numbers of posters take up a lot of display space, and to get the best effect they should be displayed on boards. Organising this is possible in most universities, for example by borrowing publicity display boards, but it needs to be planned in advance.

Allow sufficient time for students to mount their displays, and make available drawing pins, Blu-Tack, tape, Velcro sticky pads, demountable display equipment, and so on.

- **Stagger the assessment.** Where peers are assessing each other's posters, to avoid collusion, 'fixing', and outbursts of spite, it is valuable to arrange the presentation so that half the display is in one room and the rest in another, or to run successive displays at different times. Number the posters and get one half of the group to assess the odd-numbered posters and the other half to assess the even-numbered ones, and average the data that is produced.
- **Consider getting groups to produce a poster between them.** This encourages collaborative working and can reduce the overall numbers of posters – useful when student numbers are large. You could then consider getting students within the group to peer-assess (intra) their respective contributions to the group as well as to assess collaboratively the posters of the other groups (inter-peer-group assessment).
- **Link assessment of poster displays to open days.** Students coming to visit the institution when they are considering applying for courses may well get a good idea about what students actually do on the courses, from looking at posters on display.
- **Prepare a suitable assessment sheet.** Base this firmly on the assessment criteria for the exercise. Provide space for peers' comments. This paves the way towards plenty of opportunity for peer feedback.
- **Use assistance.** When working with large numbers of peer-assessed posters, you may need help in working out the averaged scores. Either get the students to do the number work for themselves or for each other (and advise them that the numbers will be randomly checked to ensure fair play). Alternatively, press-gang colleagues, partners, administrators, or progeny to help with the task.
- **Provide a rehearsal opportunity.** Let the students have a practice run at a relatively early stage, using a mock-up or a draft on flipchart paper. Give them feedback on these drafts, and let them compare their ideas. This can help them to avoid the most obvious disasters later.
- **Let everyone know why they are using poster-displays.** This method of assessment may be unfamiliar to students, and to your colleagues. It is therefore valuable if you can provide a clear justification of the educational merits of the method to all concerned.
- **Brief students really carefully about what is needed.** Ideally, let them see a whole range of posters from previous years (or some mock-ups, or photographs of previous displays) so that they have a good idea about the requirements, without having their originality and creativity suppressed.
- **Use the briefing to discuss criteria and weighting.** Students will need to know what level of effort they should put into different elements such as presentation, information content, structure, visual features, and so on. If students are not clear about this, you may well end up with brilliantly presented posters with little relevance to the topic, or really dull, dense posters that try to compress the text of a long report onto a single A1 sheet.
- **Give students some practical guidelines.** Let them know how many A1 sheets they can have, where their work will be displayed, what size of font the text should be to be readable on a poster, what resources will be available to them in college, and how much help they can get from outsiders such as friends on other courses who take good photographs or who have the knack of writing in attractive script.
- **Attach a budget to the task.** In poster displays, money shows! If you were to give a totally free hand to students, the ones with best access to photocopiers, photographic resources, expensive papers, word processors and so on may well produce better looking products than students who have little money to spend on their posters or displays (although it does not always turn out this way). Giving a notional budget can help to even out the playing field, as can requiring students to only use items from a given list, with materials perhaps limited to those provided in workshops in the college.
- **Keep records of poster-displays and exhibitions.** Take photographs, or make a short video. It is not possible to retain complete displays and exhibitions, but a handy reminder can be very useful for use when planning the next similar event. Evidence of the displays can also be interesting to external examiners and quality reviewers.
- **Get someone (or a group) to provide a 'guide booklet' to the exhibition.** This helps the students undertaking this task to make relative appraisals of the different items or collections making up the exhibition as a whole.
- **Consider turning it into a celebration as well.** After the assessment has taken place, it can be pleasurable to provide some refreshments, and make the display or exhibition part of an end-of-term or end-of-course celebration.

14 Dissertations and theses

Physical sciences students invest a great deal of time and energy in producing dissertations and theses, usually in their final year. Sometimes these arise from the results of their project work. We therefore owe it to them to mark them fairly and appropriately.

Advantages

- **Dissertations and theses are individual in nature.** There are reduced possibilities regarding plagiarism and cheating, and a greater confidence that we are assessing the work of individual students.
- **There is usually double or multiple marking.** Because dissertations and theses are important assessment artefacts, more care is taken to ensure that the assessment is as objective as possible.
- **There is usually further triangulation.** External examiners are often asked to oversee the assessment of at least a cross section of dissertations or theses, and sometimes see all of them. The fact that such triangulation exists is a further pressure towards making the assessment reliable and valid in the first instance.

Disadvantages

- **Assessment takes a long time.** Even more so than with student projects, dissertations or theses are so individual that it is not possible for assessors to 'get into their stride' and forge ahead marking large numbers of these in a given period of time.
- **Assessment can involve subjectivity.** For example, it is less possible to achieve 'anonymous' marking with large-scale artefacts such as these, as the first assessor at least is likely to have been supervising or advising the candidate along the route towards assessment.
- **Assessment can be over-dominated by matters of style and structure.** While both of these are important and deserve to contribute toward assessment of dissertations or theses, there is abundant evidence that a well-structured, fluent piece of work where the actual content is quite modest attracts higher ratings than a less-well structured, somewhat 'jerky' piece of work where the content has a higher quality.

Tips on assessing dissertations and theses

- **Make sure that the assessment criteria are explicit, clear, and understood by the students.** This may seem obvious! However, theses and dissertations are normally very different in the topics and themes they address, and the assessment criteria need to accommodate such differences. Students will naturally compare marks and feedback comments. The availability of clear criteria helps them see that their work has been assessed fairly.
- **Get students to assess a few past dissertations.** You can't expect them to do this at the same level as may be appropriate for 'real' assessment, but you can (for example) issue students with a one-sided proforma questionnaire to complete as they study examples of dissertations. Include questions about the power of the introduction, the quality and consistency of referencing, and the coherence of the conclusions.
- **Offer guidance and support to students throughout the process.** Dissertations usually take students quite some time to complete. Students appreciate and need some help along the route. It is worth holding tutorials both individually and with groups. This takes good planning, and dates need to be set well in advance, and published on a notice board or handout to students.
- **Ensure that student support mechanisms are available.** With large class sizes, we cannot afford to spend many hours of staff time with individual students. However, much valuable support can be drawn from the students themselves, if we facilitate ways of them helping each other. Consider introducing supplemental instruction processes, or setting up friendly yet critical student syndicates. Running a half-day workshop with students counselling each other can be valuable.
- **Beware of the possibility of bias.** Sometimes dissertations involve students writing on topics with a sensitive cultural or political nature. We need to be aware of any prejudices of our own, and to compensate for any bias these could cause in our assessment. Whenever possible, dissertations should be second-marked (at least!).
- **Can you provide students with equal opportunity regarding selecting their dissertation themes?** Research for some dissertations will involve students in visiting outside agencies, finding materials for

experiments, building models and so on. With resource limitations becoming more severe, students may be forced to avoid certain topics altogether. Try to suggest topics where financial implications are manageable to students.

- **Check whether dissertations always have to be bound.** This may depend on which year of the course they are set in. It may be worth reserving binding for final year dissertations, to help save students money.
- **Help students to monitor their own progress.** It helps to map the assessment criteria in a way that helps students to keep track of their own progress and achievements. Computer programs are now available which help students work out how they are getting on, and prompt them to the next steps they should be considering at each stage.
- **When assessing dissertations, collect a list of questions to select from at a forthcoming viva.** Even of there is not going to be a viva, such lists of questions can be a useful addition to the feedback you return to students.
- **Use post-its while assessing dissertations and theses.** These can be placed towards the edges of pages, so that notes and questions written on the post-its can be found easily again. They help you avoid having to write directly on the pages of the dissertation or thesis (especially when your questions are found to be addressed two pages later!).

Feedback and assessment

Quality of feedback

If "assessment is the engine that drives learning" (John Cowan), then the ways in which we give feedback are important in gearing the engine so that maximum effect is achieved from the effort put in by all concerned. This section of the 'Assessment' chapter explores a variety of ways in which feedback can be given to students, and includes many suggestions for optimising the usefulness of such feedback.

- **Feedback should be targeted to enhance learning.** Feedback should concentrate on what to do to improve. This is better than when feedback is heavily judgmental.
- **Feedback should be timely.** When marked work is returned to students weeks (or even months) after submission, feedback is often totally ignored because it bears little relevance to students' current needs then. Many institutions nowadays specify in their Student Charters that work should be returned within two to three weeks, enabling students to derive greater benefits from feedback. When feedback is received very quickly, it is much more effective, as students can still remember exactly what they were thinking as they addressed each task.
- **Think about how students will feel when they get marked work back.** Students can be in states of heightened emotion at such points. If their scripts are covered with comments in red ink (even when it is all praise) it is rather intimidating for them at first.
- **Try to do more than put ticks.** Tempting as it is to put ticks beside things that are correct or good, ticks don't give much real feedback. It takes a little longer to add short phrases such as 'good point', 'I agree with this', 'yes, this is it', 'spot on', and so on, but such feedback comments do much more to motivate students than just ticks.
- **Avoid putting crosses if possible.** Students often have negative feelings about crosses on their work, carried forward from schooldays. Short phrases such as 'no', 'not quite', 'but this wouldn't work', and so on can be much better ways of alerting students to things that are wrong.
- **Try to make your writing legible.** If there is not going to be room to make a detailed comment directly on the script, put code numbers or asterisks, and write your feedback on a separate sheet. A useful compromise is to put feedback comments on post-its stuck to appropriate parts of a script, but it's worth still using a code, asterisk or some such device so that if students remove the post-its as they read through their work, they can still work out exactly which points your comments apply to.
- **Try giving some feedback before you start assessing.** For example, when a class hands in a piece of work, you can issue at once handouts of model answers and discussions of the main things that may have caused problems. Students can read such information while their own efforts are still fresh in their minds, and can derive a great deal of feedback straightaway. You can then concentrate, while assessing, on giving them additional feedback individually, without going into detail on things that you have already addressed in your general discussion comments you have already given them.
- **Don't forget to give positive feedback.** It is sometimes difficult to find something good to say about a piece of work! Ideally, however, you should start by commenting on a positive aspect before leading into a critique.
- **Feedback should be efficient.** It has often been found that the time taken over assessment on many courses was much greater than the time devoted to teaching and learning. Assessment systems should be devised to maximise the amount of feedback given to students within the time available. Such methods include the use of assignment return sheets, statement banks, and computer marked assignments.
- **Give feedback to groups of students sometimes.** This helps students become aware that they are not alone in making mistakes, and allows them to learn from the successes and failures of others.
- **Let students argue.** When giving one-to-one feedback, it is often useful to allow students the opportunity to interrogate you and challenge your comments (orally or in writing) so that any issues that are unclear can be resolved.
- **Feedback should be realistic.** When making suggestions for improvement of student work, consider carefully whether they can be achieved. It may not have been possible (for example) for students to gain access to certain resources or books in the time available.
- **Feedback should be fair.** Check that you are not giving feedback on the amount of money that was spent on the work you mark, for example when some students can submit work produced by expensive desktop publishing systems, while other students have no access to such facilities.
- **Feedback should be motivating.** Think carefully about the language you use, so that students are encouraged into doing better next time. Using 'final' language such as 'excellent' may be rewarding to hear, but offers no indication to the best students on how they may stretch themselves even further.

- **Feedback should be honest.** When there are serious problems which students need to be made aware of, feedback comments should not skirt round these or avoid them. It may be best to arrange for individual face-to-face feedback sessions wish some students, so you can give any bad news in ways where you can monitor how they are taking it, and provide appropriate comfort at the same time.
- **Feedback can be given before scores or grades.** Consider whether sometimes it may be worth returning students' work to them with feedback comments but no grades (but having written down your marks in your own records). Then invite students to try to work out what their scores or grade should be, and to report to you in a week's time what they think. This causes students to read all your feedback comments earnestly in their bid to work out how they have done. Most students will make good guesses regarding their grades, and it's worth finding out which students are way out too.
- **Think about audiotapes for giving feedback.** In some subjects, it is quite hard to write explanatory comments on students' work. For example, in mathematical problems, it can be quicker and easier to 'talk' individual students through how a problem should be solved, referring to asterisks or code-numbers marked on their work. Such feedback has the advantages of tone of voice for emphasis and explanation. Another advantage is that students can play it again, until they have fully understood all of your feedback.
- **Consider giving feedback by email.** Some students feel most relaxed when working at a computer terminal on their own. With email, students can receive your feedback when they are ready to think about it. They can read it again later, and even file it. Using email, you can give students feedback asynchronously as you work through their scripts, rather than having to wait till you return the whole set to a class.

Reducing your load: short cuts to good feedback

Keep records carefully…

Keeping good records of assessment takes time, but can saves time in the end. The following suggestions may help you organise your record keeping.

- **Be meticulous.** However tired you are at the end of a marking session, record all the marks immediately (or indeed continuously as you go along). Then put the marks in a different place to the scripts. Then should any disasters befall you (briefcase stolen, house burned down and so on) there is the chance that you will still have the marks even if you don't have the scripts any longer (or vice versa).
- **Be systematic.** Use class lists, when available, as the basis of your records. Otherwise make your own class lists as you go along. File all records of assessment in places where you can find them again. It is possible to spend as much time looking for missing marksheets as it took to do the original assessment!
- **Use technology to produce assessment records.** Keep marks on a grid on a computer, or use a spreadsheet, and save by date as a new file every time you add to it, so you are always confident that you are working with the most recent version. Keep paper copies of each list as an insurance against disaster! Keep backup copies of disks or sheets - simply photocopying a handwritten list of marks is a valuable precaution.
- **Use technology to save you from number crunching.** The use of computer spreadsheet programs can allow the machine to do all of the sub-totalling, averaging and data handling for you. If you are afraid to set up a system for yourself, a computer-loving colleague of a member of information systems support staff will be delighted to start you off.
- **Use other people.** Some universities employ administrative staff to issue and collect in work for assessment, and to make up assessment lists and input the data into computers. Partners, friends and even young children can help you check your addition of marks, and help you record the data.

Reduce your burden…

More and more lecturers are finding that the burden of assessment is becoming unmanageable. I offer a number of strategies below.

- **Reduce the number of your assignments.** Are all of them strictly necessary, and is it possible to combine some of them, and completely delete others?
- **Use shorter assignments.** Often we ask for 2000, 3000 or 5000 word assignments or reports, when a fraction of the length can be just as acceptable. Shorter reviews, articles, memorandum-reports or summaries could replace some essays or long reports. Projects can be assessed by poster displays

instead of reports, and exam papers can include some sections of multiple-choice questions particularly where optical mark scanners could mark these, or using computer managed assessment directly.

- **Use assignment return sheets.** These can be proformas that contain the assessment criteria for an assignment, with spaces for ticks/crosses, grades, marks and brief comments. They enable rapid feedback on 'routine' assessment matters, providing more time for individual comment to students when necessary on deeper aspects of their work.
- **Consider using statement banks.** These are a means whereby your frequently-repeated comments can be written once each then printed or emailed to students, or put onto transparencies or slides for discussion in a subsequent lecture.
- **Involve students in self or peer-assessment.** Start small, and explain what you are doing and why. Involving students in some of their assessment can provide them with very positive learning experiences.
- **Mark some exercises in class time using self-or peer marking.** This is sometimes useful when students have prepared work-expecting tutor-assessment, to the standard that they wish to be seen by you.
- **Don't count all assessments.** For example, give students the option that their best five out of eight assignments will count as their coursework mark. Students satisfied with their first five need not undertake the other three at all then.

And when you still find yourself overloaded…

No one wants to have to cope with huge piles of coursework scripts or exam papers. However, not all factors may be within your control, and you may still end up overloaded. The following wrinkles may be somewhat soothing at such times!

- **Put the great-unmarked pile under your desk.** It is very discouraging to be continually reminded of the magnitude of the overall task. Put only a handful of scripts or assignments in sight – about as many as you might expect to deal with in about an hour.
- **Set yourself progressive targets.** Plan to accomplish a bit more at each stage than you need to. Build in safety margins. This allows you some insurance against unforeseen disasters (and children), and can allow you to gradually earn some time off as a bonus.
- **Make an even-better marking scheme.** Often, it only becomes possible to make a really good marking scheme after you've found out the ways that candidates are actually answering the questions. Put the marking scheme where you can see it easily. It can be useful to paste it up with Blu-Tack above your desk or table, so you don't have to rummage through your papers looking for it every time you need it.
- **Mark in different places!** Mark at work, at home, and anywhere else that's not public. This means of course carrying scripts around as well as your marking scheme (or a copy of it). It does, however, avoid one place becoming so associated with doom and depression that you develop place-avoidance strategies for it!
- **Mark one question at a time through all the scripts, at first.** This allows you to become quickly skilled at marking that question, without the agenda of all the rest of the questions on your mind. It also helps ensure reliability and objectivity of marking. When you've completely mastered your marking scheme for all questions, start marking whole scripts.

Using computer-generated feedback

Human beings can get bored when giving the same feedback repeatedly to different students; computers don't have this problem! Computer-generated feedback is where you program the feedback messages you wish students to receive in anticipated circumstances, such as replying to options in multiple-choice questions.

- **Look for those occasions where you frequently need to give the same feedback message to different students.** Work out exactly what the gist of your feedback message is on such occasions, and consider whether it will be worthwhile packaging up this feedback so that students can get the same help from a computer instead of from you.
- **Listen to yourself giving live feedback to students after they have attempted a task.** It can be worth tape-recording some examples of the way you talk to fellow human beings. The little 'asides' that you slip in to make sure they understand you are very important, and it's worth incorporating such asides in the feedback you get the computer to give them.
- **Devise a task leading towards the planned feedback message.** Normally, the feedback will be reserved for those students who don't get the task right first time. Check out with live students that the

planned feedback is self-sufficient, and that they don't need any further explanation from you in person to get the task right next time.

- **Don't forget to provide feedback to students who get the task right first time.** It is just as important to give positive feedback for successful work as it is to give helpful feedback when students encounter problems. Remind them exactly what they got right, in case it was a lucky accident.
- **Let students who get things right know about some of the things that might have gone wrong.** Learning from mistakes is useful, and people who don't make any mistakes can miss out on some valuable learning. Students are often quite hooked on finding out more about what they might have done wrong, even when they got it all right, and will search for what the computer would have told them if they had got it wrong.
- **Be sympathetic to students who get it wrong.** When you programme feedback into a computer-based learning package, it is important that your students feel that the computer is treating them like human beings. Don't include blunt messages such as "Wrong!" or "Wrong yet again!". It is better to come across almost apologetically, with feedback messages starting perhaps as "Sorry, but this doesn't work out in practice…."
- **Remind students about what they get wrong.** It is important that mistakes can be linked firmly to the task that brought them about. The danger is that when your students read your feedback messages, as programmed into the computer system, they may have forgotten exactly what they were trying to do when things went wrong.
- **Try to devise feedback which explains why students may have got something wrong.** It isn't enough just to know what was wrong. Whenever you can, devise feedback messages about mistakes along the lines "For this to have happened, you may have been thinking that……., but in fact it's like this……".
- **Road test your feedback messages with small groups of students.** Ask them if they can think of any better ways of getting the feedback message across. Get them to put into words what they might have said to someone sitting next to them who attempted the same task, and got it wrong. If their words are better than your original ones, use theirs!
- **Explore the possibilities of using email for 'later' feedback.** When you know how well (or badly) students have tackled a computer-based exercise, you may be able to give them feedback through the system of networked computers. This means that only the students concerned see these particular feedback messages, and they have the comfort of privacy in which to read the feedback and think about it.

▪ ***Using e-mail and computer conferencing to give students feedback***

Computer communications are very fast and cheap, so they are very useful for providing feedback to students. E-mail is particularly useful as a vehicle for giving students individual feedback on assessed work, whether as stand-alone email communications to students, or alongside or within a computer conferencing system. Electronic feedback can apply to computer-mediated coursework (where the work is submitted through a computer system), but can also extend usefully to giving students feedback on hand-written or hard copy work that they have submitted for assessment. The following suggestions may help you to exploit the benefits of communications technology, not least to save your own time and energy in giving students feedback.

- **Encourage students to send you assessments or samples of work as email attachments.** If work is being produced on a computer, it is easy and quick to attach a saved file to an e-mail message. It will arrive very quickly and it is very cheap to send it.
- **Make the most of the comfort of privacy.** When students receive feedback by e-mail (as opposed to face-to-face or in group situations), they have the comfort of being able to read the feedback without anyone (particularly you!) being able to see their reactions to it. This is most useful when you need to give some critical feedback to students.
- **Remember that you can edit your own feedback before you send it.** For example, you may well want to adjust individual feedback comments in the light of students' overall performance. It is much harder to edit handwritten feedback on students' written work. E-mail feedback allows you to type in immediate feedback to things that you see in each student's work, and to adjust or delete particular parts of your feedback as you go further into marking their work.
- **Exploit the space.** Inserting handwritten feedback comments into students' written work is limited by the amount of space that there may be for your comments. With e-mail feedback, you don't have to restrict your wording if you need to elaborate on a point.
- **Acknowledge receipt of assessments.** Students will be worried that their work hasn't arrived safely, so tell them when it has arrived. An e-mail message is best for this because it is private.

- **Provide specific feedback to individuals by e-mail.** As this method of communication is private, it is suitable for giving comments on work to individuals. It is much easier to write this kind of communication by computer than by hand, so use the technology for the whole process.
- **Investigate word processing software to help with assessment of written work.** If work is produced by word processing, it is often possible to add comments to it. You can use this to provide comments on the work as part of the feedback process.
- **Consider combining e-mail feedback with written feedback.** For example, you can write onto students' work a series of numbers or letters, at the points where you wish to give detailed feedback. The e-mail feedback can then translate these numbers or letters into feedback comments or phrases, so that students can see exactly what each element of feedback is telling them. The fact that students then have to decode each feedback element helps them to think about it more deeply, and learn from it more effectively, than when they can see the feedback directly on their work.
- **Spare yourself from repeated typing.** When designing computer-delivered feedback messages, you should only have to type each message once. You can then copy and paste all of the messages where you need to give several students the same feedback information. It can be useful to combine this process with numbers or letters which you write onto students' work, and building up each e-mail to individual students by pasting together the feedback messages which go with each of the numbers or letters.
- **Consider the possibilities of 'global' feedback messages.** For example, you may wish to give all of the students in a large group the same feedback message about overall matters arising from a test or exercise. The overall message can be pasted into each e-mail, before the individual comments addressed to each student.
- **Check that your e-mail feedback is getting through.** Most e-mail systems can be programmed to send you back a message saying when the e-mail was opened, and by whom. This can help you to identify any students who are not opening their e-mails. It can also be useful to end each e-mail with a question asking the student to reply to you on some point arising from the feedback. This helps to make sure that students don't just open their e-mail feedback messages, but have to read them!
- **Keep records of your e-mail feedback.** It is easy to keep copies on disk of all of your feedback to each student, and you can open a folder for each student if you wish. This makes it much easier to keep track of your on-going feedback to individual students, than when your handwritten feedback is lost to you when you return their work to them.
- **Make the most of the technology.** For example, many e-mail systems support spell-check facilities, which can allow you to type really fast and ignore most of the resulting errors, until you correct them all just before sending your message. This also causes you to re-read each message, which can be very useful for encouraging you to add second thoughts that may have occurred to you as you went further in your assessment of the task.
- **Use email to gather feedback from your students.** Students are often bolder sitting at a computer terminal than they are face-to-face. Ask your students questions about how they are finding selected aspects of their studies, but don't turn it into an obvious routine questionnaire. Include some open-ended questions, so that they feel free to let you know how they are feeling about their own progress, and about your teaching too.
- **Use a computer conference to provide subtle pressure on students to submit work on time.** Publish lists of work you have received from students, but without names. This will make those who haven't submitted work realise that they could be falling behind.
- **Create a new conference topic for discussion of each assessment.** Students may want to exchange ideas after they have received feedback on assessed work. If you provide a topic for this, they will know where to discuss this without affecting the structure of the rest of the conference.
- **Seek permission from participants to use their work to give general feedback to the group.** If the work of one of the students includes something that you could use to illustrate a useful point to the whole group, ask their permission to use it. An e-mail message is the appropriate medium to use for this: the work could remain anonymous. Once you have permission, you can copy the appropriate sections to the conference and discuss it there.
- **Use the conference system to provide general feedback to groups.** When assessing work, there will be common points that need to be raised for several people. If these are discussed on the group's conference without naming anybody, participants can learn from each other's mistakes.
- **Consider putting assessment statistics on the conference.** You could make some basic information (such as average scores) available to the group. Some people might find it helpful to see how their performance compared with others in the group. On the other hand, some people might find this demoralising, so this issue needs careful thought.

Involving students in their own assessment

Nothing affects students more than assessment, yet they often claim that they are in the dark as to what goes on in the minds of their assessors and examiners. Involving students in peer- and self-assessment can let them in to the assessment culture they must survive. Increasingly peer-assessment is being used to involve students more closely in their learning and its evaluation, and to help to enable students really understand what is required of them. It is not a 'quick fix' solution to reduce staff marking time, as it is intensive in its use of lecturer time at the briefing and development stages. It can have enormous benefits in terms of learning gain. The following suggestions may help you get started with student peer-assessment.

What lends itself to peer-assessment?…

- **Student presentations.** Peer-assessment is particularly useful for the style and process dimensions of student presentations. It can also be used for the content side of presentations, when the topics are sufficiently shared so that students are well informed enough to make judgements on the content of each other's presentations.
- **Reports.** Peer-assessment helps to alert students to good and bad practice in report writing, and helps them develop awareness of the importance of structure, coherence and layout in reports.
- **Essay-plans.** Peer-assessment of essay-plans can widen students' horizons about different ways of brainstorming the content and structure of essays. It takes almost as much creative thinking to design the content of an essay-plan as it would to produce the final essay, so peer-assessing such plans helps students to cover a lot of sharing of ideas in a relatively short time.
- **Calculations.** Peer-assessing correct answers is simple and quick. Peer-assessment allows students to identify exactly where things went wrong when marking incorrect answers, and alerts students to potential trouble spots to avoid in the future.
- **Interviews.** Peer-assessment allows students to exchange a range of opinions, attitudes and reactions to each others interview performance, in a less threatening way than can be the case when such performance is lecturer-assessed.
- **Annotated bibliographies.** Peer-assessment of bibliographies can be a fast and effective way of alerting students to other sources of reference, that students working on their own might otherwise have overlooked.
- **Practical work.** Peer-assessment of experimental work can allow students to receive feedback on their practical skills, when lecturer-assessment of such skills may be threatening – or not possible, for example due to limited lecturer availability when large groups of students are involved.
- **Poster displays.** Peer-assessment of poster-displays can be a rapid way of alerting students to a wide range of approaches to the visual presentation of ideas.
- **Portfolios.** Where students are familiar with all the requirements for the successful demonstration of their achievements through portfolios, students are often highly competent in assessing each other's, particularly if they themselves have recently undertaken a similar preparation task.
- **Exhibitions and artefacts.** Art students in particular have a long tradition of participating in critiques of each others' paintings, plans, models, garments, sculptures and so on. Students participating in 'crits' learn a lot about the level of work required, and the ways in which aesthetic judgements of work are formed within their own particular subject contexts.

Getting started with peer-assessment…

- **Take it a bit at a time.** Some people (students and lecturers) find the use of peer-assessment is very radical, so it is a good idea to introduce it gradually, on a small scale, until you, your colleagues and students are confident about how it will work best.
- **Keep everyone in the picture.** Tell everyone what you are doing and why. Students and colleagues need to understand the thinking behind what you are doing, to avoid them perceiving it as a soft option or abdication of responsibility. If they understand that peer-assessment is actually part of the learning process, they may find it more acceptable.
- **Provide mark-free rehearsal opportunities.** This helps students get the hang of what is required of them, and also builds in an opportunity for students to get interim feedback at a stage where there is time to bring about improvements.
- **Provide, or negotiate, really clear assessment criteria.** Students should not be able of over-mark friends or penalise enemies if the criteria are unambiguous and explicit. All marks should be justifiable by reference to the criteria, and to the evidence of achievement of them.

- **Make peer-assessment marks meaningful.** Some argue that peer review is really only suitable for feedback purposes. However, if students are to take peer-assessment seriously, it should count for something, even if it is only a small proportion of the final grade. You may prefer to parallel-mark, with lecturer grades counting as well as averaged peer-grades if this is appropriate.
- **Moderate peer-assessment.** To ensure that the students see peer-assessment as fair, lecturers must overview the marks awarded and provide a 'court of appeal' if students feel justice has not been done. This may mean offering vivas to any dissatisfied candidates.
- **Keep the system simple.** Try not to give yourself really complicated addition and averaging tasks to do after peer-assessment has taken place. Too many separate components make it laborious to arrive at final marks. If the numerical side can't be simplified, it is worth using computer programs to do the donkeywork!
- **Involve students in the assessment criteria.** You can do this by letting students participate in the generation of assessment criteria, and the weighting to be given to each criterion. Alternatively, you can provide the criteria in the first instance, and give students lots of opportunities to ask questions about what they really mean.
- **Allow plenty of time.** Just because you can assess a poster display or an essay fairly quickly doesn't mean that students will be able to do so too, especially if groups are assessing other groups and are required to provide a mark by consensus. Presentations always over-run, and students will tend to make snap conclusions and 'guesstimates' when under pressure regarding time.
- **Monitor student achievement.** It's a good idea to review how well students are peer assessing, by the same kinds of methods you may use to review your own assessment, to ensure reliability and validity of marking. It is often reassuring for students (and colleagues) to see that peer-assessment using explicit criteria, and based on the production of clearly specified evidence, produces data that are very similar to marks produced by lecturers themselves.

Using student self-assessment to enhance their learning

There are many levels on which student self-assessment may be used, ranging from activities intended simply to promote reflective learning, to formal strategies that allow student self-assessment to count in their overall marks. The following suggestions may help you decide when to introduce elements of student self-assessment into your courses.

- **Make self-assessment an integral element of learning.** Help students to become lifelong learners who can evaluate their own performance after they have finished formal study. This is a valuable skill that will help them in their professional careers.
- **Think of some things that no one but students can really assess.** For example, students alone can give a rating to how much effort they put into a task, how strong their motivation is in a particular subject, or how much they believe they have improved something over a period of time.
- **Give students practice at positively evaluating themselves.** For example, give them nine post-its and ask them to list nine qualities or skills they have, and get them to prioritise them in a ranking order one to nine.
- **Emphasise the crucial relationship between criteria, evidence and self-evaluation.** Help students to learn to make balanced judgements about themselves that relate directly to the assessment criteria, by providing clear evidence of what has been achieved.
- **Encourage the use of reflective accounts and journals, to promote self-evaluation.** By encouraging students to review their own performance regularly through journaling, they can build up a picture of their own work over a period of time.
- **Support students in self-assessment.** Give them lots of guidance at the outset and then progressively let them take a greater degree of responsibility for their assessment as their understanding of the process matures.
- **Help students to get to grips with assessment criteria.** Let them discuss what the criteria will mean in practice, and get them to describe exactly what sorts of performance or evidence will demonstrate achievement of the criteria.
- **Help students to prepare for self-assessment by assessing peers.** It is often easier to make judgements about their own work when they have participated in looking critically at what others have done.
- **Include self-assessment when assessing group process.** Frequently students are asked to peer-assess each other's contribution to group tasks. It is also feasible for them to assess realistically what they have added themselves to the process, applying the same notions of criteria and evidence as they did to their peers.

- **Use flexible learning materials.** Most such materials include a lot of self-assessment exercises in one way or another. Usually, the primary benefit of these is not strictly self-assessment, but the delivery of feedback to students who have had a try at the exercises. However, flexible learning continuously develops students' own picture of their progress.
- **Provide computer-based self-assessment opportunities for students.** It can help students find out a lot about how their learning is going when computer-based packages are available in a library or resource room, where they can check their knowledge in the comfort of privacy. Check out web sites that could serve a similar purpose for your students. Such packages can also provide feedback and direction, as well as giving students a quantitative indication of the state of their learning.
- **Provide self-assessment opportunities to as diagnostic aids.** Open-learning or computer-based packages can include sets of questions designed to help students identify which sections of their work may need particular attention. The packages can also include remedial 'loops' which students experiencing particular difficulties can be routed through.
- **Use self-assessment to establish existing competence.** Self-assessment exercises and tests can be a quick way of enabling students to establish how much of their prior learning is relevant to the prerequisite knowledge for their next course or module. This can help students avoid wasting time studying things they have already achieved well enough.
- **Use self-assessment sometimes in lectures and tutorials.** For example, when students have brought along coursework expecting to hand it in for tutor marking, it can be useful to lead the whole group through self-assessment against clear marking guidelines. The work can still be handed in, and it is usually much faster and easier to moderate students' own assessments than to mark the work from scratch.
- **Use self-assessment as part of learning contracts.** When students are producing evidence specifically relating to their own learning contracts, it can be useful to ask them to self-assess how well they have demonstrated their achievement of some of their intended outcomes. One way of firming this up is to allocate some tutor-assessed marks for the quality of their own self-assessment; this also allows students to be given feedback on this.
- **Suggest that students use video to informally self-assess their presentation skills.** Watching videotapes of their own presentations in the comfort of privacy can allow students to reflect very deeply on their skills. In fact, it is sometimes useful to suggest that students view each other's videos informally after self-assessing, to put the self-critical evaluations some students may have made of themselves into more comfortable perspective.
- **Include self-assessment with student portfolios.** Ask students to include in their portfolios self-evaluations of their work. Reserve some of the marks for portfolios for the quality and depth of students' self-appraisal.
- **Experiment with non-print media for self-assessment.** For example, when art students are preparing an exhibition or display, ask them to provide an interim self-critique on audiotape.
- **Get students to self-assess added value.** Getting students to self-appraise the added value that a course or module had given them can be a useful adjunct to student feedback procedures, and helps students to put their learning into perspective in the overall context of their development.

Setting up self-assessment tutor dialogues

Think of the following scenario. A piece of coursework is to be handed in and tutor-assessed. This could be just about anything, ranging from a practical report, a fieldwork report, a dissertation, and even an essay or set of answers based on a problems sheet.

Imagine that students are briefed to self-assess their efforts at the point of submitting the work for tutor assessment, and are supplied with a pro-forma for this self-assessment, of no more than two pages length. Suppose that the pro-forma consists of a dozen or so short, structured questions, asking students to make particular reflective comments upon the work they are handing in, and that the principal purposes behind these questions are to:

- Get students to reflect on what they have done;
- Give tutors assessing their work additional information about 'where each student is' in relation to the tasks they have just attempted;
- Form a productive agenda to help tutors to focus their feedback most usefully;
- Save tutors time by helping them to avoid telling students things about their submitted work, which they know all to clearly already;
- Give students a sense of ownership of the most important elements of feedback which they are going to receive on the work they have submitted.

Some ideas for self-assessment questions

Each of the suggestions below could take the form of a relatively small box on the proforma, requiring students to give their own reply to the question, but allowing space for tutors to add a sentence of two in response to each student's reply. Sometimes, of course, tutors would wish to (or need to) enclose additional response information on separate sheets – often pre-prepared handout materials dealing with anticipated problem areas or frequently-made errors. A reminder: the menu of questions below is exactly that – a menu – from which individual assessors will need to select carefully only a few questions, those which are most relevant to the nature of the assessed task. Also, for every separate task, it is vitally important that the self-assessment questionnaires are patently task-specific, and that students don't see the same (or similar) questionnaires more than once. (We all know how 'surface' students' responses become to repetitively-used course evaluation questionnaires, and how limited is the value of the feedback we receive from such instruments!).

For each of the questions I include below, I've added a sentence or two about why or when it may prove useful to assessors and students. Some parts of the menu below are much more 'obvious' than others, and I believe it is among the less-common questions which are those most likely to set up deep tutor-student dialogue.

- *What do you honestly consider will be a fair score or grade for the work you are handing in?*
  Most students are surprisingly good at estimating the worth of their work. Only those students who are more than 5% out (or one grade point) need any detailed feedback on any differences between the actual scores and their own estimates – saves tutors time.
- *What do you think was the thing you did best in this assignment?*
  Fact is that assessors know soon enough what students actually did best, but that's not the same as knowing what they think they have done well. Where both are the same thing there's no need for any response from assessors, but on the occasions where students' did something else much better (or did the original thing quite poorly) feedback is vital, and very useful to students.
- *What did you find the hardest part of this assignment?*
  Assessors know soon enough what students do least well, but that's not always the thing they found hardest. When a student cites something that was completely mastered – in other words, the assignment gives no clue that this was a struggle – it is quite essential that the student is congratulated on the achievement involved, for example a few words such as "you say you found this hard, but you've completely cracked it – well done!" go a long way.
- *If you had the chance to do this assignment again from scratch, how (if at all) might you decide to go about it differently?*
  This question can save assessors hours! Students usually know what is wrong with the approach they have taken. Let them tell you about this! This saves you having to go on at length telling them about it. Moreover, when students themselves have diagnosed the weaknesses in their approach, the ownership of the potential changes to approach lie with them, rather than us having to take control of this.

- *How difficult (or easy) did you find this assignment?*
  Don't use number scales! Provide words or phrases which students can underline or ring. Use student language, such as 'dead easy', 'tough in parts', 'straightforward', 'a real pain', 'took longer than it was worth', 'hard but helped me learn' and so on.
- *What was the most important thing that you learned about the subject through doing this assignment?*
  Answers to this question give us a lot of information about the extent to which the assignment is delivering learning payoff to students.
- *What was the most important thing that you learned about <u>yourself</u> while doing this assignment?*
  Such a question gives us information about how well (or badly) the assignment may be contributing to students' development of key transferable skills, including self-organisation.
- *What do you think are the most important things I am looking for in this assignment?*
  This question can be sobering for assessors – it can show us how students perceive our activities, and it can often show us a lot about how we are found to be assessing. Students can benefit from feedback on their responses, when their perceptions of the purposes of an assignment have gone adrift.
- *How has doing this assignment changed your opinions?*
  Not all assignments have anything to do with developing students' views, attitudes or opinions, but some do this, and it is important that we acknowledge this when such issues are intentional. Such a question is better than simply asking 'has your opinion changed?', where the expectation is clearly for a 'yes' response.
- *What's the worst paragraph, and why?*
  This question is particularly useful as a feedback dialogue starter when assignments are substantial, such as long reports or dissertations. Students quite often know exactly where they were trying to firm up an idea, but struggling to express it. Their help in bringing to our attention the exact positions of such instances can save us hours in finding them, and can ensure that we have the opportunity to respond helpfully and relevantly to students' needs.

Making the most of learning outcomes

Discussion of learning outcomes could well have been placed right at the start of this booklet, as all assessment needs to link firmly and coherently to the goalposts as set by such stated outcomes. However, I've left this till the end, because it is particularly useful to fine-tune learning outcomes after working out what the real outcomes are going to be, and this can only be done realistically when it is known what exactly will be assessed, how, and when.

The intended learning outcomes are the most important starting-point for any teaching-learning programme. Learning outcomes give details of syllabus content. They can be expressed in terms of the objectives which students should be able to show that they have achieved, in terms of knowledge, understanding, skills and even attitudes. They are written as descriptors of ways that students will be expected to demonstrate the results of their learning. The links between learning outcomes and assessment criteria need to be clear and direct. Learning outcomes indicate the standards of courses and modules, and are spotlighted in quality review procedures.

Why use learning outcomes?

- Well-expressed statements of intended learning outcomes help students to identify their own targets, and work systematically towards demonstrating their achievement of these targets.
- Learning outcomes are now required, in the higher education sector in the UK, for subject review by the Quality Assurance Agency, and will be increasingly cross-referenced by Academic Reviewers against assessment processes, instruments and standards.
- In the context of benchmarking, learning outcomes can provide one of the most direct indicators of the intended level and depth of any programme of learning.

Where can learning outcomes be useful to students?

Learning outcomes should not just reside in course validation documentation (though they need to be there in any case). They should also underpin everyday teaching learning situations. They can be put to good use in the following places and occasions:

- **In student handbooks**, so that students can see the way that the whole course or module is broken down into manageable elements of intended achievement, and set their own targets accordingly.
- **At the start of each lecture,** for example on a slide or transparency, so that students are informed of the particular purposes of the occasion.
- **At the end of each lecture,** so that students can estimate the extent to which they have travelled towards being able to achieve the intended outcomes associated with the lecture.
- **At suitable points in the briefing of students for longer elements of their learning,** including projects, group tasks, practical work and field work.
- **On each element of handout material** issued before, during or after lectures, to reinforce the links between the content of the handout and students' intended learning.
- **On tasks and exercises, and briefings to further reading,** so that students can see the purpose of the work they are intended to do.
- **On the first few screens of each computer-based learning programme** that students study independently (or in groups).
- **At the beginning of self-study or flexible learning packages,** so that students can estimate their own achievement as they work through the materials.

Tips on designing and using learning outcomes

- **Work out exactly what you want students to be able to do by the end of each defined learning element.** Even when you're working with syllabus content that is already expressed in terms of learning outcomes, it is often worth thinking again about your exact intentions, and working out how these connect together for different parts of students' learning.
- **Don't use the word 'students' in your outcomes** - except in dry course documentation. It is much better to use the word 'you' when addressing students. "When we've completed this lecture, you should be able to compare and contrast particle and wave models of radiation" is better than stating "the expected learning outcome of this lecture is that students will……". Similarly, use the word 'you' when expressing learning outcomes in student handbooks, handouts, laboratory briefing sheets, and so on. Students need to feel that learning outcomes belong to them, not just to other people.
- **Work imaginatively with existing learning outcomes.** There may already be externally defined learning outcomes, or they may have been prescribed some time ago when the course or programme was validated. These may, however, be written in language which is not user-friendly or clear to students, and which is more connected with the teaching of the subject than the learning process. You should be able to translate these outcomes, so that they will be more useful to your students.
- **Match your wording to your students.** The learning outcomes as expressed in course documentation may be off-putting and jargonistic, and may not match the intellectual or language skills of your students. By developing the skills to translate learning outcomes precisely into plain English, you will help the outcomes to be more useful to them, and at the same time it will be easier for you to design your teaching strategy.
- **Your intended learning outcomes should serve as a map to your teaching programme.** Students and others will look at the outcomes to see if the programme is going to be relevant to their needs or intentions. The level and standards associated with your course will be judged by reference to the stated learning outcomes.
- **Remember that many students will have achieved at least some of your intended outcomes already.** When introducing the intended learning outcomes, give credit for existing experience, and confirm that it is useful if some members of the group already have some experience and expertise that they can share with others.
- **Be ready for the question 'why?'.** It is only natural for students to want to know why a particular learning outcome is being addressed. Be prepared to illustrate each outcome with some words about the purpose of including it.
- **Be ready for the reaction 'so what?'.** When students, colleagues, or external reviewers still can't see the point of a learning outcome, they are likely to need some further explanation before they will be ready to take it seriously.
- **Work out your answers to 'what's in this for me?'.** When students can see the short-term and long-term benefits of gaining a particular skill or competence, they are much more likely to try to achieve it.
- **Don't promise what you can't deliver.** It is tempting to design learning outcomes that seem to be the answers to everyone's dreams. However, the real test for your teaching will be whether it is seen to enable students to achieve the outcomes. It's important to be able to link each learning outcome to an assessable activity or assignment.
- **Don't use words such as 'understand' or 'know'.** While it is easy to write (or say) "when you have completed this module successfully, you will understand the 3rd Law of Thermodynamics", it is much more helpful to step back and address the questions: "how will we know that they have understood it?", "how will they themselves know they have understood it?", and "what will they be able to do to show that they have understood it?". Replies to the last of these questions lead to much more useful ways of expressing the relevant learning outcomes.
- **Don't start at the beginning.** It is often much harder to write the outcomes that will be associated with the beginning of a course, and it is best to leave attempting this until you have got into your stride regarding writing outcomes. In addition, it is often much easier to work out what the 'early' outcomes actually should be once you have established where these outcomes are leading students towards.
- **Think ahead to assessment.** A well-designed set of learning outcomes should automatically become the framework for the design of assessed tasks. It is worth asking yourself "How can I measure this?" for each draft-learning outcome. If it is easy to think of how it will be measured, you can normally go ahead and design the outcome. If it is much harder to think of how it could be measured, it is usually a signal that you may need to think further about the outcome, and try to relate it more firmly to tangible evidence that could be assessed.
- **Keep sentences short.** It is important that your students will be able to get the gist of each learning outcome without having to re-read them several times, or ponder on what they really mean.

- **Consider illustrating your outcomes with 'for example…' descriptions.** If necessary, such extra details could be added in smaller print, or in brackets. Such additional detail can be invaluable to students in giving them a better idea about what their achievement of the outcomes may actually amount to in practice.
- **Test-run your learning outcome statements.** Ask target-audience students 'what do your think this really means?', to check that your intentions are being communicated clearly. Also test your outcomes statements out on colleagues, and ask them whether you have missed anything important, or whether they can suggest any changes to your wording.
- **Aim to provide students with the whole picture.** Put the student-centred language descriptions of learning outcomes and assessment criteria into student handbooks, or turn them into a short self-contained leaflet to give to students at the beginning of the course. Ensure that students don't feel swamped by the enormity of the whole picture! Students need to be guided carefully through the picture in ways that allow them to feel confident that they will be able to succeed a step at a time.
- **Don't get hung up too much on performance, standards and conditions** when expressing learning outcomes. For example, don't feel that such phrases as 'on your own', or 'without recourse to a calculator or computer' or 'under exam conditions' or 'with the aid of a list of standard integrals' need to be included in every well-expressed learning outcome. Such clarifications are extremely valuable elsewhere, in published assessment criteria. Don't dilute the primary purpose of a learning outcome with administrative detail.
- **Don't be trivial!** Trivial learning outcomes support criticisms of reductionism. One of the main objections to the use of learning outcomes is that there can be far too many of them, only some of which are really important.
- **Don't try to teach something if you can't think of any intended learning outcome associated with it.** This seems obvious, but it can be surprising how often a teaching agenda can be streamlined and focused by checking that there is some important learning content associated with each element in it, and removing or shortening the rest.
- **Don't confuse learning outcomes and assessment criteria.** It is best not to cloud the learning outcomes with the detail of performance criteria and standards until students know enough about the subject to understand the language of such criteria. In other words, the assessment criteria are best read by students <u>after</u> they have started to learn the topic, rather than at the outset (but make sure that the links will be clear in due course).
- **Don't write any learning outcomes that can't (or won't) be assessed.** If it's important enough to propose as an intended learning outcome, it should be worthy of being measured in some way, and it should be *possible* to measure.
- **Don't design any assessment task or question that is not related to the stated learning outcomes.** If it's important enough to measure, it is only fair to let students know that it is on their learning agenda.
- **Don't state learning outcomes at the beginning, and fail to return to them.** It's important to come back to them at the end of each teaching-learning element, such as lecture, self-study package, or element of practical work, and so on. Turn them into checklists for students, for example along the lines "Check now that you feel able to…." or "Now you should be in a position to….".

Conclusions

None of the forms of assessment discussed in this booklet is without its merits or its limitations in the context of assessing various facets of the skills, knowledge and performances of physical sciences students. The challenges caused by greater numbers of students and increased assessment workloads provide an opportunity to make a radical review of the ways we assess our students. The requirement placed upon us to match assessment criteria to intended learning outcomes give us further opportunity to adjust our assessment so that we are attempting to measure that which is important, rather than merely that which is relatively straightforward to measure.

In particular, we must ensure that our attempts to meet these challenges do not lead to a retreat from those forms of assessment which are less cost-effective, but which help students to get due credit for a sensible range of the knowledge and skills they demonstrate. Probably the best way to do our students justice is to use as wide as possible a mixture of the assessment methods outlined above, allowing students a range of processes through which to demonstrate their respective strengths and weaknesses. Moreover, the fourteen assessment methods discussed in some detail in this booklet are only a cross-section of those that could be used. Ideally, for each area of physical sciences students' learning, we should be asking 'what is the most appropriate way to measure this fairly, validly, and reliably?'

Finally, we need to ensure that learning is not simply assessment-driven. It can be argued that presently we have far too much assessment, but that neither the quality nor the diversity of this assessment is right. Students are highly intelligent people; if we confront them with a game where learning is linked to a rigid and monotonous diet of assessment, they will learn according to the rules of that game. To improve their learning, we need to improve our game.

Acknowledgements and Sources

In writing this booklet, I've drawn on two sources listed below:

- 'The Lecturer's Toolkit': particularly Chapter 3 (1998, Phil Race and Sally Brown, Kogan Page, London);
- '2000 Tips for Lecturers' (Ed. Phil Race, Kogan Page, 1999).

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LTSN Physical Sciences Practice Guides are designed to provide practical advice and guidance on issues and topics related to teaching and learning in the physical sciences. Each guide focuses on a particular aspect of higher education and is written by an academic experienced in that field.

This practice guide is concerned with best practice in assessment of higher education physical sciences courses. It considers a variety of approaches and discusses associated advantages and disadvantages.

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