

[P11] Activity diary program to enhance teaching of energy balance

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This paper describes a web-based program that can be used to illustrate the importance of exercise to energy balance. The program was written in JavaScript and works in Internet Explorer. First year university students who are studying nutrition have used it and completed an evaluation questionnaire. Energy requirements depend on the basal metabolic rate (BMR), which can be applied during sleep and the extent of physical activity during the day. The Government publication on reference nutrient intakes suggests a method for calculating individual energy requirements based on BMR and activity (Department of Health, 1991). The web program shows how manipulating these two factors can alter energy requirements. It helps students to test out the effect of varying lifestyles on energy requirements.

METHOD

The screen has a grid of numbers on the right. Each of these represents what a person is doing for a 5-minute period. There are 12 figures per hour and scrolling down can reveal the full 24-hour period. When a student enters the program, the data are all set at 1 to represent the physical activity ratio (PAR) of sleep. The student selects a time of rising by clicking the relevant part of the grid. The student can select from one of eight PAR buttons on the left of the screen. Next to each of these buttons is a list of activities suggested to be included at each of the eight PAR values (Department of Health, 1991). The numbers chosen replace the values in the grid and the student can continue clicking the buttons on the left of the screen and the data is entered into the grid until it is time to

retire to bed again. It is not important to try to be precise in an educational exercise of this nature. Students can alter the sex and age group and set the weight.

The program was used as part of a practical class that also involved measurement of the energy content of foods by bomb calorimetry and their resting metabolic rate by indirect calorimetry. Students rotated through these activities in groups and when they used the program they operated it on a single computer so that they could all see and discuss the results. The first task was to estimate the energy requirement of an 18-year-old female student in energy balance during a typical day spent attending classes at University and an evening of studying/relaxing. Then students were asked to find out how much weight she is likely to lose by taking up swimming for 1 hour a day for a year. Students were then supplied with a snack bar and asked to find its energy content and calculate how much of the snack the subject could eat in order to return to energy balance. The last task was to investigate the difference in energy requirement between a female and a male of equal age and weight doing the same physical activities. They were asked whether a male would require less, the same or more snack bars than a female, to provide the energy for 1 hour of swimming.

RESULTS

The students clearly considered the program worthwhile as shown in Table 1. In particular a high proportion considered that computer programs are a good way to help them learn. There were two questions that asked the

Table 1: The attitudes of students to the program

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The activity program is user-friendly	0	3	5	22	8
The activity program is clearly laid out	0	0	6	26	6
The activity program is difficult to understand	8	20	8	2	0
I learned about energy balance using the activity program and the exercises	0	2	9	23	4
I think the best way to lose weight is to take more exercise	0	0	2	20	16
I think the best way to lose weight is to cut down on snacking	0	4	3	23	8
I think that energy requirements and energy balance could be better taught using a textbook	8	25	3	2	0
Computer programs are a good way to help us learn	0	1	4	18	15

students the best way to lose weight; they thought that both exercise and reducing snacking were best.

DISCUSSION

This study shows that a simple JavaScript program that works in a browser was considered useful by students, but they showed an elementary lack of understanding of the question about the 'best' method, since they could not both be the 'best'. Probably more time using the program and trying out different ideas would be necessary to demonstrate that generally it requires much more exercise than many people would expect to oxidise what appears like a relatively small snack. The time constraints of the practical class limited the extent to which they grasped

this important aspect of energy balance. Probably the question should have been phrased differently to make it clear that the two possible answers were mutually exclusive. The web page has been incorporated into a commercial program called WinDiets, which includes other dietary calculations aimed at teaching nutrition (www.windiets.co.uk).

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[P12] Digital alternatives and disability in science education

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This poster aims to provide a debating point for the use of e-learning materials such as virtual laboratory and fieldwork for supporting disabled students in science education.

The poster provides viewpoints from different perspectives, including disabled students and disability support workers.

The poster is linked to the workshop 'E-learning and disability: tales from the riverbank (and other non-classroom based learning environments)'.

Material will be provided for delegates to annotate, and offer their own viewpoint. The poster is designed to be a forum where delegates can present a view of teaching disabled students that they may not be confident articulating in other situations. The aim is address issues that science lecturers may have concerns about, but feel that quality and legislative dictates force them to carry out without question. The annotations will be anonymous, unless the contributor wishes to identify themselves.

[P13] Training the teachers: virtual learning – real benefits?

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Virtual Learning Environments (VLEs) are now in widespread use in British Universities (Ward, Gordon *et al.* 2001; Browne and Jenkins 2003). The University of Leicester first deployed the Blackboard Virtual Learning Environment in May 2002. The School of Biological Sciences was an early adopter of the VLE and was the first to deploy an undergraduate module using online assessment. VLE usage is voluntary and at the discretion of the module convenor or Degree Teaching Team. In order to facilitate development of the VLE across the School of Biological Sciences, we conducted an audit of all module convenors by means of face-to-face interviews to complete a standardized questionnaire.

Two questionnaires were devised, Questionnaire 1 for those classed as Blackboard users and Questionnaire 2 for those classed as Blackboard non-users. The convenors were classed as established 'Blackboard users' if they had created a Blackboard site for a module that they convened by uploading teaching material to the system. Convenors were classed as 'Blackboard non-users' if they had either only used Blackboard to view material that was already online, or had never accessed the system at all. There were five common questions, referring to background information that was independent of Blackboard usage.

The response rate was 84%. Face to face interviews were conducted with 41 staff, covering 66 modules. Sixty two percent of

convenors surveyed used Blackboard. All of these users employed the software to make teaching documents available to students, and 85% used the inbuilt Announcements and Staff Information areas. In contrast, only 19% of users attempted any sort of online assessment, and even fewer used the more sophisticated communications tools provided (Discussion Boards, 8%; Virtual Classroom, 0%). In general, the majority of staff were using Blackboard as an alternative (or as a supplement) to providing printed handout material at the lecture. Only three modules used Blackboard tests for summative assessment. General comments about why staff used Blackboard were collated. The most commonly cited reason was that it led to student pull for information and provided an easy method to distribute lecture handouts. Peer pressure from colleagues was the next most cited reason for starting to use Blackboard.

Over a third of staff admitted that lack of time was the biggest barrier to expanding their use of the system, and a fifth stated that they felt they did not have the knowledge required to go further. Interestingly, these were the same reasons given by non-users of Blackboard to explain why they did not use the system.

However, in spite of a comprehensive program of staff development and training in the use of the VLE, only 10% of staff in the School of Biological Sciences had received any centralised formal training in Blackboard, with the rest being entirely self-taught. There was

widespread lack of knowledge of the SENDA legislation and how it applied to teaching material on Blackboard.

Overall, there is relatively widespread adoption of the VLE throughout the School, and this is growing (shown by an increase in the proportion of modules now on Blackboard from 56 to 65% over the last semester).

The findings of this audit indicate that while many staff have used Blackboard to some extent, a large majority fail to make use of the potential pedagogical advantages offered by the full functionality of the software. A small percentage of staff had attended formal centralized staff development sessions, the majority of those classed as Blackboard users being self-taught. These results indicate that when academic staff begin to use a VLE in a self-taught environment, they do not consider how it can be used to improve the educational value of their teaching. Instead, it is seen as a quick way to deliver learning materials that would otherwise have been delivered by alternative means, e.g. printed handouts. In particular, time constraints and the naïve expectations that learning technology is either a bottomless pit or a quick technological fix for pedagogical problems result in the use of sophisticated C&IT systems as mere filing systems – the lowest educational denominator.

Models for the establishment of VLEs and e-learning in university education suggest that it is a process which occurs in stages (Jevons and Northcott 1994) along a continuum. If this is so, our survey shows that there is little training required to reach the first stage of enhancement– transfer of existing teaching materials to a VLE. However, it is not clear how progression towards substitution should be encouraged or supported. How staff development handles this progression will be key to the development of e-learning in our Universities (Orsmond and Stiles 2002). It is acknowledged that the experience of being a student in an online course increases the

awareness of online tutors to the needs of their students (Salmon 2002). One example of an online course about computer aided assessment demonstrated that this approach is popular with academics and encouraged a sound approach to online assessment (Walker, Adamson et al. 2004). Models for situated learning (learning embedded in the social and physical context within which it is used) have been shown to be popular and effective modes for change within universities (Taylor 2003). Emphasis on the provision of exemplars of effective online teaching, faculty-based and discipline-based support, and a range of diverse options for staff learning (O'Reilly, Ellis et al. 2000) will lead us forward from 'simply putting notes on the web' to providing an enhanced learning experience for our students, and to appreciate the difference between the simple, document repository-push response to VLEs which results in 'e-Teaching', and the interactive, reflective, student-pull of well thought out e-Learning.

ACKNOWLEDGEMENTS

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[P14] Chemistry: the next generation: a multi-dimensional Aimhigher project tackling under representation in the chemical sciences in HE

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OBJECTIVES

The principal objective of the programme will be to ensure that universities within each region collaborate on outreach activities and that local and national industries interface with these coordinated groups. The programme will draw on the considerable expertise available through the local Aimhigher networks as well as current good practice within HEIs and the considerable resources and expertise available from the RSC and industry partners.

- Visits to industrial labs to raise career aspirations
- Support for teachers in schools
- Mentoring
- Informing parents and carers
- Development of a web site and web resources for schools and colleges
- Any other innovation!

TARGETS

The targets are that 12,000 school students should be involved within the pilot period with 5% of the 13-16 age range going on to study A level chemistry and 5% of the 16-19 age range going on to higher education in the chemical sciences including HNC/D and foundation courses. Currently less than 1% of students study chemistry at HE in the UK.

HOW IS THIS BEING DONE?

- Visits by schools and colleges to HEIs to use labs and equipment
- 'Roadshows' – HEI staff to put on events for clusters of schools and colleges
- Targeted summer schools

TARGETS, OUTPUTS AND DELIVERABLES

- To provide a diverse range of chemistry outreach activities in university laboratories for approximately 3000 students per year
- To provide chemistry outreach activities for students in schools and at regional events for approximately 3500 students per year
- To provide good quality outreach activities nationally that are sustainable beyond the 2 year Aimhigher funding period
- To develop 20 – 30 new materials for national dissemination.
- To develop a chemistry outreach website www.rsc.org/outreach

- To organise two national conferences to disseminate 'good practice'

PARTNERS

Universities

Imperial College London
Kingston University
Liverpool John Moores
Loughborough University
Manchester Metropolitan University
Nottingham Trent University
University College London
University of Greenwich
University of Leicester
University of Liverpool
University of Manchester
University of Nottingham

Companies

AstraZeneca
GlaxoSmithKline
Pfizer

Professional Body

Royal Society of Chemistry

Sector Skills Councils

Cogent
SEMTA

EXEMPLAR REGIONAL EVENT

During Science Week the East Midlands staged its first regional event *Chemistry: 'Hands Free and Hands-On!'* This attracted 160 students and their teachers to the EM Science Learning Centre and gave them the opportunity to explore the chemistry of mobile phones. The event involved the collaboration of all four regional HEI partners and AstraZeneca. Students began the day with an inspiring talk about the importance of chemistry in the development of mobile

phones, followed by five different practical activities. Students and their teachers participated in workshops making nanochips, using electrochromic cells, testing Graetzel cells, seeing how liquid crystals work and making green polymers.



[P15] Using real-world forms to focus undergraduate learning

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SUMMARY

Sometimes students find it difficult to focus on precisely what is required of them. One way to help achieve a precise focus and to increase students' motivation is to require them to complete the kinds of detailed forms that practitioners use in their professional activities. Using such forms helps students focus their energies on providing only relevant information, address important aspects that might otherwise be forgotten, and occasionally process information in a way that gives it new significance. It also makes assessments of student learning more effective. Here I show how I have sourced, modified and trialled a variety of forms, in particular the British Ecological Society's *Expedition Grant Application Form*, the Field Studies Council's risk assessment for field work, and forms for environmental impact assessment for adventure activities. Forms will soon be available from the HEA-GEES Subject Centre for downloading.

RATIONALE

Filling in forms is part of everyday life. This is equally true in our professional lives, when we need to fill in forms to apply for funding, report on the successes of courses, assess and record risks, submit tenders, and so on. The most effective forms allow the originator to:

- obtain the desired information
- do so with a suitable level of detail

- do so in a way that saves time
- At the same time, well-designed forms help those completing them to:
 - focus their energies on providing only relevant information
 - address important areas that might otherwise have been forgotten
 - occasionally process the information in a way that gives it new significance
- do so in a way that saves time

The first list can just as easily be read as a wish list for tutors endeavouring to make their assessments of learning as effective as possible. The second list can be read as a set of guidelines for those devising worthwhile tasks for students. In other words, using forms should help tutors to set and assess student learning that is highly focussed. Many tutors use forms devised by themselves to foster and to assess undergraduate learning with conspicuous success (eg as worksheets or for student self-evaluation).

At UCC, we have concentrated on using the actual forms that practitioners themselves are required to complete as part of their professional activities. This has an additional benefit of increasing students' interest and motivation in the tasks. For example, I have used a modification of the NERC form *Application for a Small Project Grant* as the template that level 2 Environmental Science

undergraduates completed to propose and justify an innovative field project as a follow up to a residential field course. I use the British Ecological Society's *Expedition Grant Application* Form for level 2 Adventure Education undergraduates in the same way. In both cases, students are also provided in advance with instructions for applicants (only slightly modified from the ones actually provided in real life) and submitted forms are assessed using the published criteria of the organisations concerned (once again with only very minor modifications). Student feedback on use of these real-world tasks is consistently positive. They appreciate the challenge of the real-world task and revel in the need to provide answers to focussed questions that they admit they would forget or avoid addressing if writing an essay or a few paragraphs of prose. This need to focus on answering very specific questions in order to satisfy very specific criteria is something that other kinds of student tasks do not push so strongly. Furthermore, by using such structured, focussed tasks it is clear that tutors find it much easier to see if learning objectives have been met and to feed back to students.

At UCC, the real-world nature of the tasks is extended further. For example Adventure Education students form panels to assess previous grant applications and decide which merit funding, then afterwards compare their decisions with the criterion scores and the actual decisions of the real-life panel. They also peer review each other's proposals and give written feedback before submission.

OUTCOMES

Recently I have increased the use of real-world forms in learning and teaching activities by:

1) sourcing, modifying as necessary and testing appropriate forms for students to undertake:

- risk assessment of environmental field

experiments (for use by Adventure Education and Animal Science undergraduates)

- environmental impact assessment for specific outdoor activities (for use by Adventure Education undergraduates)
- risk assessment for those leading groups in the field as part of environmental education (for use by trainee teachers and Adventure Education undergraduates).

(These themes were selected because of their significance to current programmes at UCC, their relevance across the HEA-GEES spectrum, and their suitability for use with only minor modifications at Levels 0-4.)

2) trialling these with cohorts of students at UCC.

I am promoting the use of these and existing forms to the wider HE community by:

- making available freely downloadable forms, instructions for students, and instructions for tutors with permission of the source organisations. These should be available in due course from www.gees.ac.uk
- promoting the use of forms in general across disciplines in my own institution through activities of UCC's Centre for Learning and Teaching; this involves working with colleagues on diverse programmes at Foundation, undergraduate and taught Masters level, as well as HNC/HND courses at the Isle of Wight College (a partner FE college) to show how the approach can be translated.

While there are many ways in which the general literature on student assessment, motivation, realia etc is related to the theme, no worthwhile review draws together all these areas to underpin the approach described

here. Therefore, in parallel with this practical work, I am developing an overview of the rather disparate literature on this subject.

This project is a result of Small-Scale Project Funding from the Higher Education Academy Subject Centre for Geography, Earth and Environmental Sciences (GEES), 2004-5.

[P16] RRICE: recruitment and retention in a chemical environment

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BACKGROUND: THE UNIVERSITY OF GLASGOW

Faculty Entry system. Science students are admitted by a central Admissions Office to the Science Faculties, and study a broad curriculum for the first one or two years, choosing their degree subject as they enter their third year. Chemistry therefore constitutes one third of a typical first-year science degree, with around 400 students taking 'Chemistry-1'. All students entering the course are required to have a good pass at Scottish Higher Chemistry or equivalent, and the course approximates very roughly to English A2 level. There is no segregation at first year level between potential chemists, and those who are taking chemistry as a requirement for a different degree. In a typical week, students attend three lectures, one problem session, and one 3-hour laboratory class. There is no small-group teaching, and lab experiments are carried out in pairs, with 60-80 students in the lab at any given time. At level 2, students may take chemistry as either 25% (about 40 students) or 50% (about 100 students) of their curriculum, by taking either or both of 'Chemistry-2X' and 'Chemistry-2Y' These 'courses approximate very roughly to English University first-year level. A student taking both X and Y typically attends five lectures a week, and either two 3-hour lab sessions or a (paper-based) group-work exercise, with small-group tutorials fortnightly. About 50-70 students are in the lab at any given time, with experiments carried out individually or in pairs. Although single-course students cannot continue with chemistry beyond this level, no

distinction is made between potential chemists and other students.

In Glasgow University Chemistry Department, we are therefore involved with Recruitment and Retention over three periods: school level; a large first year class with a minority of future chemists; and a small second year class with a small majority of future chemists. Although students name a degree subject on their UCAS forms, they are in no way bound by this choice, and many graduate in a different subject, so recruitment and retention are both active and vital to the health of the department. This poster will present some of our recent approaches to RRICE with current under-graduates.

WHAT WORKS WELL AND WHAT NEEDS IMPROVEMENT?

Standard student feedback questionnaires, and informal verbal feedback, have in recent years indicated several strong likes and dislikes among the student body. *Laboratories appear to be unpopular, while group work at second year level has received very positive comments. Our approachability and 'open door' policy within the department is very highly appreciated, and seems to be one of our greatest assets. The last two points will be explored further on the poster. We decided to probe students' likes and dislikes further at first and second year level, particularly with respect to the apparently unpopular lab classes, using more focussed questionnaires.*

RECENT CHANGES TO LABORATORY TEACHING

The questionnaires were timely since our junior labs are in the process of redevelopment, to improve students' experiences and to reflect changing staffing within the Department of Chemistry. This year (2004-5), our second year students experienced the old-style 5-week Physical, Organic and Inorganic labs (in that order), while the first years had the first running of our new 8-week Synthetic and Quantitative labs. The Synthetic lab incorporates the old Organic and some Inorganic experiments, while the remaining Inorganic join the old Physical experiments to form the Quantitative lab. Although the experiments are thus changing relatively little, we have taken the opportunity to change the lab books more extensively. In particular, we were dissatisfied with the standard of report-writing, and felt students were under-prepared for this skill. First years therefore now have 'fill-in-the-blanks' report forms to show them what we expect to be incorporated into a report. Second years are required to complete independent reports in a separate hard-back lab notebook. Most of our lab reports, for both years, incorporate both 'pre-lab' and 'post-lab' questions. Other areas in which students seemed under-prepared included basic skills in handling both quantitative equipment (burettes etc.) and numerical data, so a new exercise to improve these aspects was developed to introduce the Quantitative lab at level 1.

STUDENTS' EXPERIENCES IN TEACHING LABORATORIES

We had several ideas about why students disliked lab classes. Based on our own experience, and students' comments, we suspected that school lab teaching was a poor preparation for the large labs encountered at University, which can seem intimidating. Increasing concerns about health and safety have reduced the range of chemicals available in school labs, so we wondered whether

students found the actual experience of handling chemicals exciting or daunting. We know that the time required to complete the labs is much greater than that apparently required to attend lectures, problem classes, tutorials, etc., while the contribution to the final course assessment is relatively small (10% for labs, 50% for the June exam, and 40% for other continuous assessment for both years). One reason for maintaining this small 'reward' is the difficulty of preventing plagiarism in lab reports. We probed opinions on the importance of labs, on the extent of plagiarism, and on what aspects of the lab reports students felt took 'too much time'.

The questionnaires took the form of a series of statements, the students being asked to indicate how far they agreed or disagreed with each proposition. The take-up was pleasing, with return rates greater than 50% in each year group. The results of these questionnaires will be presented in greater detail on the poster, but here are some of our more interesting, and some of our more encouraging, results.

- Especially in first year, students clearly find working with 'real' chemicals and equipment satisfying.
- Students overwhelmingly enjoy working in pairs, but a significant minority strongly dislike group work.
- First year students were more likely to have enjoyed the labs, and to have found them 'lively and stimulating', and most students either enjoyed the labs or at least had no strong feelings against them.
- First year students were rather less likely to find the new-style write-ups 'too long and difficult', compared to the second years' response to the old ones.
- The longer new labs, as intended, enabled students to feel confident and efficient by the end of each lab.

- Opinion on whether 'School labs were good preparation for University labs' was divided, with significantly less agreement from second year than from first year.
- 2nd year students were more likely to find the labs intimidating at first, despite having seen them before. Our new structure seems to have eased the transition for the students who have experienced it.

These conclusions suggest that our new structuring has significantly improved students' experiences in our laboratory classes.

[P17] Written feedback – is there any point?

Chris Glover and Evelyn Brown

FAST

University teachers spend a great deal of time marking and providing written feedback on written assignments. It seems an important part of the guidance that is offered to students. Students comment on the importance of such feedback. The nature of written feedback has been studied at the Open University and Sheffield Hallam University using a quantitative coding system applied to the written comments made by teachers. This coding exercise has revealed major variabilities in the style and value of the feedback offered and limitations in the extent to which it provokes further learning.

Student surveys at Sheffield Hallam University (SHU) and the Open University (OU) suggest that students regard individualised feedback on their work to be more valuable than generic feedback and that they value written feedback more highly than oral feedback. Such comments were made in the context of general satisfaction with the feedback.

However, and in spite of these generally favourable attitudes, there was very limited evidence that science students at the OU and SHU engaged fully with the written feedback provided. In response to this worrying data, the formative potential of the written feedback on assignments on several courses was studied by analysing the type and depth of the feedback using a coding system described previously (Brown, Gibbs and Glover, 2003). The outcomes of the analysis have been used to identify areas where written feedback practice could be improved with the potential for more effective learning.

SUMMARY OF FEEDBACK ANALYSIS

- Overall amount high, but most feedback feeds 'back', little feeds forward
- Most mark-loss focused, not achievement-focused, mainly justifies grade given
- Most content (topic) focused, not criteria-related – skills feedback relatively rare
- Content mostly omissions focused
- Most not explanatory – weakness-learning, strength-building gaps not bridged
- Engaging students in learning dialogue rare
- Reference to learning resources rare
 - Usually referencing
- Relevance to future work not explicit, rarely implicit

A disproportionately large amount of the feedback appeared to serve mainly to justify the students' grades. Although it clarified what good performance was in relation to the students' work, there was limited potential to feed forward to future work. Students were usually provided with information on how to close the performance gap, but explanatory detail was often lacking. It was simply assumed that students would understand the relevance of the comments and know how to use them.

In some instances a shared understanding between the students and their assessors of the assessment criteria appeared to be lacking. In other instances the students received messages that were enigmatic or which obfuscated the key criteria against which students were being assessed. The data also suggested that the depth and volume of feedback received bore no relationship to the quality of students' work.

An informed understanding of the various and distinct roles of written feedback and the overt and hidden messages that it is giving can enable teachers to improve their practice. They are able to refocus the design of assessment tasks in order to enhance the formative potential of students' assessment, and having done so, can refocus the type of feedback they provide.

Trials are underway in the OU and SHU in various science courses to see if we can enhance engagement. For example, in one course tutors are providing only feedback and no marks on a formative-only assignment. In another an assignment is being split in some way such that students receive only feedback on the first part, and no marks until the second part has been assessed. In both trials students will need to engage with the feedback received to assess the extent of their achievement, which should help them to become less marks focused.

Other trials involve encouraging tutors to positively highlight students' strengths, as well as their weaknesses, and to draw attention to issues that will feed forward to future assessment tasks.

It would be absurd to conclude from the FAST evidence that tutors should stop providing detailed feedback. Absolutely not. The issue is not about whether to do it but about how to do it. How do we ensure that the maximum possible value is extracted from assignments and from the work of tutors? The answer may be found by looking at the criteria under which assessment supports learning. These highlight

the key roles of engagement and feedback. We must secure the engagement of the student and provide advice that feeds forward to influence future learning.

The tutor can refine their teaching to maximise engagement and feed-forward in many ways. Individual styles vary and there is no unique definition of best practice. However, here are some suggestions.

1. Prompt feedback is more likely to be attended to as the topic is fresher in the student's mind. This may have implications for your scheduling of 'marking' and for your response to requests for assignment extension. One person's extension may, through delay, be another's lost learning opportunity.
2. Feedback that is clearly relevant to an imminent task is more likely to be attended to. This suggests that you should identify areas where a skill that needs development will be required in the next assignment.
3. An undue focus on marks may reduce the attention given to learning opportunities. In some cases, script comments seem to be driven by the need to explain why a certain mark was awarded. Is this helpful? A comment that highlights a clear target in future work is more likely to change behaviour than a comment on where marks were lost.
4. Feedback that only notes an error/omission etc or that provides a better alternative is useful but, without an explanation, may not provide the student with a way forward. It is always worth asking whether a comment would benefit from adding '... because ...'
5. Comment that is explicit and does not contain hidden codes is more likely to be helpful. What does a tick mean? What does 'good' mean? Is the level of knowledge you are assuming appropriate?

[P18] Improving learning and assessment with confidence-based marking

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Confidence-based marking (CBM) has been known for many decades to stimulate constructive thinking by students, and to improve both the reliability and validity of exam data. It is surprisingly little used at present, perhaps due to a degree of scepticism, lack of experience, and the fact that major software vendors have not yet adopted CBM in most marketed products. At UCL we have set up web facilities, using FDTL funding for dissemination of CBM (see www.ucl.ac.uk/lapt), to make it easy to experience CBM and to use it in your own institution, with your own material and students. The software was designed with basic sciences in mind – Maths, Physics and Chemistry, Biological Sciences and Medicine. Its first application was for teaching Maths and Physics to students of biomedical science.

We have used a simple and flexible, carefully designed CBM scheme for ten years now, mainly with the aim of improving student study habits, rigour of thought, and depth of reflection. In the last four years we have also used it (partly at the students' instigation) in medical 1st and 2nd year summative exams. The software became known as **LAPT** (London Agreed Protocol for Teaching) following collaboration between several London medical schools now mostly subsumed within UCL and Imperial College. The mark scheme is shown in Table 1. It rewards students for correct answers given with high confidence, while penalising confident wrong answers. The increasing ratio of penalty to reward with higher confidence ensures that the scheme is properly motivating:

the student always benefits by reporting his/her true confidence honestly, whether this is high or low. $C=1$ gives the best score on average if the probability of being correct is $<67\%$, while $C=3$ is best if this probability is $>80\%$. We use the scheme both with computer marked exercises (for example, numerical, multiple choice or true/false) and in exams with Optical Mark Reader cards on which the student marks both the preferred choice (MCQ or T/F) and the confidence (1, 2 or 3) for each answer.

The poster sets out the rationale of CBM and the extent of success evidenced by student evaluations and analysis of large bodies of data from formative and summative assessment. Students appreciate CBM a lot, finding it more searching in identifying their areas of weakness or misconception, and more fair as a mode of assessment. They recognise that unconfident right answers and lucky guesses are not the same and deserve less reward than sound justified knowledge, while confident wrong answers warrant both penalty and (in formative work) careful reflection why confidence was misplaced and attention to explanations on offer. Feedback to students about both individual answers and the overall calibration of their confidence for optimal scores are both important features of our software.

An issue often raised by staff is concern that CBM might somehow favour particular personality types, or one or other gender. Our data shows no evidence for gender differences in the calibration of confidence judgements,

Table 1: The LAPT Confidence-Based Marking scheme (www.ucl.ac.uk/lapt)

Confidence level:	C=1 (low)	C=2 (mid)	C=3 (high)	No Reply
Mark if correct:	1	2	3	0
Penalty if wrong (T/F Q)	0	-2	-6	0

either in formative or summative work, despite a significant tendency for both sexes to be less cautious (and more often overconfident) when working for study and revision than in exams. By the time our students take summative exams with CBM they are well practiced, and they generally match their confidence judgements accurately to their probability of being correct, within the optimal bands set out above. Any students who may be, at the outset when they first experience the system, excessively diffident or confident about their knowledge will be helped through practice and feedback to calibrate these judgements correctly. This judgement – the skill of conveying correctly the degree of reliability of one's knowledge or inferences – is not only relevant to a marking scheme such as we use, but is critical for effective academic communication in any field. The premium that CBM places on the correct identification of either reasons for confidence in a conclusion or reasons for reservation about it, also helps to encourage the habits of rigour, cross-checking and reflection about questions that we all want to encourage in our students. Exam data show that CBM scores are both more reliable (Cronbach alpha) as measures of student performance and better predictors even of the number of correct answers that students will obtain on different questions (Gardner-Medwin and Gahan, 2003).

Teachers interested in trying out CBM with their students can find on the website (www.ucl.ac.uk/lapt) sample exercises in a variety of fields. You can use the software to run (from your own website) your own existing or new material, readily adapted from other formats with translation or authoring tools or

word processing routines. Access for students can be arranged within a VLE, with return of grades from LAPT for storage and handling by the VLE software. UCL will currently assist with such development, and is keen to collaborate in evaluations and the development of new material in other institutions and new disciplines.

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[P19] Distance education in elementary physics without face-to-face sessions: the design of problem-solving and laboratory content for a web-based course

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Poster not submitted in time for publication

[P20] Using the technology – integrating the learning experiences

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INTRODUCTION

During the 1990's a number of important new teaching and learning resources were developed with funding from the Higher Education Funding Councils. Within the sciences some of these still survive, notably CVC (1), Mathwise (2), FLAP (3) and SToMP (4) projects, and the latter two are still evolving. The subject of this paper is the SToMP project, and some of its recent developments.

The SToMP project was awarded three years funding in 1992 to develop two modules (Waves & Vibrations and Measurement & Uncertainty). Further funding was awarded in 1995 in order to maintain the existing product and to support the organisation of further development work. In 1998 a further round of development funding was awarded for a module in Mechanics. Since 1995 a new module in Optics has been developed from contributed work and from monies taken in sales. Another module in Astronomy has been drafted, but only a few units have been prepared.

The original product presented a wide range of document types to the user by means of a document management system called Microcosm. This had its own viewers for standard document types, and a well defined system interface so that interactive applications prepared using different development systems and languages could be integrated seamlessly into the modules. The SToMP materials themselves have recently (2005) been

republished in their original formats but with a new presentation system to replace Microcosm.

STOMP VERSION 5

The new version of SToMP uses a completely new presentation system that runs over the internet. It operates in a similar manner to the World Wide Web, but uses its own document viewers that are designed specifically for this type of learning environment. One of the features of the original SToMP system that is maintained in this version is the ability to display several documents at once. Windows are kept simple, with the minimum of wasted area, allowing users to manipulate their environment to be able to use whatever combinations of documents they need.

The original aims of logically grouping together appropriate instructional scripts, interactive simulations and animations, other documents of various media types, problems and tests has been maintained. These groupings are achieved as before by use of button links (for those which the author wanted grouped), by keyword searching (providing topic groups) and by associative links. The result is a system that can be used in a variety of different ways, with documents of different purposes available for each topic covered.

Whilst maintaining the philosophy of the original system, there have been a large number of minor improvements incorporated

into the new system, as well as a few larger changes. One of the more important developments is a new testing system for the self tests and assessed tests that form an integral part of each module.

ASSESSMENT SYSTEM

The new assessment system offers compatibility with other commercial and academic testing systems for conventional questions (via IMS QTI compliance (5)). It also provides the numeric functionality of the original SToMP testing system together with some enhancements. These include number bases other than decimal, the checking of values for order of magnitude errors, and the use of incorrect student responses to create alternative answers for later parts of multi-part questions.

The new system can be used in a stand-alone mode without SToMP, and has been used in this way for a number of years within the author's department for a substantial part of the coursework of one first and one second year course. Questionnaires have been used to find student attitudes and opinions about what aspects are better than or worse than setting the equivalent coursework on paper. Results of these questionnaires have led to improved functionality of the system and ways in which questions are asked (6).

One such improvement concerns the propagation of errors through multi part questions. This allows a student's incorrect answer in an early part of a question to be used to create alternative answers to a later part. An example is a question where the standard deviation of a set of data points was to be calculated. The question was split into eight parts (sum, mean, square of the mean, sum of squares, etc.). If the sum value is entered incorrectly, it is used to calculate an alternative mean value. If the student obtained this new value for the mean, then they did not lose marks for the second part of the question, only for the first part. There were seven

additional answers in this eight-part question, and several students gained marks from this, and were thus marked more nearly as if hand marking had been employed.

CONCLUSIONS

SToMP provides an environment in which learning can take place, and therefore can honestly be described as a learning environment. It is possibly as appropriate for use in the sciences as some of the so called virtual learning environments, but at the moment it lacks content for more than just part of a first year course in Physics (Waves & Vibrations, Optics, Mechanics and Measurement & Uncertainty). As the functionality is developed to make it even more like a VLE, the project needs to be joined by users and developers to become a community owned resource for the benefit of Physics. The Physical Sciences Subject Centre has contributed to this aim by purchasing free access for all UK HE until summer 2006.

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