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Learning and Teaching
Support Network
Physical Sciences

LTSN Physical Sciences News

...supporting learning and teaching in chemistry, physics and astronomy

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Special points of interest:

- The future of LTSN in the new Higher Education quality framework.
- The Centre's Employability project is starting to produce resources
- Development project reports

In this issue:

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This 'bumper' issue of the LTSN Physical Sciences newsletter, reports on the review of teaching quality in UKHE and the possible impact on the future of LTSN. There are also the details of the new Employability Project being run by the Centre, Summary Reports from several completed Development Projects funded by the Centre, news from some of the science-based FDTL4 projects and from the MathsTeam project. Finally, there are outlines of some of the projects with which the Centre will be producing resources in the near future.

Good reading! ■

The Future of the LTSN - All Change?

The services provided by the LTSN Physical Sciences Centre may soon be provided under the auspices of a different umbrella organisation following the recent report from The Teaching Quality Enhancement Committee (TQEC). The TQEC was established in early 2002 by UUK, SCOP and HEFCE. The Committee, chaired by Professor Sir Ron Cooke, was asked to review the existing arrangements for supporting quality enhancement in UK Higher Education. In particular, it aimed to identify any gaps or overlap in the activities of the four agencies that work in this area; the QAA, the ILTHE, HESDA and the LTSN. Research showed that there is a widespread perception that arrangements for quality enhancement are fragmented and that many VCs favour a single integrated body. The TQEC set out its vision for the emerging quality enhancement agenda in its report delivered in January 2003. (http://www.hefce.ac.uk/learning/TQEC/final.htm)

The report recommends the establishment of a new organisation that would encompass the work currently carried out by the ILTHE, HESDA and the LTSN. The TQEC report suggests that this new organisation is called the 'Academy for the Enhancement of Learning in HE'. The Academy would provide an integrated approach and would work with individuals, groups and institutions. Such an organisation was also described in the recent White Paper 'The Future of Higher Education' where it was referred to as the 'Teaching Quality Academy'. (http://www.dfes.gov.uk/highereducation/hestrategy/)

It is not yet clear how this will affect the LTSN Subject Centres. The discipline-based nature of LTSN services received strong support in the TQEC report and we hope that the Academy will be built on the strengths of the LTSN. However, there are issues related to defining the role of subject centres in the light of the increased emphasis on learning and teaching identified in the White Paper, such as Centres of Excellence, CPD, HE in FE etc. It is also possible that the LTSN 'brand' may be affected in the transfer to an Academy. There has been widespread consultation on the proposals and we have been able to provide feedback from our community.

We expect to receive clear indications of the future position of the Subject Centre by the summer.

Watch this space! ■

Employability Resources

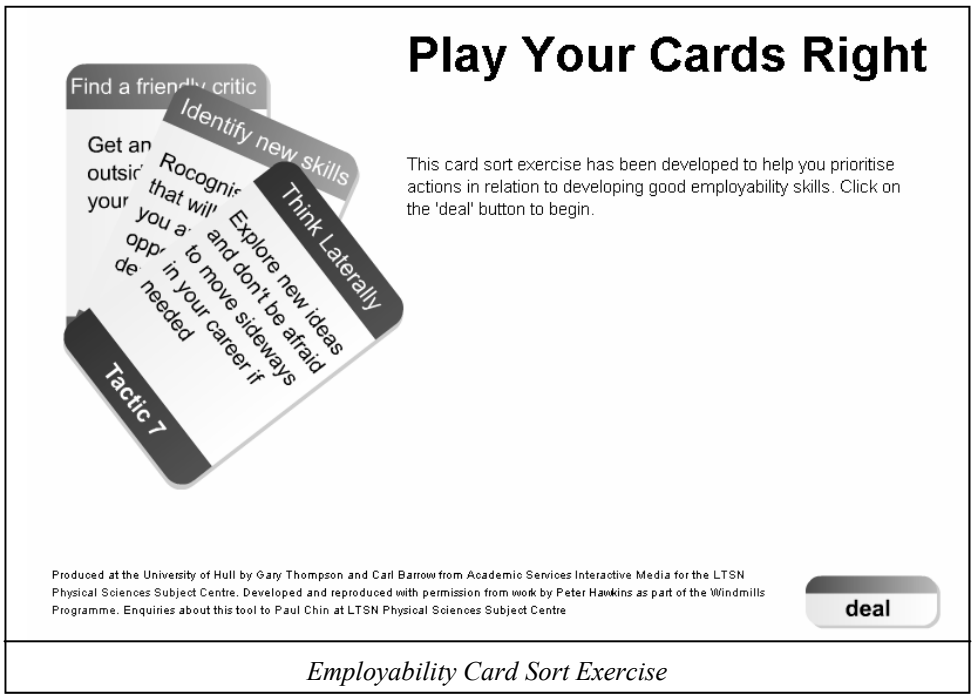
Della Grice is the Development Officer at LTSN Physical Sciences who is specifically supporting the Employability Project run by the Centre.

Della is based at the University of Hull and you can contact her by phoning 01482 465418 or by email to d.d.grice@hull.ac.uk

In response to the national move towards enhancing student employability the LTSN Physical Sciences Centre is undertaking a number of projects to produce subject specific resources to develop student employability and disseminate existing good practice in this area. The resources that have been developed by the Centre and are currently in place include...

Website
The LTSN Physical Sciences website now has a section dedicated to employability. This will be updated regularly with news and information about new resources as they are developed.

Employability Briefing paper
This document outlines some of the background that led to the current focus on employability. This is not intended to be a comprehensive document but it does emphasise some of the key skills students need to develop. References may be followed to obtain more detailed background information.



Employability Card Sort Exercise

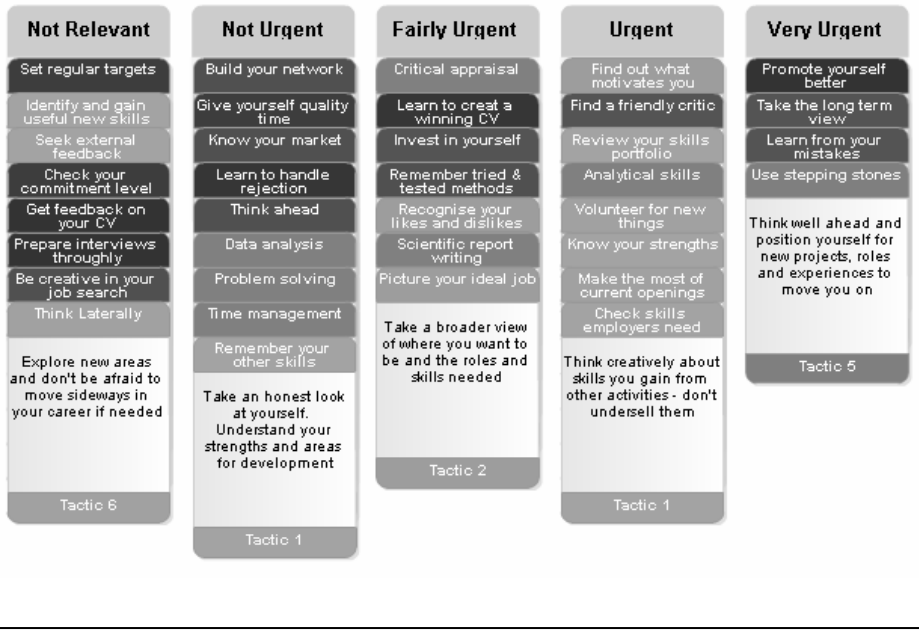
Employability card sort exercise
A subject specific adaptation of an activity from the Windmills[1] programme, this electronic resource uses the popular 'solitaire' game format. The areas covered include the range of employability skills and encourage students to think about how they can develop these skills further during their course. Students are able to choose various options by moving the card of choice to identify their skills priorities. Tutors have the option of including some customised cards if they wish. When used in conjunction with other employability resources, this acts as a simple and useful exercise initiating forward thinking and early-stage career planning. This resource is available free to Higher Education institutions and may be downloaded from the LTSN Physical Sciences Centre website.

Employability Toolkit
The Toolkit provides a summary of some of the subject specific resources currently available to help students develop their employability skills. A range of activities are included, from database searching to advice on giving presentations and report writing. The activities are available, either on-line, or in hard copy and are free of charge in most cases. More detailed information on employability issues and developments can be obtained via the reference section.

Employability Resources

Collating good practice
In addition to the resources available examples of good practice are currently being collected to be presented in the form of a practice guide. The practice guide is a more detailed document and includes cases studies and more comprehensive examples of good employability practice currently undertaken at some of the Universities across the country. If you or your institution has any examples of good practice that we may include in this publication please contact the Centre. A £50 book-token will be given for each resource we include.

'The LTSN Physical Sciences website now has a section dedicated to employability. This will be updated regularly with news and information about new resources as they are developed.'



An example card sort

What's next?
One aspect of the project currently in progress is the 'Developing Employability' resource pack. This product will be a structured resource providing tutors with a simple and effective way of helping students to develop their employability skills. The pack will focus on the various stages of the students' development and will include a range of relevant activities to help the students to think about their employability skills. Although the resource will be based on the Windmills[1] programme, it will comprise of resources which have been developed to be subject specific to the physical sciences, with the emphasis on an easy to use format. The completion date for this pack is expected to be May 2003 and the product will be launched at the employability workshop in June 2003. On request, the staff from the centre will help implement the activities within departments in the 2003-2004 academic year.

Workshop
There will be a workshop covering employability issues, provisionally taking place in June 2003. The workshop will provide a forum for the sharing of existing expertise within the physical sciences community. It will also provide the Centre with the opportunity to launch the 'Developing Employability' resource pack and enable participants to trial some of the activities developed for the pack.

Reference
1. P. Hawkins, Windmills Programme, University of Liverpool http://www.windmillsprogramme.com/

Computer Assisted Assessment

Development project summary report from...

Keith Adams, Bill Byers, Ron Cole and David Ruddick,
School of Applied Medical Sciences and Sports Studies,
University of Ulster,
Jordanstown,
Co Antrim, BT37 0QB.

...a more detailed report can be found on our web site.

'...Conventional paper-based tests... require a significant amount of marking time which may delay their handing back to students. Questions are often marked simply right or wrong and do not provide particularly rich feedback …'

A problem facing many academic staff these days is the large amount of student assessment that needs to be undertaken. Not only is this necessary to give students feedback on their performance during a module, but also to determine what the level of achievement is at the end of the module. For large classes, particularly those encountered in the early years of courses, how are we to provide individuals with feedback on their performance in a timeframe that is likely to have a positive effect on their progress? Conventional paper-based tests, even if based on multiple choice questions, require a significant amount of marking time which may delay their handing back to students. Questions are often marked simply right or wrong and do not provide particularly rich feedback giving students few clues as to why their answers are right or wrong.

In our experience computer assisted assessment (CAA) can prove to be a very effective means of overcoming these problems. Feedback is not only instant with CAA, but it can also be tailored to the individual answer selected by the student. Feedback can be made extensive with graphical material if necessary.

From August 2001 to September 2002 we were funded by the LTSN Physical Sciences Centre to write banks of questions in Introductory Chemistry/Biological Chemistry. The project is now complete and the questions are freely available (details below) to the academic community over the web. Virtually all of the questions have detailed feedback and this allows them to be used as "cyber-tutorials" in formative assessment. At our own institution we are also using selected questions, with the feedback disabled, in summative tests held at regular intervals (2/3 weeks) during the course of a module. The question banks are shown in the Table.

We have used QuestionMark Perception™ software to create the questions. A powerful feature of this software is the range of ways in which questions can be asked. In this project nearly all of the available question templates have been employed: MCQ, Multiple Response, Drag and Drop (Hotspot), Pull Down List, Select a Blank, Text Match, True/False. Also a significant number of the questions contain graphics. The drag and drop questions are particularly useful in Chemistry. They can be used to test understanding of chemical structures by requiring the student to place a marker on a particular part of the structure.

How to access the questions
From our server at:
http://general.ulst.ac.uk/qm/perception.dll

Under *Name* you should enter: **LTSN** and the *Password* is: **LTSN-psc** . Both of these are case sensitive.

	Topic	Number
00.	Foreword	
01.	Introduction to Atoms, Molecules and Equations	37
02.	Introduction to Solutions, pH and Buffers	74
03	Introduction to Kinetics and Equilibria	15
04.	Introduction to Naming of Organic Molecules	30
05.	Introduction to Organic Chemistry	29
06.	Introduction to Fatty acids and Fats	12
07.	Introduction to Amino Acids and Proteins	24
08.	Introduction to Carbohydrates	45
09.	Introduction to Enzymes	39
10.	Introduction to Metabolism	22
11.	Introduction to Safety and the Environment	30
12.	Adaptive Case Study (Student Project)	

On CD as a run-time version. Copies of the CD can be obtained by e-mailing to caa-group@ulster.ac.uk. A small charge may be made for postage.

On the LTSN Physical Sciences web site as a download.

The full database of questions and graphics can be supplied by e-mail as a "Qpack" file. This allows questions and tests to be edited using the Perception Software. Qpacks offer the greatest flexibilty to anyone who wishes to tailor tests and questions to their own requirements. Trial versions of Perception are available from: http://www.questionmark.com/uk/home.htm

If you install the server software at your own institution you can record students' answers.

We would welcome any feedback on these questions, including suggestions for improvement or future collaboration. Please send any correspondence to Dr Keith Adams at the address above or KR.Adams@ulster.ac.uk ■

Interactive simulations for introductory physics

Development project summary report from...

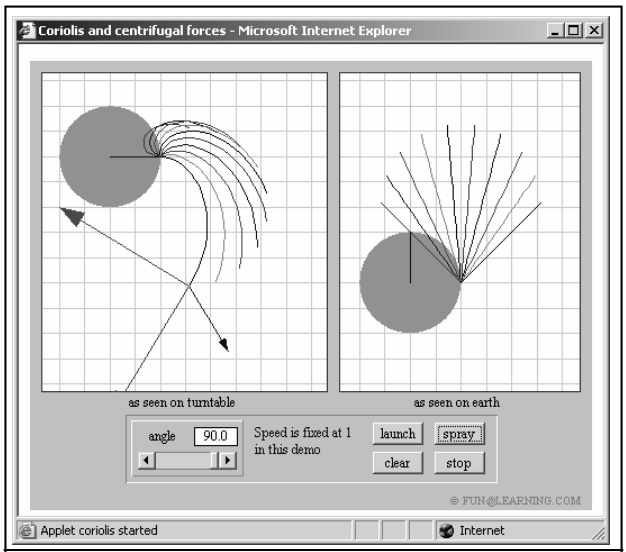
Simon Bates,
School of Physics,
University of Edinburgh,
Edinburgh EH9 3JZ.

...a more detailed report can be found on our web site.

'...simulations enable students to form connections between the many and varied representations that we use in Physics and to build mental pictures ('models') of physical systems…'

1. Introduction

Our view of the role of C&IT in the teaching of the Physical Sciences is that it should augment and enrich traditional teaching methods in a coherent learning environment. Interactive simulations enable students to form connections between the many and varied representations that we use in Physics and to build mental pictures ('models') of physical systems whilst offering an engaging, hands-on, active learning experience that puts the student in control of events and can lead to a deeper learning. The world wide web is a rich source of existing simulations that could be effectively used to help our students grasp items that have been traditionally difficult to conceptualise. We have created and started populating a library of applets considered appropriate and written it in such a manner as to make it easily accessible. We have designed our own home-grown applets to meet needs not catered by existing sources and we have devised a means of "wrapping" applets so that the relevant information can be extracted from the source and integrated into the body of the teaching material.



An example simulation

2. Applet library

The Applet library is published online at: http://www.ph.ed.ac.uk/applets

- The applet library (database) exists as a MySQL database
- Perl / cgi scripts (1200 lines) query the database on the fly, creating customised web pages, depending on how the user wants the information presented, e.g. ordered by course, by topic, full listing etc.
- The database is managed remotely using the ODBC protocol through Microsoft Access 2000. This allows modification of database content and design in a transparent way. The scripts and database design is fully documented to enable transfer of management responsibilities to different people.
- The script automatically checks whether or not links are dead or alive and adjusts the displayed web page that is delivered to the user accordingly.
- An Applet Wrapper has been created, which the user views as a series of step-by-step instructions. This enables a non-expert to create high impact web pages with Applets embedded in them for offline use, without detailed knowledge of the html language.

3. Application and Evaluation

- The Applet database now contains nearly 100 resources
- Four home-grown applets have been developed and these are accessible in the database
- The first year Foundations of Physics course now contains over 40 applets within it that the students can access and use any time.
- Students on the course were specifically asked in the course questionnaires as to their opinion of the inclusion of applets. An almost unanimous vote of confidence was given; all agreed that these were valuable resources that allowed the students to investigate the material "off-line".

4. The future

With the infrastructure in place, we now intend to:

- Extend the number and range of applets in the database.
- Create more home-grown material to fill in what we perceive to be the gaps in material available remotely on the web.
- Make further efforts to more extensively integrate applets into our existing introductory level courses.
- Explore the possibility of transferring this generically to other subjects (eg chemistry and engineering). Collaborations are also currently being discussed with SELLIC, Intrallect and Multiverse. ■

Assessment and examinations

Development project summary report from...

Stuart W Bennett,
Open University,
Milton Keynes,
United Kingdom.
Rowan W Hollingworth,
University of New England, Armidale,
NSW,
Australia.

...a more detailed report can be found on our web site.

'...in the worst cases, students are able to achieve a pass grade with less than twenty per cent of the learning outcomes fully achieved.'

Over the last two decades, there has been a move from examination testing to continuous assessment in chemistry at the tertiary educational level. Even so examinations still play a major part in assessment. We set out to find if there had been a change in examinations in line with the changing assessment regimes.

Our analysis was based on first year university chemistry examination papers alongside the claimed learning outcomes: 137 papers from 31 universities in the UK, 10 in the USA and 7 from Australia. In all of the work, there were no significant differences between the papers from all the universities, within or between countries.

The first part of the project involved the matching of examination questions to the claimed learning outcomes tested. Our observations are:

- that there are major mismatches between the learning outcomes that are claimed to be tested and those that are actually tested.
- some outcomes are tested several times in the same paper and some omitted. This situation is made worse where the paper embodies a choice of questions.
- in the worst cases, students are able to achieve a pass grade with less than twenty per cent of the learning outcomes fully achieved.
- questions that are easy to set and easy to mark tend to predominate.

The next step was to look at problem solving as tested in the examination. The first stage of this analysis was to use the categorisation based on input data, method and output of the problem. We found that:

- 94 per cent of problems were in the category of input data given, method familiar and output defined. In other words, these are not problems but simple algorithms (see Table).

An analysis of open problems with Open University students revealed that true problem solving ability:

- improved enormously with practice and discussion.
- was not related to prior formal educational experience.

The shortcoming of the categorisation based on input data, method and output was that it did not translate well to questions of the type: 'Compare and contrast…, identify the factors that affect/control…',etc.

Type	Data	Method	Outcome	Analysis
1	G	F	G	94.6
2	G	U	G	3.00
3	I	F	G	2.10
4	I	U	G	0.00
5	G	F	O	0.30
6	G	U	O	0.00
7	I	F	O	0.00
8	I	U	O	0.00

G given, F familiar U unfamiliar, I incomplete, O open

We developed a matrix in which we introduced the three lower Bloom levels of knowledge, comprehension and application. The overall analysis of the examination papers then painted a slightly less depressing picture in the context of the repertoire of skills that students required to complete the examination paper.

The matrix for the analysis of examination questions can be applied easily to almost any examination question and can quickly reveal the overall form of the examination. ■

Thermodynamics in Context

Development project summary report from...

John Holman,
Department of Chemistry,
University of York,
Heslington,
York YO10 5DD.

...a more detailed report can be found on our web site.

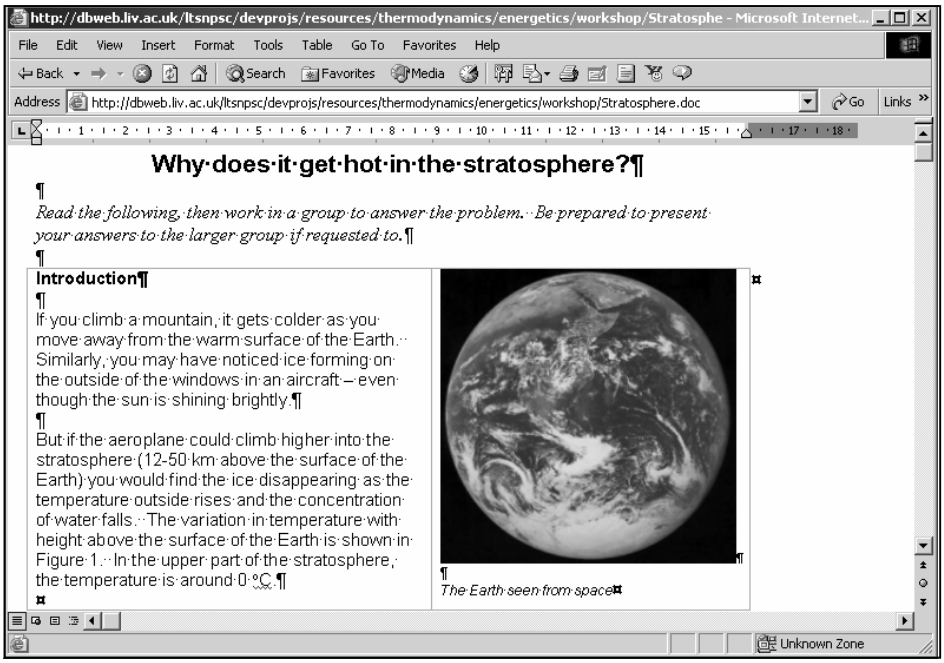
'...the ratings in undergraduates' evaluations for the course improved significantly and the examination mark rose from 48% in 2000 to 61% in 2001. Further evidence of success was provided by a focus group discussion.'

The first phase of this project, which was funded by an LTSN grant is now complete.

Trials of the new lecture course on the First Law of Thermodynamics took place in the Universities of Leeds and York with first year undergraduates during 2001/02. The trials proved very successful: in York for example the ratings in undergraduates' evaluations for the course improved significantly and the examination mark rose from 48% in 2000 to 61% in 2001. Further evidence of success was provided by a focus group discussion.

The successful trial has encouraged us to proceed to a second phase of the project. We are currently developing materials for the course on the Second Law of Thermodynamics which will be delivered in early 2003.

As with the First Law, the resource materials will consist of a contextualised lecture course, contextualised problems for tutorials and workshops and a computer based question bank to give students practice in standard calculations. As with the First Law materials they will be made available



An extract from one of the resources

The results of these trials have been written up and submitted to the *Education in Chemistry* (UK) and *Journal of Chemical Education* (USA).

Presentations have been made on the project at a number of chemical education conferences, and a further presentation has been made at the LTSN's seminar on context-led learning at Nottingham Trent University on 4 December 2002.

The resources are available at:
http://www.physsci.ltsn.ac.uk/devprojs/resources/thermodynamics/readme.htm

on the web for access by all who are interested. This second phase of the project has been funded by a small grant from the Salters Institute. ■

Knowledge Mapping in Physics

Development project summary report from...

Ashley Clarke,
Department of Physics and Astronomy,
University of Leeds,
Leeds LS2 9JT.
Jim Ryder,
Centre for Science and Mathematics Education,
University of Leeds,
Leeds LS2 9JT.

...a more detailed report can be found on our web site.

'Surprisingly, most of the students (who formed a random subset of the first year physics cohort at Leeds) had already met some form of knowledge map at school, but NOT in connection with their physics!'

A small-scale pilot project has been undertaken to introduce and investigate the uses of different forms of Knowledge Mapping at physics undergraduate, level 1 for twelve students studying basic electronics. The idea behind Knowledge Maps was introduced by Ashley Clarke at the beginning of semester 1 during an elective, 10 credit, laboratory-based module in 'digital and analogue electronics'. The students were encouraged to use the maps for planning oral presentations and also reviewing/ preparing for end of semester examinations. In the second semester, the students operated in small teams working on open-ended projects and maps were used to brainstorm ideas at the beginning of the project, for scheduling of the team members activities during the project and also for preparing for status meetings with the academic facilitator. Finally, the students were interviewed by Jim Ryder and their attitude towards these learning maps was elicited.

Surprisingly, most of the students (who formed a random subset of the first year physics cohort at Leeds) had already met some form of knowledge map at school, but NOT in connection with their physics! For example, one or more of the students had met spidergraphs at year 7, flow diagrams (for essay planning in English), memory maps, concept maps, 'Inspiration'™ software (to help with dyslexia) and an Australian student had met mapping for mathematical proof generation. To the authors' knowledge, although maps are used in many different ways to put across specific concepts in physics courses, there is very limited usage by lecturers to use these teaching and learning techniques explicitly and coherently.

The Final Report for this Knowledge Mapping project will survey the published literature (mainly for high school and secondary school pedagogic research), reflect on the impact of this work on the students attitudes and provide resource (mainly website) locations where more information on these techniques can be found. ■

Development Projects. Want to get involved?

The Centre is keen to support further development projects in the physical sciences and includes a sum in its annual budget for such activity.

If you have an innovative idea for improving an aspect of learning, teaching or assessment then we would like to hear from you.

We are particularly interested in bids based upon the following themes…

- **Widening Participation**
- **Developing Employability Skills**
- **Computer-aided Assessment**
- **Research into Learning and Teaching**
- **Implications of SENDA Legislation**

You can find details of how to apply on our web site. The current deadline for applications is 11th April 2003.

Mathematical Learning Hierarchies Sciences

Development project summary report from...

Paul C Yates,
School of Chemistry and Physics,
Lennard-Jones Laboratories,
Keele University,
Keele,
Staffordshire ST5 5BG.

...a more detailed report can be found on our web site.

'Users are also invited to submit interesting problems to the author for mathematical skills analysis and inclusion in the web page resources'

This resource has been designed to assist those who are instructing students in chemistry and physics at degree level who have a weak mathematical background.

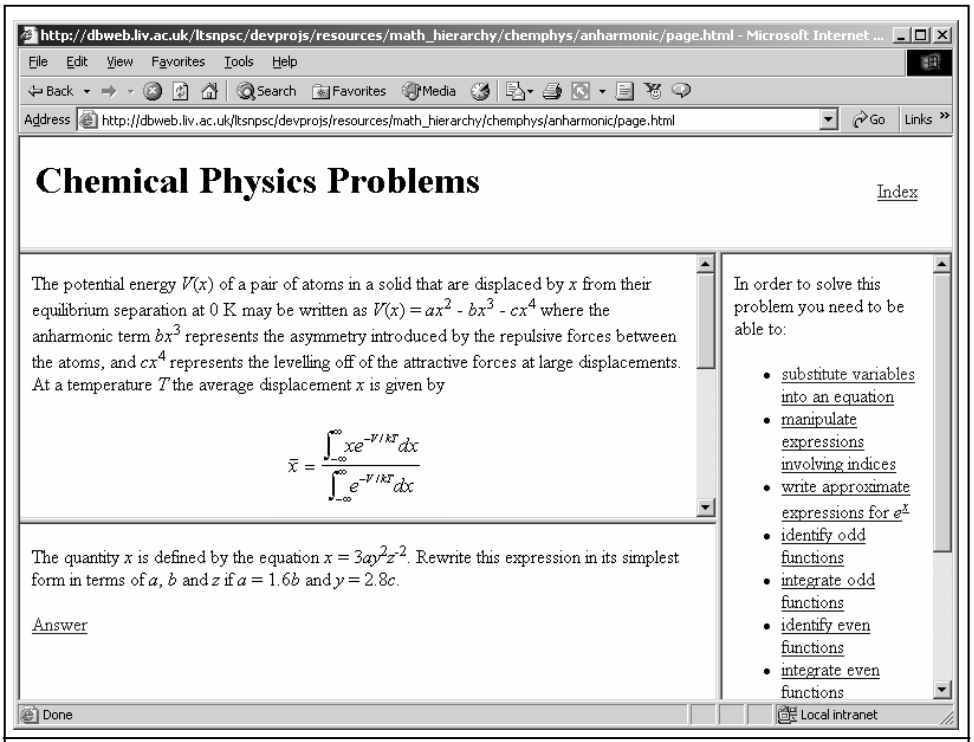
The material is split into three sections: chemistry, physics and an overlap area labelled as chemical physics. Within each discipline there are a number of applied problems; although each of these problems is highly relevant to the discipline, each is constructed in such a way that they can be solved without detailed knowledge of the topic other than the mathematics required.

Each problem has been analysed in terms of the mathematical skills required. This list of skills appears in a side window, and each member of the list comprises a link to one or more relevant questions in this area. A total of 159 unique skills questions exist; the most commonly used of these are those which test the ability to rearrange algebraic expressions.

The answers to each question are provided by a link to a popup window. Since the popup windows are generated by the inclusion of a small amount of javascript code, browser options can be varied in order to disable the appearance of the windows.

The remainder of the materials have been produced in simple HTML, with the more complicated expressions being represented by graphical GIF files.

Users are also invited to submit interesting problems to the author for mathematical skills analysis and inclusion in the web page resources.



An example of one of the problems

The current URL of the home page for this resource is:
http://www.keele.ac.uk/depts/ch/ltsn/home.html

and this is 'mirrored' at:
http://dbweb.liv.ac.uk/ltsnpsc/devprojs/resources/math_hierarchy/home.html ■

Teaching Units in Physics

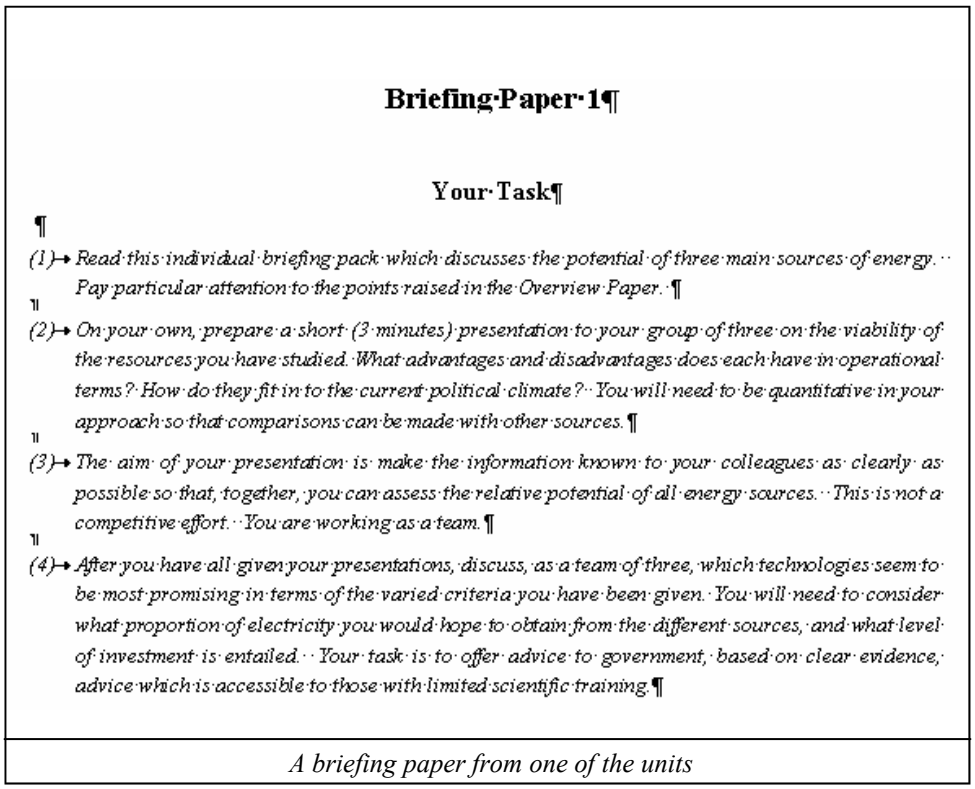
Development project summary report from...

Norman Reid,
Centre for Science Education,
University of Glasgow,
Glasgow G12 8QQ.

...a more detailed report can be found on our web site.

'The project developed and tested teaching units for use at level 1 of undergraduate courses in Physics. They do not seek to teach physics but to apply physics into real-life situations.'

The project developed and tested teaching units for use at level 1 of undergraduate courses in Physics. They do not seek to teach physics but to apply physics into real-life situations. They involve paper-based group work and contain a full tutor's guide. They are relatively short, being suitable for tutorial use. While focussing on physics applications, their use involves group discussion, debate and argument as well as opportunities for developing presentational skills. Supplementary activities are suggested.



Briefing Paper 1

Your Task

(1) Read this individual briefing pack which discusses the potential of three main sources of energy. Pay particular attention to the points raised in the Overview Paper.

(2) On your own, prepare a short (3 minutes) presentation to your group of three on the viability of the resources you have studied. What advantages and disadvantages does each have in operational terms? How do they fit in to the current political climate? You will need to be quantitative in your approach so that comparisons can be made with other sources.

(3) The aim of your presentation is make the information known to your colleagues as clearly as possible so that, together, you can assess the relative potential of all energy sources. This is not a competitive effort. You are working as a team.

(4) After you have all given your presentations, discuss, as a team of three, which technologies seem to be most promising in terms of the varied criteria you have been given. You will need to consider what proportion of electricity you would hope to obtain from the different sources, and what level of investment is entailed. Your task is to offer advice to government, based on clear evidence, advice which is accessible to those with limited scientific training.

A briefing paper from one of the units

The four units are:

Renewing Energy
After a brief introduction, students work in collaborative groups of three to assess the key features of a range of primary sources of energy in order to make a recommendation about national policy to meet the requirements of the Renewables Obligation, a Parliamentary Order which came into effect in 2001, compelling all electricity suppliers to source at last 10% of their power from renewable sources by 2010.

Mobile Phones
After a brief introduction, students work in role play groups representing various view points to develop a policy for the installation of phone masts on an imaginary island where competing interests are strong.

Fibre Optics
Students are required to consider the essential physics of the use of fibre optics and then, working in small groups, they assess data provided on various materials and make selections of materials for various applications: communications and endoscopes.

Colour
After an introduction which deals with the nature of colour in terms of spectra, incident light and colour perception, student work in pairs to look at one primary colour, seeking to select potential colours for use in road signs. They come together to exchange their findings and come up with a set of three colours which are suitable for use. Colour matching functions are considered as a supplement.

The resources are available at:
http://www.physsci.ltsn.ac.uk/devprojs/resources/physics_teaching/readme.htm

Developing Business and Entrepreneurial Skills

Development project summary report from...

Derek Raine,
Department of Physics and Astronomy,
University of Leicester,
Leicester LE1 7RH.
Deborah Price,
Management Centre,
University of Leicester,
Leicester LE1 7RH.

...a more detailed report can be found on our web site.

'Students were introduced to aspects of running a business including: Researching the market; Market sectors; Making a business plan; Financial control; Quality matters. They then ran an Internet Training Company for 6 weeks…'

The purpose of this project was:

- to provide a vehicle for introducing basic awareness of business skills.
- to enable students to begin to learn about business by experience.
- to teach high-level group work skills and to use group work to motivate student interest and engagement.
- to exploit internet technology.

Students were introduced to aspects of running a business including:

- Researching the market.
- Market sectors.
- Making a business plan.
- Financial control.
- Quality matters.

They then ran an Internet Training Company for 6 weeks providing training courses to students in the Faculty of Science. Finally they produced a company report with groups of students responsible for individual sections).

Implementation
The first meeting for the course was a briefing session explaining the structure, intended outcomes and assessment.

The initial part of the course was taught by 6 lectures delivered by two staff from the Management Centre at the University of Leicester. Because the number of students taking the course was small, the lectures were delivered informally.

In the second part of the course the students organised a company to deliver a web training course. The company web site, marketing strategy and teaching materials were produced by the students and the course delivered to 10 registered students who provided feedback for the evaluation. The company report was prepared jointly and assessed by the lecturers according to the extent to which it showed that the lecture material had been understood and applied.

The company posts were as follows:

- Director of Operations.
- Director of Strategy.
- Marketing Director.
- Customer Relations Officer.
- Finance Director.

The students gave three class sessions and produced follow-up tutorial material on their web site:
http://www.le.ac.uk/physics/teach/recruit/year3/webdocs/index.htm

The material is password protected. The current password is wpd.

Results
The company report was evaluated as first class by the lecturers concerned.

Evaluation
The evaluation consisted of an hour long interview with all the participants. Several main areas were discussed:

- Timing of the course.
- Choice of material.
- Number of sessions.
- Marketing.
- Low enrolment.
- Workload.

Overall: the module was felt to have achieved its purpose in a way that was much more interesting than lectures alone.

Assessment: The original agreement with the Management Centre was that it would be possible to disentangle the individual contributions to the report, since each student was responsible for one aspect. In fact the final form of the report was a collective effort and it was not possible to ascribe individual marks. Students were of the opinion that all had contributed equally. My guess is that this really means equal effort rather than equal achievement. Therefore the assessment strategy will have to be re-addressed even though it may be that 5 credits out of 240 or 360 assessed on a group basis is unlikely to distort degree classes to a significant extent. ■

New Web-based Learning tools for Maths in Physical Chemistry

Development project summary report from...

Karl S Ryder,
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...a more detailed report can be found on our web site.

'This project is specifically concerned with the teaching and learning process… and... has addressed some of these problems through the development of interesting and appealing interactive web-based software...'

Communicating the fundamental concepts, techniques and methodologies in the Physical Sciences is becoming more and more difficult in many University Departments because of student abilities in, and attitudes towards learning and application of, mathematical skills. Many students experience difficulties with calculations involving logarithms, exponents, manipulation of equations and the application of simple calculus, whilst at advanced levels students are held back from an understanding of the more complex, interesting phenomena and an appreciation of their application in the real world by a poor grasp of the mathematical language of science.

This project is specifically concerned with the teaching and learning process in Physical Chemistry and this programme of work has addressed some of these problems through the development of interesting and appealing interactive web-based software to stimulate and facilitate student learning in Physical Chemistry. Completed material, along with this report (in PDF ***Acrobat***, format), is currently available on-line at the addresses below:
http://www.dmu.ac.uk/ln/chemistry/lectures.html
http://www-staff.lboro.ac.uk/~cmksr/index.html

Three learning areas within the original remit, summarised above, were targeted for development during this project. These three areas are;

- Visualisation and calculations involving simple mathematical functions.
- Fundamental calculations in physical chemistry.
- Symmetry classification of molecules for group theory.

Tutorials have been designed around these areas, making use of interactive and graphical features associated with the various programming technologies compatible with network browsers such as ***Netscape*** and ***Microsoft Internet Explorer***, for dissemination across the World Wide Web. Each of these areas was chosen because it highlights specific learning, or technical issues required for the project as a whole although they share certain technical challenges such as maintaining compatibility (and function !) across different browser environments. These issues and a brief description of each project area are outlined in the remainder of this report together with an some concluding remarks and indication of future work. All completed aspects of this project are available from the web address above. These tutorials should function equally well on PC, Mac or Unix workstation platforms.

Conclusions

Informal feedback from students using these tools in conjunction with their tutorial material has indicated that this project has been a success. In particular students appear to find the material for Point Group assignment useful and worthwhile. Some technical issues have been reported (by users) that have interfered with the function of the software and these have most commonly applied to the Point Group material. The problem originates from the software "object model" that is implemented by the different versions of web-browsers such as Netscape and Explorer. Additionally, some versions of Netscape allow the user to change the size of fonts and this will alter the appearance of the program occasionally moving some components out of view. Work is underway to alleviate these problems and to incorporate code to make the most up to date version of this software compatible with the new versions of Netscape (v6.1 and higher). In general for the emergence of new tutorials the use of JavaScript has differed to Java. Although the latter is more technically demanding for the author, it offers better compatibility, reliability and consistency of function.

Future work

This project has produced a series of functional tutorial tools for the use of undergraduates in applications of mathematical problems in Physical Chemistry. These software tools are available anywhere across the web and will function on any computer. The development methodology for these tools is now firmly established and this will facilitate the ongoing nature of this project. The themes and methods developed here are already in use and planned applications will include, for example, calculations in polymer synthesis, fluorescence spectroscopy and gel permeation chromatography. These applications are targeted at students undertaking Physical Chemistry laboratory classes. Software for the latter application is already in test use in the 2nd year undergraduate laboratory classes in Loughborough. The author is committed to the continued development and dissemination of these methods. ■

Persuading Physicists to Engage in PDP

Development project summary report from...

Alison Voice,
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...a more detailed report can be found on our web site.

'The majority of recent graduates who replied to the survey were actively using PDP processes within their employment (for regular appraisal and promotion) and to help them acquire or change employment.'

The expansion of Personal Development Planning (PDP) within Higher Education arose out of the Dearing Review in 1997, however its uptake by physics students (and probably students from many other disciplines) has not been very enthusiastic so far. This project set out to survey current physics undergraduates, recent physics graduates and staff in HE physics departments, to find out the main reasons for the slow uptake of PDP activities within physics departments. This information was then used to update PDP materials and procedures in the physics department at Leeds, and to devise and deliver an interactive seminar to incoming 1st year physics students in their first week at university, to persuade them of the benefits of engaging with PDP activities throughout their time in HE.

The results of the surveys revealed the main reasons for the lack of engagement with PDP activities were:-

- lack of perceived benefit.
- lack of time.
- student apathy.
- use of PDP at school tainted students' view for HE.
- lack of prior training for staff.

The majority of recent graduates who replied to the survey were actively using PDP processes within their employment (for regular appraisal and promotion) and to help them acquire or change employment.

A major re-write of the department's Progress File was then undertaken in the light of these surveys.

The interactive seminar for incoming 1st year physics undergraduates was delivered on the first day of semester 1.Three speakers were used:

- **A physics lecturer** to help students realise the need to develop their study skills and to make use of their tutor and Progress file.
- **A recent physics graduate** to show how PDP is used in job applications / interviews / appraisals / promotion.
- **A careers advisor** to give the wider picture of transferable skills and employability.

All material and procedures developed in this project are readily transferable to other disciplines, and electronic copies of the material can be supplied on request. ■

PDP Resources from LTSN Physical Sciences

The Centre has produced…

- a Briefing Paper entitled '*Personal Development Planning*' (January 2003)
- a Learning and Teaching Toolkit entitled '*Personal Development Planning'* (September 2002)

Both these resources are available to download from our web site.

We have also…

- run workshops on PDP in London (23rd October 2002) and at Glasgow (29th January 2003).

Further events in the future are planned.

Software Resources for Remedial Physics Teaching

Development project summary report from...

Steve M Walker,
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...a more detailed report can be found on our web site.

'...there is a substantial minority of students who do not have the necessary physics background to tackle parts of most first year physical chemistry courses and for whom some kind of remedial action is required.'

Introduction
The mathematical deficiencies of physical sciences students are well documented and almost all science departments have instituted measures to alleviate the problem. The exact nature of these remedies and the 'holes' they are addressing varies by institution and subject, but support using software tools forms a part of most strategies.

It is gradually being recognised that, in chemistry departments, this is not the whole story and a lack of knowledge of 'A' level physics is a strong contributor to the numerical weakness inhibiting progress in (particularly physical) chemistry. An example from this institution illustrates the types of problem encountered.

Students were unable to convert between frequency and wavelength, not because they could not carry out the necessary arithmetic (although this might be the case for some) but because they did not know the relationship between the two. This important part of science is assigned to the physics syllabus at 'A' level and either does not figure in most of the combined science curricula at GCSE level, or it has been forgotten in the intervening 2½ years between GCSE and 1st year at university.

In summary, there is a substantial minority of students who do not have the necessary physics background to tackle parts of most first year physical chemistry courses and for whom some kind of remedial action is required.

Solution
The first task was to establish the precise nature and magnitude of the problem. The several GCSE physics syllabuses were examined and compared with the typical requirements of a university chemistry degree. A report was produced highlighting the discrepancies and was made available via a LTSN briefing paper.

Software
In the second phase, software tools have been developed to address the issues raised in phase one with priority being assigned to topics most frequently occurring in the curricula. After discussion with colleagues, the topic of 'Particles and Waves in Chemistry' was selected. The tools consist of simulations (and high quality diagrams with relevant animations) designed to accompany tutorials or workshops. They are not 'stand-alone' programs and assume that the teacher has covered the basic groundwork. In this way, the material does not impose any learning style and should be treated as a simple resource similar to an illustration or photograph. Substantial numbers of numerical problems (in practice, an infinite number) are included for use as reinforcement learning tools – a technique that has been shown to be extremely effective in tackling specific numerical shortcomings. Given that the overwhelming majority of the targeted students have chosen to avoid physics, great care has been taken to ensure that the context enclosing the materials is identifiable as chemistry only.

Software content
Electromagnetic waves
Wavelength and frequency
The electromagnetic spectrum
Radiation energy
Atomic spectroscopy
The hydrogen atom spectrum
Interference
Diffraction
De Broglie wavelength
The photoelectric effect.

The teacher
A separate program is provided for the class teacher. This not only supplies full information about the package and its operation but also allows the teacher control over the students' replies to numeric questions.

Evaluation
It was intended that volunteer teachers would carry out formative assessment and support was canvassed at the 'Variety in Chemistry' meeting in 2001. Despite much interest, only one teacher responded from all those who requested the *alpha-version software. The* referees suggested that university students could have a useful input, but none who were approached could recall their state of knowledge on entry to the university. It was decided to use 6th formers from schools that were sympathetic to the project. The tutorials have been modified substantially based upon their recommendations.

It is unlikely that summative assessment can be put in place before the beginning of the next academic year.

Distribution
The package occupies some 4.5 Mb and will be made available free of charge via FTP (ftp.liv.ac.uk/FTPANON/ftpanon1/ftp/pub/chemistry/ltsn/physics) from the LTSN website. It is also available on CD-ROM as part of a very much larger collection of software (The Chemistry Tutor II+), which can be purchased for £30. ■

FDTL4 News

Project LeAP

From: Sarah Symons,
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The Project LeAP team will be staging their first 'Road Show' in York on Wednesday, 5th March. The Project consortium, comprising the Universities of Leicester, Hertfordshire, Reading, and Sheffield, aims to encourage the successful implementation and integration of problem-based learning (PBL) in undergraduate physics and astronomy courses. Road Shows will be presented across the country, generating interest in the benefits of using PBL alongside or in place of traditional teaching methods. All interested in teaching physics are welcome to attend. For more information, or to arrange for the Project LeAP Road Show to visit your institution, please e-mail: project.leap@leicester.ac.uk or phone 0116 252 2069. ■

Maths Support at the Transition to University

From: Mike Savage,
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"Can't do the maths."

This is the single biggest factor in first year drop-out from physical sciences and engineering courses where a sound basis of mathematical understanding is needed. It has led to the:

- diagnostic assessment of students' mathematical skills in 250+ departments of Mathematics, Physics and Engineering.
- growth of Maths Support Centres in more than half of all UK universities.
- Engineering Council report, London (2000), *Measuring the Mathematics Problem.*
- on-screen maths tutorials delivered by Tom Roper in the M^{4}E Maths for Engineers hybrid DVD-Rom.

Experience gained in all these activities has led to this FDTL4 project to bring accessible maths support directly to students on-line and on disk.

The universities of Leeds, Loughborough and Coventry have a strong track record in creative approaches to providing maths support. They are combining with the new media development work of the Educational Broadcasting Services Trust to develop the *Mathcentre* website and the *Mathtutor* disk, offering related and complementary resources in ways that students and lecturers will find easy to get hold of and attractive to use.

Designed to revise and refresh students' knowledge and skills, the project will produce e-diagnostics, digital video tutorials, associated texts and interactive exercises. A key feature will be the non-linear, interactive design which enables students to navigate various pathways to access the specific support they need at the level they need it. And students will be closely involved in all stages of designing and testing to make sure it works for them. First stage trials will be under way after Easter. ■

STARS: Creation of Statistical Resources from Real Datasets

From: Colin James,
Project Director,
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De Montfort University,
The Gateway,
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When and Who?
This 3-year project started in October 2002, and the team consists of the Project Director Colin James (De Montfort University), Penny Bidgood (Kingston University), Neville Hunt (Coventry University), Brad Payne (The Nottingham Trent University) and Vanessa Simonite (Oxford Brookes University).

Overview
The goals, which have been set in response to feedback from our community and others, are to:

- make available real datasets, from accessible databases, in a form suitable for a learning and teaching resource in HE across a range of disciplines.
- construct learning materials to accompany these datasets.
- develop such materials so they can be used with various statistical packages for a range of student abilities, backgrounds and needs.

The materials will be accessible electronically for use by both staff and students. All materials will reflect real, in-context, scenarios so they will address a number of issues, including:

- professional development for lecturers.
- student motivation and retention.

What happens next?
Please email Colin, with an appropriate response, at cj@dmu.ac.uk (subject: FDTL) if you answer **YES** to any of the following questions.

- Do I know where to find datasets **with** scenarios?
- Could I and my students benefit from these resources and, if so, which three disciplines (in rank order) are top of my list?
- Can I offer existing materials which I would like the team to develop further?
- Would I like to be associated with this project in the capacity of a pilot/ evaluator? ■

Coming soon!

New Directions
We are in the process of producing two new publications, 'New Directions in Physics Teaching' and 'New Directions in Chemistry Teaching'. The broad aim of these publications is to identify and disseminate innovative work in the respective fields of physics/astronomy and chemistry teaching. The intention is to publicise the good work of practitioners and highlight the availability of useful, relevant resources which you might consider helpful for your own teaching. These will be published annually.

Database of Practicals
We will shortly be advertising the database of practicals project, which will call on academics in the physical sciences community to share examples of experiments they use in their own teaching. We are able to offer an honorarium for every practical published in the database. Even if most people only offered one example from their own work, this could soon add up to several hundred practicals from which the whole community could benefit.

Library of Images
Tony Rest, Director of the Chemistry Video Consortium, at Southampton University has been commissioned by the Centre to undertake a pilot study to determine the feasibility of producing a library of images for use in physical sciences teaching. It is intended that these images should be freely usable within the teaching environment, with copyright and/or royalty considerations settled through negotiation with the owners/distributors.

The MathsTeam Project

In June 2000, the Engineering Council made the following pronouncement:
"*This past decade has seen a serious decline in students' basic mathematical skills and level of preparation on entry into Higher Education*".

Teachers in the Physical Sciences might well have asked why it took them so long to realise this when we had been bemoaning the fact for at least five years before this! Nevertheless, one consequence of this sudden attention was the setting up of MathsTEAM, a joint initiative by LTSN Engineering, LTSN Maths, Stats & OR Network, UK Centre for Materials Education and LTSN Physical Sciences aimed at utilising the knowledge of methods current in the science and engineering communities.

An in-depth survey, examining the following three topics has been carried out:
- Maths support programs and resources.
- Current practices for teaching mathematics to engineering and science students.
- A study of diagnostic testing.

The information will be published in three booklets:
- Maths Support for Students.
- Maths for Engineering and Science.
- Diagnostic Testing for Mathematics.

Each booklet provides a comprehensive collection of case studies, intended to help academics cope with the challenge of enhancing engineering or science students' basic mathematical skills. The contributing authors discuss the execution of current teaching practices based on each of the three topics above. They talk about the barriers and the enablers in setting up these learning initiatives. For those academics considering the implementation of any of the programmes, each case gives the opportunity of reviewing the learning processes and tools. Each booklet contributes to the transfer of knowledge within higher education communities; each case study offers practical suggestions for academics to gain a better understanding of the present situation and related topics that merit further exploration and research.

The booklets, containing over 60 case studies will be launched at the "IMA Mathematical Education of Engineers Conference" at Loughborough on the 2nd of April and will be of interest to all those involved in supporting student learning of mathematics, whatever the discipline.

The LTSN Centre for Physical Sciences has ordered sufficient numbers of booklets to provide a copy for each department and more can be purchased (at £1 each) from MathsTEAM. ■

LTSN Physical Sciences

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Events —2003—

- New lecturers event, 10th April 2003, Warwick
- Evolving Science, 7th May 2003, Edinburgh
- Departmental Representatives Meeting, 21st May 2003, Birmingham
- Widening Participation, 4th Jul 2003, Warwick
- Variety in Chemistry Education in association with Irish Variety in Chemistry Teaching, 31st Aug to 2nd Sep 2003, Dublin
- Physics Discipline Network IX, 11th to 12th Sep 2003, Leeds

Contact us or visit our web site for details.