

Wavelength

Autumn 2009

This issue...

See accounts on pp2-3 and 4-5 from two of our Departmental Representatives, describing how they interact with the Centre. One, about to retire, has spent many years in this interaction (and with the fore-runners to the Centre); the other has 'joined' with the Centre more recently.

The Centre has some new priority themes for the next academic year. These three themes are: Education for sustainable development (ESD), standards and quality, and student engagement. See more on pp6-7.

Next we have details of four projects the Centre is working on; the Question Bank (an update), the 'Skills for Scientists' (Open Educational Resources project), Working Higher (in collaboration with Cogent Sector Skills Council and the University of Hull) and the survey of Chemistry graduates. See pp8-13

Go to pp14-15 to read about the Royal Society's Partnership Scheme which aims to inspire new scientists through interactions between pupils, teachers and professionals.

In this academic year the Centre will be ten years old (including its previous existence as a Learning and Teaching Support Network Subject Centre). To celebrate we will be organising special events and our focus for the year will be on the future of learning and teaching within our disciplines. There will also be a special logo for the celebratory year. Read more on pp16-17.

The final article inside this issue is from the winner of our 'student essay' competition. This year for all the entries the competition 'essay' was in fact a PowerPoint file and the topic was 'what you need to know before embarking on a physical sciences course at university'. A version of the entry is on pp18-19.

We are funding seven new Development Projects for 2009/10 and you can see initial details of them on the rear cover plus a note to acknowledge the achievements of our Director, with two new awards; one from the Higher Education Academy and one from the Royal Society of Chemistry. Congratulations, Tina! ■

The newsletter is free of charge to academics in UK higher education institutions. The material is also published electronically on our web site. Subscriptions are available for those outside the UKHE sector who wish to receive the paper version. Contact the Centre for details.

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Computers, Teaching and Learning: some Personal Recollections

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Computers, Teaching and Learning

It was just a couple of days after my 42nd birthday that Roger Gladwin and Steve Walker from the Computers in Teaching Initiative (CTI) Centre for Chemistry (Liverpool University) crossed the country to give a presentation at Sunderland Polytechnic. Nineteen years on I am about to retire from the University of Sunderland and Steve and Roger are part of the Higher Education Academy Physical Sciences Subject Centre. During this time technology, software and communications

'My experience of... computing started with punched cards... with teletypes and text-only visual display units connected to a mainframe computer'

have improved dramatically, 'teaching and learning' has become 'learning and teaching' and, via expansion and mergers, the focus has widened from just Chemistry to include Physics, Forensic Science and the Universe. Throughout these changes Roger, Steve and their increasing number of colleagues have, using an ever widening variety of methods, provided help and advice on new technology and innovative learning and teaching methods.

During this time there have been several hotbeds for chemistry education, computers in chemistry education and coordination of projects. Those which have had the most influence on me are the Universities of Liverpool (CTI Chemistry, Chemistry Courseware Consortium), York (the original home of Variety in Chemistry Teaching) and Hull (Project Improve). The chemistry and managerial components of the present HE Academy Physical Sciences Subject Centre are essentially a merger of the Hull and Liverpool teams. When one initiative or funding drew to a close there was always a doubt about what, if anything, would replace it and would essential services and resources be lost. However, due to very hard work and negotiations behind the scenes, the new has smoothly built on the old.

My experience of academic computing started with punched cards for data/programs along with teletypes and text-only visual display units connected to a mainframe computer which was used mainly for complex scientific calculations. Then came the personal computer with coloured graphical display and it was at this stage that the potential of computers for teaching and assessment became obvious: lecturers even became apprehensive that they would be replaced by computers. Academic computing expanded to local area networks followed by the internet and the World Wide Web. Universities hosted departmental and personal websites run by enthusiastic academics and there was a huge outpouring of creativity and information exchange. Senior managers and administrators then began to take an interest in websites, useful links to other institutions disappeared, webpages had to conform with a standard template and vetting or restrictions on who could publish were imposed. Academic computing retreated into intranets, virtual learning environments and pen drives for PowerPoint presentations. Or at least it would have but for the Computers in

'Very rarely did I come away from a meeting, workshop or conference without being enthusiastic about something new to develop, try out or share'

Teaching Initiative, the Teaching and Learning Technology Programme, the Teaching and Learning Support Network, the Higher Education Academy Subject Centres and conferences such as Variety in Chemistry Teaching/Education.

Computers, Teaching and Learning

My interaction with CTI, LTSN and the HE Academy Subject Centre and Variety has been two-way both contributing and receiving. Very rarely did I come away from a meeting, workshop or conference without being enthusiastic about something new to develop, try out or share with my colleagues. Since the introduction of departmental representatives this is a three-way interaction and sharing has increased. The Physical Sciences Subject Centre website¹ is a veritable mine of resources and information: most very useful, some absolutely essential. No one should set a computer based test without having first read the Practice Guide 'Effective Practice in Objective Assessment'². I ensure my colleagues have a copy, whether they want it or not.

Perhaps my biggest regret is the downgrading of knowledge and practical skills under the unfortunate title of 'low level'. Even understanding is frowned upon. Knowledge (Latin *scientia*) is the foundation of any scientific subject, and includes examples and definitions: the very language of the subject. Only by building up a sound knowledge and skill base, whether it be first or final year undergraduate, MSc or PhD, can there be any meaningful synthesis or evaluation. At some time in the future the pendulum will swing back. Perhaps we can stop looking behind us all the time and even have teaching for learning.

References

1. <www.heacademy.ac.uk/physsci>
2. Alex Johnstone (2003) Effective Practice in Objective Assessment, LTSN Physical Sciences Practice Guide. ISBN 1-903815-10-X

The views expressed in this article are my own and do not necessarily represent the views of either the University of Sunderland or the Physical Sciences Centre. ■

'Perhaps my biggest regret is the downgrading of knowledge and practical skills'

Academic computing expanded to local area networks followed by the internet and the World Wide Web.

Alongside all the changes in technology there have also been changes in educational thinking with greater emphasis on the student, or should I say the learner. Problem based learning, for example, should stimulate enquiry, research and understanding. But should all learning, teaching and assessments be of the same type? Surely students should experience a wide variety of methods and academics should select the method most appropriate for the topic and for stretching and challenging the students. The conferences, resources and workshops allow us to make informed decisions.

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Working with the Higher Education Academy Physical Sciences Centre

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Working with the Physical Sciences Centre

Over the past few years I have worked increasingly closely with the Higher Education Academy Physical Sciences Centre (the Centre) and I would like to outline how this relationship has developed and how it has benefited my work culminating in the creation of ChemTube3D <www.chemtube3d.com>, award of a National Teaching Fellowship and JISC support.

'All this changed when I attended a one-day special interest meeting on Animations and Simulations'

I have always been aware of the support offered to academic staff in Physical Sciences over the years, the latest incarnation of which is the Centre, as it has been partly based in Liverpool in my own department. Oddly I never felt it was particularly successful at assisting the intended audience and I don't recall adopting anything in my own teaching as a direct result. I think I was waiting for key information or resources to be placed in my lap which is in retrospect completely unrealistic.

All this changed when I attended a one-day special interest meeting on Animations and Simulations at the University of Central Lancashire. I was interested in learning *Flash* but instead what I discovered is that today's undergraduates can be given software, that the supervising academic doesn't fully understand, and expected to produce useful educational resources with appropriate input. I showed the early stages of a project to animate organic chemistry reaction mechanisms to a few of the attendees including two of the centre staff. I was encouraged to seek funding for a Summer student and the required software from the Centre to take the animated organic mechanisms idea forward as a Development Project. I had previously been sceptical about what could be achieved with ca £5k but the productivity, creativity and enthusiasm of the students and other funding that is unlocked by having a supported project is powerful.

Liverpool Teaching Quality Enhancement Fund provided matching funding which enabled me to employ the same student for two successive summers which provided continuity and dramatically improved output. The success of the first phase, ChemTube3D, also attracted support from the EPSRC as a Vacation Bursary for a second student and was followed by a second Development Project funded by the Centre covering Solid State Materials and Polymers which again attracted matching support from EPSRC Complex Materials Portfolio Partnership allowing the project to be stretched across two summers and will be available shortly. In addition I was able to make related projects available as part of the Year 3 curriculum which suited certain students. Working with all these highly motivated, creative, dedicated students to produce a valuable resource is most enjoyable and stimulating and they obviously felt the same as three of them came back for a second spell!

'Two members of the centre also directly assisted me in my successfully application for a National Teaching Fellowship'

There are regular project reports and project meetings as part of development projects and these provide valuable feedback on plans and progress as well as cross-disciplinary ideas. I have met like-minded colleagues from other Physical Sciences through this route and it is difficult to imagine how we would otherwise have met in the narrow subject related worlds we typically inhabit.

I offered to take up the role of Departmental Representative in my department and I have established a notice board that I populate with publicity provided by the Centre. I circulate the regular emails either generally or specifically depending on the precise content. I was invited to participate in the annual Departmental Reps meeting and present a talk on ChemTube3D. It was particularly pleasing to see all the other Development projects, that had run in parallel at the earlier project meetings, presenting at this meeting to a much wider audience as well as more general topics.

Working with the Physical Sciences Centre

As a result of the Development projects I was invited to deliver departmental seminars at a number of Universities and contribute a lecture to Eurovariety in Chemistry in Manchester 2009. All of this activity was funded by the Centre and it enabled me to present ChemTube3D to a much wider and interested audience. This brought a number of projects to my attention that I hope to incorporate directly into areas of our teaching particularly supporting Maths and laboratory work.

'As a result... I was invited to deliver departmental seminars at a number of Universities and contribute a lecture to Eurovariety in Chemistry'

The biggest challenge is effective dissemination of useful teaching resources, strategies, etc. It is hard enough in one's own department, never mind between institutions. In spite of that, the work of the HEAPSC is our best hope and if you engage with them, then you (and they) will benefit.

The Centre can help you with:
 Regular emails - look for interesting and relevant material
 Departmental rep – talk to yours about what you are interested in
 One day meetings on topics that interest you - attend
 Development Project Funding – apply and leverage support from elsewhere

We have now secured JISC funding for iChem3D which is examining how such online resources are used and how to improve them for teaching at all levels and I am participating in the Open Educational Resources Skills for Scientists project coordinated by the Centre. Two members of the centre also directly assisted me in my successfully application for a National Teaching Fellowship. All of these will support further development of ChemTube3D which is already an internationally significant resource and can only become more valuable. ■

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Priority themes for 2009/10

It is the start of another academic year full of promise and opportunity for all. The Centre has planned its operations for the forthcoming year based on consultation with its community and input from its funders. Ongoing activities will include our popular funding of development projects, regular publications, discipline focused events, special interest groups and resource development, to name but a few.

As priorities shift and change within our disciplines so do those of the wider higher education sector and this year sees some additional themes to which our Centre is required to respond. Amongst the many and varied themes the Centre already engage with, such as assessment and feedback, the research-teaching nexus, evidence informed practice... we will be required to address three key themes that are currently high on the sector's radar. These three themes are: Education for sustainable development (ESD), standards and quality, and student engagement. Whilst these themes may not necessarily jump out at you as being directly relevant to the physical sciences, they impinge on our day to day activities. Therefore, we would like to give you a flavour of the sorts of activities we are planning in the forthcoming year which address the themes for the benefit of the physical sciences.

Education for Sustainable Development

The term 'sustainability' has been a buzz word in society for some years now and has entered mainstream thinking in most walks of life. It could be argued that Education for Sustainable Development, ESD, is relatively new and many in higher education are still coming to grips with the term, let alone understand how to embed ESD into their curricula. People may have different reasons for engaging with ESD such as promoting lifestyle changes, improving our understanding of sustainability to reduce waste or even as a way of reducing costs.

In education, there is another reason which is becoming increasingly prominent, and that is the development of an understanding of the issues which will make students more employable. Employers are increasingly citing an understanding of sustainability as a desirable attribute amongst its graduate employees in order to help their business and operations become more sustainable, efficient, environmentally aware and cost effective. Therefore, there are many reasons to engage with ESD in order to promote and develop student skills and awareness.

To address this theme, our Centre will be working with colleagues from across the Academy who have an established ESD team as well as the STEM Subject Centres. We also acknowledge that our disciplines have probably been doing a lot of 'ESD' for many years without necessarily being badged as such and we will aim to highlight such innovations.

At our summer STEM meeting we discussed how we might support the ESD theme and heard from a colleague at Hull who has undertaken a recent ESD project to embed the theme of ESD seamlessly across various departments. Further information can be found at www.hull.ac.uk/esd/index.html. Our plans for the coming year will include looking at ways to fund specific ESD projects and an ESD themed event. We will also be promoting ways of embedding ESD within the curriculum. We will keep you posted on developments but would be happy to hear from people who have embedded ESD in their practice and/or have other good ESD work to report.

Standards and Quality

The words 'standards' and 'quality' can be emotive within higher education. However, the ethos for promoting the standards and quality agenda by the funding councils and Government is simply to ensure that the world-renowned quality of UK Higher Education is maintained. The Centre supports academics in maintaining high quality and standards through its regular activities. These activities include continual professional development activities (updating sector knowledge and skills) through events and conferences; and innovation in the disciplines through engaging in resource development and dissemination. Therefore, the Centre already addresses the support for, and development of high quality standards in the sector, helping disseminate excellent work nationally and even internationally.

This year, one aspect of standards being looked at is that of the external examiner. Through its work this year the Centre, alongside its STEM colleagues, will host an external examiners event to raise the profile of the good work undertaken by external examiners. It will also be an opportunity to demystify the role for newer colleagues who may be keen to engage with external examining. We will look at developing lines of support such as the possibility of an external examiners' 'database' where people can offer their services and share experiences. There are a number of possibilities open to us so we

Priority themes for 2009/10

will be drawing on the extensive experience already available in our disciplines to help us promote the work of external examining.

Student engagement

The Higher Education Academy's mission is "to support the sector in providing the best possible learning experience for all students." Student engagement is about engaging students in their own learning and this work is being undertaken through a variety of ways by the Centre. It is becoming more widely acknowledged that it is beneficial to put the student at the centre of our decision making processes – be they inclusion on academic committees or simply being more aware of student needs when designing the curriculum. The Centre therefore promotes this ethos in a number of different ways.

The Centre has hosted various events and activities over the years to explore ways of supporting students; enabling them to become more autonomous learners and become more self motivated. This includes such activities as our employability events/resources and e-portfolio projects to enable students to become more skills-aware and reflect more on their own learning, as well as events and development project promoting use of student-centred pedagogies such as enquiry-based learning. This work continues to be central to our aims and this year we will offer other related activities such as exploring pedagogic research for the sciences and hosting our regular new lecturers event to provide advice on how best to engage students in their learning.

In addition to this type of student engagement, last year the Centre undertook a series of student focus groups and student questionnaires as part of our national subject reviews, which have now been published. This involvement of students proved very valuable and provided both the Centre and the sector with valuable information and insights into student experiences of higher education. This year therefore, we have decided to continue engaging students in focus groups and other relevant ways to keep eliciting their viewpoints and how this might help inform the sector's practices to provide "the best possible learning experience for all students".

As we hope you can appreciate, these three themes, combined with our ongoing regular themes provide the basis for a very busy but exciting and rewarding year for all of us. Through engagement with these themes, we hope to support you in the best possible way and look forward to accomplishing our (and your) goals in the coming year. ■

These three themes are: Education for sustainable development (ESD), standards and quality, and student engagement.

Ongoing activities will include our popular funding of development projects, regular publications, discipline focused events, special interest groups and resource development...

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Physical Sciences Question Bank

The Physical Sciences Question Bank¹ is now in its second year and is being used by about 150 academics from UK HE Chemistry and Physics departments. Together, they have used the Question Bank for over 100 hours and have performed nearly 4000 question downloads. The Physical Sciences Centre² has provided continuing support for the Question Bank resulting in more questions being made available (there are now approximately 1600) and the introduction of some new features.

The basic functionality of the Question Bank is, however, unaltered. Questions can be browsed via a hierarchical structure of subjects and topics. Various filters can be applied to control which questions are displayed, such as those with or without feedback, only questions of particular types (MCQ, text, etc.) or questions of particular difficulty and pedagogic domain (knowledge recall, comprehension, etc). There is also a text search filter that can operate on keywords, the question description or on the question text. These filters can be applied to all the questions in a subject, or just those in a topic or sub topic. When appropriate questions are identified they can be added to a 'shopping basket' and downloaded together in an appropriate format for the selected target assessment or display system. In most cases this results in a single file to be imported into the system.

New Questions

When launched in March 2008, the Question Bank contained about 500 chemistry questions, mainly from the Universities of Ulster³ and Bath⁴, and 300 physics questions, mainly from the University of Edinburgh⁵. The number of questions in the bank has been just about doubled since that time, with approximately 900 chemistry questions and 700 physics questions now available.

The new chemistry questions comprise more of the Ulster and Bath collections, and over half of a set of 650 questions from the University of Hull. These questions are the result of the Physical Sciences Centre funded development project 'Testing Your Organic Chemistry Knowledge to Reinforce Comprehension and Understanding using Web-Based Multiple Choice Questions' from Andrew Boa and Jason Eames⁶. We hope to complete the import of this set within the next few months.

The additional physics questions comprise further DUMP project⁵ questions (Edinburgh) and a set from a recent

Physical Sciences Centre funded project at the University of St Andrews. Of the 450 DUMP questions provided over 350 have now been imported into the question bank. The rest require more detailed processing, but will follow as time permits. The project at St Andrews, 'Development of learning material for formative computer based assessment in physics and astronomy' from Antje Kohnle and seven of her colleagues⁷ in the Department of Physics and Astronomy, has yielded a set of 300 questions covering eleven topics, mostly in modern physics, at a range of academic levels from A-level to HE 3 (SHE 1 to SHE H). These are now available in the Question Bank.

New Features

- Question formats

Within a few months of the Question Bank being made public it was suggested that it would be useful to be able to display questions in MS PowerPoint. They could then be used in lectures, possibly with an electronic voting system. The advent of PowerPoint 2007 with its text based (xml) import rendered this feasible, and it was implemented and introduced in July 2008. Only multiple choice or multiple selection question styles are available and each question is put on a separate PowerPoint slide. Answers and feedback are put into the notes for that slide. The question body and the options are put into two different text blocks so that they can be rearranged if required. This is likely, for example, if an e-voting system is being used which requires a fixed part of the screen. Questions with pictures are more difficult to lay out automatically and are therefore also likely to need rearrangement. If users would like other question styles to be available in PowerPoint, please let the question bank team know⁸.

The second new question format is related to the base-format being used in the Question Bank – QTI v1.2⁹. This is an international specification designed to facilitate question transfer between different e-assessment systems. The Question Bank uses it for download to WebCT, Blackboard and Questionmark Perception, and the 'raw' QTI v1.2 can be downloaded and imported into Respondus, for example. A new (very different) version of the specification, QTI v2.1, has now been incorporated into the Question Bank, and questions have been translated into this new form. In addition, a new question viewer (from the STOMP project) has been incorporated so that questions can be previewed from within the Question Bank as an alternative to the synopsis view. The

Physical Sciences Question Bank

QTI v2.1 versions can be downloaded and there is a lightweight QTI v2 assessment system (ASDEL¹⁰) available from the University of Southampton.

- **Question submission**

It is now possible to submit new questions to the Question Bank, and pressing the new **submit a new question** button opens the appropriate form. Clearly it is important that as much metadata as possible is supplied for each question, although some of this can be generated automatically. Thus, the author's name, a unique question ID and the publisher organisation are filled in from the user's data, and the topic name from the topic selected in the Question Bank. The source format of the question can be selected from a drop down box (usually) and the question type, academic level, difficulty and pedagogic domain are set to likely default values. This leaves only the keywords and the question description to be entered which will not (we hope) be too onerous. If many questions are to be submitted (eg more than 15 or 20), then it is probably best to contact the Question Bank team⁸ and discuss methods for bulk submission.

Conversion of questions to the required formats for the Question Bank is only semi-automatic, and always requires some manual intervention. Therefore the time between submitting a question and seeing it in the bank cannot be accurately predicted. It might be the same day but it is more likely to be several days.

- **Numbers of questions**

The number of questions available in each subject and at each academic level is now displayed in the table of academic levels on the options page.

Statistics

Some statistics are recorded automatically as the Question Bank is used. There are 150 registered and active users, who have together logged in to over 400 sessions with a total connect time of over 100 hours. The number of questions downloaded are counted for each target system or type, and are:

WebCT	1494
Rich text	1075
Moodle	495
Blackboard	423
Powerpoint	119
QTI v1.2	271
Perception	42

We would really like to know what use is being made of these questions. If you have used questions from the Bank with your students, please let the Question Bank team or the Physical Sciences Centre know⁸. It would also be helpful if you could let us know the number of questions used, the number of students who used them, and whether you used the questions to obtain marks or to provide feedback, or both.

References

1. **Question Bank** <tinyurl.com/ldak4p>
2. <www.heacademy.ac.uk/physsci>
3. **K Adams et al** <tinyurl.com/kouw8b>
4. **G Price** <tinyurl.com/nsl6on>
5. **S Bates** <tinyurl.com/l3oz6l>
6. **A Boa & J Eames** <tinyurl.com/ma26xl>
7. **A Kohnle et al** <tinyurl.com/ludfyd>
8. **Question bank team** at psc@hull.ac.uk
9. **QTI** <en.wikipedia.org/wiki/QTI>
10. **ASDEL** <www.asdel.ecs.soton.ac.uk>

The number of questions in the bank has been just about doubled... with approximately 900 chemistry questions and 700 physics questions now available.

Questions can be browsed via a hierarchical structure of subjects and topics. Various filters can be applied to control which questions are displayed...

Open Educational Resources Project

'Skills for Scientists': Open Educational Resources Project

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Background

In his October 2008 report, titled *On-line innovation in Higher Education* to John Denham, the then Secretary of State for Innovation Universities and Skills (now the department for Business Innovation and Skills, BIS); the late Professor, Sir Ron Cooke stated that the UK lags behind "in generating and making available high quality modern learning and teaching resources." He recommended that there should be a "National co-ordinated collection of freely available open learning resources."

In response to this, later in October 2008 HEFCE announced initial project funding of £5.7million for a project to make existing educational resources available to the Higher Education sector. Through this project "Students, academics and higher education institutions are to benefit from the combined experience and knowledge of educators throughout the country."

This project, entitled the *Open Educational Resources Programme*, was formally announced by David Lammy MP Minister of State for Higher Education and Intellectual Property on the 24th June 2009, in his speech titled *The Edgeless University*. It will be managed by the Higher Education Academy and the Joint Information Systems Committee (JISC) and will last for 12 months.

OER Programme

Under the initial call, the JISC and the Higher Education Academy asked for project bids under three strands: institutional, discipline and individual. Originally, there was funding for up to six institutional projects, with up to £250k per project; 12 discipline projects with up to £250k per project (each of which had to be led by a Subject Centre); and 10 individual projects with up to £20k per project. Seven institutional projects have been funded, along with 14 discipline projects and eight individual projects. A full list of projects can be found on the JISC website (see below.)

The main deliverable for each project is a number of resources which would be freely available for use by UK HE. As HEFCE stated in their announcement, these resources "could include full courses, course materials, complete modules, notes, videos, assessments, tests, simulations, worked examples, software, and any other tools or materials or techniques used to support access to knowledge." For the institutional and discipline projects, the resources would be equivalent to a minimum of approximately 360 credits or 30 credits per project.

The Physical Sciences Centre was successful in bidding for a discipline project called 'Skills for Scientists'. A high level of interest from the community meant that resources equivalent to about 700 credits were offered (including some from the Centre) from 17 contributors – including a Spanish university.

What are Open Educational Resources?

Open Educational Resources (OER) are materials which have been made available for reuse with an 'open' licence. There are a range of open licences, some general in scope, some designed for certain types of resource; eg software. Granting a resource an open licence allows others to reuse the resource without having to pay a fee or royalty. However, it does allow the owner of the resource to place certain restrictions on its reuse. For instance, the owner may choose an open licence that states that attribution must be given or the materials cannot be used for commercial purposes.

Creative Commons (CC) offers a range of open licences with different use restrictions. They also take into account that there are differences in copyright law around the world. These licences are relatively easy for the potential end user to interpret so they know how they may reuse the material.

The 'Skills for Scientists' project will be exploring how the resources made available will be licensed to meet the needs/requests of the content creators and those of the end users and this is a key aspect of the project.

Aims of the project

The initial call for the OER programme asked successful bidders to produce a range of resources to be licensed for free use in Higher Education. However, the funders are also interested (perhaps even more so) in the sustainability of making resources openly available in the future. Currently, many institutions and individuals make resources 'freely' available via public websites but the issue of Intellectual Property Rights and licensing has never really been fully addressed. The OER Programme is therefore interested in finding successful sustainable models that will address these issues, enabling individuals and institutions to easily and readily make their resources freely available under appropriate licenses. Each of the projects will individually and collaboratively explore the issues that arise during the process.

Open Educational Resources Project

Project deliverables

'Skills for Scientists' will include resources that teach:

- discipline specific skills
- experimentation skills
- maths skills
- professional skills
- public engagement skills

Some of these resources have content specific to forensic science, chemistry, physics or astronomy, whereas some are generic in nature.

As the project develops, information will be made available via the project website and wiki along with the resources themselves in OER form.

Further information

Skills for Scientists website

<www.heacademy.ac.uk/physsci/home/projects/skillsforscientists>

HEFCE announcement of the OER programme

<www.hefce.ac.uk/news/hefce/2008/os.htm>

List of OER projects

<www.jisc.ac.uk/whatwedo/programmes/oer.aspx>

Sir Ron Cooke Report (On-line innovation in higher education)

<www.dius.gov.uk/higher_education/shape_and_structure/he_debate/~media/publications/O/online_innovation_in_he_131008>

David Lammy MP speech announcing the OER Programme

The Edgeless University

<www.dius.gov.uk/news_and_speeches/speeches/david_lammy/edgeless_university> ■

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Working Higher

Origins of Working Higher

Working Higher was developed to be a solution to workforce development needs by creating a suite of flexible, work-based Foundation Degree frameworks in collaboration with a consortium of providers and employers. The project aims to address the higher level skills gap that has been identified, providing those working in the strategic science-based industries with an opportunity to develop their talents and reduce shortages of expertise.



Working Higher logo

Working Higher is a £2.9m collaborative project between the Physical Sciences Centre, Cogent Sector Skills Council and the University of Hull. The project is funded by the Higher Education Funding Council for England (HEFCE) under their Employer Engagement Fund. The project also includes collaboration with other stakeholders such as Semta and other Academy Subject Centres.

Foundation Degrees

Foundation Degrees allow employers to combine work-based learning with academic study to optimise staff performance. Key features of a foundation degree include:

- Integrating academic and work-based learning
- Driven by the voice of the employer
- Demand led content relevant to your business needs

Key benefits:

- Improved performance and productivity
- Enhanced skills and knowledge
- Improved competitiveness
- Increased motivation and staff retention
- Value for money
- Applied learning within the work place
- Minimal disruption

Working Higher Foundation Degrees will allow for a step-on, step-off modular approach to learning, allowing employers to easily access knowledge and skills which can lead to an academic qualification.

The Framework Strands, Timescale and Funding

Following a rigorous tender process we are pleased to be able to confirm the Working Higher Consortium partners as follows:

- University of Hull, Petrochemical industry
- University of Portsmouth and University of Central Lancashire, Nuclear industry
- Manchester Metropolitan University, Chemicals industry
- London Metropolitan University, Polymers industry
- University of Kent, Biosciences/ Pharmaceutical industry

Each HEI project will run for two years. Working Higher seeks to tackle risks related to market uncertainty and levels of income associated with developing new training provision. The project has an allocation of Higher Education Funding Council for England (HEFCE) co-funded student numbers for the delivery phase of the project and part of the work will be the development of a value for money funding model.

Five industry champions will be seconded to the project and linked to each of five HEIs established to lead a given sector

For further details contact the Working Higher Project Team at:
workinghigher@hull.ac.uk
Website: <www.heacademy.ac.uk/physsci/home/projects/workinghigher> ■

Chemistry graduate survey: a pilot study

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Although there have been many reports on the skills looked for by employers in graduates (eg CIHE (2008) *Graduate Employability: What do employers think and want?*), relatively little has been reported on the skills that graduates themselves have found of value. A 2009 report from UUK/CBI, entitled *Future fit: Preparing graduates for the world of work*, included the recommendation that universities should obtain regular feedback from their graduates on how well the universities are fostering employability skills in their students. In one limited study 14 years ago by a major pharmaceutical company, R&D chemistry graduates were asked which areas of training not received from university would have been useful in preparing them for work. The results, in order, were: presentation skills, team-work, IT/access to PCs, time management, interpersonal skills and experimental write-up. However that was 14 years ago and most chemistry degree programmes have changed considerably since then.

In 2008 the Centre was commissioned by the Royal Society of Chemistry to carry out a pilot study in order to identify areas of chemical knowledge/skills and generic skills which were considered particularly useful by chemistry graduates in all sectors of employment (and further study) and to investigate the development of these skills in degree programmes. The twenty areas of knowledge/skills included in the survey were chosen based on benchmark and accreditation statements, i.e. *QAA (2007) Subject benchmark statement Chemistry and the RSC Accreditation of Degree Programmes, Draft 2008*; they ranged from chemical, such as fundamental chemical principles and kinetics of chemical change, through to generic, such as oral presentation and time management skills.

The study focused on the 2006 graduate cohort, two years after graduation. Such graduates had sufficient time to gain understanding of the skills requirements of their employment, whilst retaining a reasonably up-to-date knowledge of their chemistry degree programmes. The sample covered BSc and MChem graduates including those with industrial experience as part of their programme. A survey form was designed which proved both user-friendly (based on focus group comments) and generated a wide range of information. A sampling methodology was developed with a response rate of over 59% for graduates from three universities (two pre-1992, including a Russell Group, and one post-1992), a total of 95 respondees. Their main activities since graduation were: 57% employment (other

than teaching), 12% science teaching, 26% PhD and 5% other further study. Only 17% had no involvement of chemistry in their activities since graduating.

The survey results obtained were very similar for all three universities. The generic skills generally came out at a higher level of usefulness than the chemical knowledge/skills. Of the chemical knowledge/skills, chemical terminology, fundamental chemical principles and analytical techniques and related practical skills had proved most useful. The generic skills were found to be less well developed within the degree programmes than the chemical skills, in line with the results from the pharmaceutical company 14 years ago! The sample size was too small to draw conclusions about the effect of the programme (BSc/MChem, industrial placement) on skills development.

At a focus group, graduates were not surprised when presented with these results. They suggested that they would like the methods of teaching in chemistry degrees to be such that more training in generic skills could be included whilst keeping most of the chemical content.

Although the sample size of this pilot study limits the conclusions that can be drawn, nevertheless some interesting and potentially very useful trends were observed which could help with revision of benchmarks, assist academics in programme development and be used in advising undergraduates on skill needs after graduation.

The Centre is now planning to work with the RSC to extend the chemistry graduates' survey to several more universities and carry out similar surveys for physics and forensic science graduates in collaboration with the Institute of Physics and the Forensic Science Society. We will be getting in touch with departments to invite them to take part. For further information, please contact Steve Hanson or Tina Overton at the Centre. ■

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Inspiring future scientists

The Royal Society's Partnership Grants scheme is at the forefront of initiatives seeking to ignite enthusiasm for science among young people, develop skills and interest in genuine scientific investigation, and support teachers and scientists learning from each other. Grants of up to **£3000** are now available for teachers and scientists or engineers to work together on creative investigations involving 5–16 year olds. For successful applicants, the grant is

caused to York minster. This moved them in a new direction – exploring the nature of on-going restoration. The project helped to build a valuable working relationship with Dr Lowe and enriched the pupils' learning. As Mrs Hines says, "Working as a scientist is a means of understanding what is happening and perhaps with creative thought and perseverance we can intervene and help protect our future".



Figure 1: Interacting with pupils at Osbaldwick Primary School, York

awarded directly to the school involved, enabling the school to pay for any specialist equipment needed for the investigation, travel expenses for the scientist/engineer and/or the school group and possibly teacher supply cover.

Is acid rain destroying the historic buildings of York? This was the question posed to pupils at Osbaldwick Primary School, York (figure 1). The school was awarded a grant of £470 for teacher Morag Hines and her Year 6 pupils to work with Dr Nigel Lowe from the department of chemistry at the University of York. The pupils began by looking at the difference between acids and alkalis, and investigating indicators and pH scales. The local secondary school gave them access to their laboratories so the pupils could discover ways in which acid rain can be traced. Taking this knowledge into the real world, the pupils were expecting to see some damage to historic sites across York but they were shocked at the damage that had been

This year Simon Langton Grammar School in Kent (figure 2) was selected to provide an exhibit at the Royal Society's Summer Science Exhibition, which was a great success. Graeme Poole, Director of Science at Simon Langton is under no illusions that the Partnership Grant has provided a vital contribution to the school and science as a whole. "This project provides students with endless opportunities to expand their knowledge and communication skills. It has also increased the students' thirst for scientific knowledge and senior students are now passing on this knowledge to junior students".

Over the past eight years Partnership Grants has awarded over £1 million to 568 projects giving pupils and their teachers the opportunity to work on stimulating and inspiring projects in partnership with a scientist or engineer. All across the UK primary and secondary schools are benefiting from the funding of the

Inspiring future scientists



Figure 2: Exhibit at Simon Langton Grammar School in Kent

All across the UK primary and secondary schools are benefiting from the funding of the Partnership Grants scheme

Partnership Grants scheme. Schools directly supported by the Royal Society so far stretch from the Shetland Islands to the Isle of Wight, and have forged links with partners from many universities across the UK, as well as with organisations such as GlaxoSmithKline, British Telecom, and Rolls Royce.

Support from a dedicated team at The Royal Society is offered at all stages of the application process, including advice on investigations you may be considering and guidance in finding a suitable scientist/engineer partner. The next round of Partnership Grants applications opens in September and the closing date is **November 6 2009**.

For more information and application forms visit: <www.royalsoc.org/partnership> or contact The Royal Society directly at education@royalsociety.org. ■

Over the past eight years Partnership Grants has awarded over £1 million to 568 projects giving pupils and their teachers the opportunity to work on stimulating and inspiring projects...

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Ten Years After...

Introduction

In January 2010 the Physical Sciences Centre (in its various forms) will be ten years old! We wish to mark the occasion with a series of changes, events and celebrations through the year.

We will have a new logo for the year and a new name: from Jan 1st 2010 we will be the **UK Physical Sciences Centre**

'Visit of Joe Redish, influenced us to think about some of the current US ideas on teaching physics'

Where did we come from?

We do have a 'Pedigree'.

Back in 2000 the Centre (then part of the Learning and Teaching Support Network, LTSN) was formed from those previously involved in two CTI (formerly Computers in Teaching Initiative) Centres; members of the Physics and Chemistry Networks; those from Project Improve, the FDTL (Fund for Development of Teaching and Learning) project and two projects from the Teaching and Learning Technology Programme (TLTP). Over the years we have augmented the 'old hands' with 'new blood' to ensure a steady flow of new ideas and enthusiasm in the team.

From a support network to an academy

So, set up in 2000 as part of the LTSN, in May 2004 the Institute for Learning and Teaching in Higher Education, the National Coordination Team, the National Teaching Fellowship Scheme and the LTSN Subject Centres joined and became the Higher Education Academy.

'... the PBL day meeting in Leicester convinced me that our 3rd year labs needed complete rethinking'

What have we achieved?

Over the life of the Centre we have many achievements - here we highlight just some of them together with a selection of quotations, from Departmental Representatives when asked about the 'Impact of the Centre'.

Stimulating effective practice

Over 60 development projects have been funded by the Centre covering such wide areas as mathematics support, the transition from secondary to tertiary education, support for students with Asperger's Syndrome, web-based physics applets and chemistry reaction mechanisms. (To see more of the projects; their outcomes, downloads, reports etc, see our web site). On completion, the more successful project leaders are invited to offer a lecture tour to interested institutions to further disseminate their project. In addition the Centre has undertaken a number of projects; notably those funded as part of the JISC/DeL: e-learning project (Employability, E-Portfolio and the Question Bank). More recently we also are partners in the HEFCE/JISC/Academy Open Education Resources project 'Skills for Scientists'. (The goal of the programme is to make a wide range of learning resources created by academics freely available, easily discovered and routinely re-used by both educators and learners) and with Cogent Sector Skills Council and

'Award of development project... has resulted in various 'spin-offs' impacting on... students, colleagues and self'

the University of Hull we are partners in Working Higher which aims to develop a suite of flexible, work-based Foundation Degrees. These are just some of the projects in which we are involved. Visit our web site for further details.

Influencing strategy

In addition to our regular offerings of newsletters, journals, practice guides, briefing papers/primers/toolkits and student focused information sheets we have produced:

- The report: Forensic Science: Implications for Higher Education 2004, with SEMTA Sector Skills Council. The research was undertaken because of employers' concerns about the increasing number of Forensic Science degree courses in relation to the number of jobs available in the Forensic sector. As a consequence of this report and further 'ad hoc' work undertaken by the Centre with the Forensic Science community, in 2008 we were asked to 'officially' support Forensic Science by the Academy.

Ten Years After...

- Science Boxes - Outreach Resources
The Science Box CD contains free resources for stimulating students in Chemistry and Physics.
- Teaching Entrepreneurship CD-resources designed to help academics teach entrepreneurship and enterprise to undergraduate and postgraduate students.

'Attending the... New Lecturers Workshop gave me the confidence to go out on a limb and try new teaching ideas...'

- Reviews of the student learning experience in chemistry and physics. These are major reviews undertaken in 2008 to provide a snapshot view of the student experience in UKHE.

Encouraging Continuing Professional Development

We run a series of events designed to provide academics with opportunities to develop new skills, consider alternative delivery methods, learn about new technology solutions etc. Of note are the workshops for New Lecturers, the high-profile, overseas practitioners we have invited to give lecture tours, the three conferences we run (in conjunction with others) annually, Physics Higher Education Conference, Variety in Chemistry Education and FORREST (forensic science) plus the biannual Science Learning and Teaching Conference (with the Bioscience and Materials subject Centre).

'Use of web site as first port of call to find information on an unfamiliar educational area'

What are we doing in 2010?

We are planning a 'launch' event for our anniversary celebration in London in February. We will invite those who contributed to/were involved in the success of the Centre (in development projects, participants at events, our Advisory Committee members, Departmental Representatives etc) to come and share their experiences.

Our Events program will have a focus on the future and some of the workshops we will be offering include:

- The future of technology enhanced assessment
- Green Science (part of an Education for Sustainable Development theme)
- Pedagogic Research – the future
- Teaching Problem Solving: beyond the single piece jigsaw
- Developing professional skills for physicists
- Enquiry and Problem-based Learning – Future Pedagogy

'Presentations on the implementation and evaluation of a blended learning module... inspired me to implement a similar blended learning module...'

Our journal, New Directions (in the teaching of physical sciences), is to be renamed *Future Directions* for one year only and the content will cover opinions on the future of HE.

Our annual student 'essay' competition will challenge students to write about the future of HE (as a PowerPoint presentation).

Throughout the year we will continue to be active in the Academy's themes for 2009/2010:

- Student Engagement
- Education for Sustainable Development (ESD)
- Standards and Quality

Finally, we will conclude the celebrations with a reflective meeting in December 2010. ■

Over the years we have augmented the 'old hands' with 'new blood' to ensure a steady flow of new ideas and enthusiasm in the team.

Physical Sciences: what you need to know... for Dummies, Geniuses and everybody in between

Physical Sciences Centre
Student Essay Award

This year the 'essays' were entered as PowerPoint presentations.

Here is the winning entry for 2009 to the Physical Sciences Student Essay Competition, by...

Frederik Floether

University of Cambridge
Email: ffbcm@gmail.com

Frederik also won last year's competition.

The complete presentation can be seen on our web site at: <www.heacademy.ac.uk/physsci/home/students>.

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Physical Sciences: what you need to know

This presentation addressed the following areas with reference to a 'mythical' student, 'Albert' and a fictitious university, 'Harvoxcam':

1. Coming to university

Goals while studying:

- *Successfully completing the degree*
This goal may seem obvious, but it is easy to lose sight of. Being awarded his degree is, ultimately, the key objective Albert needs to work towards. However, feeling overwhelmed by the daily work is common during a challenging physical science course. In order to stay motivated, this aim must be kept in mind.
- *Meeting new people and building connections*

No matter which secondary school Albert may have attended, Harvoxcam is likely to be bigger and more diverse (I was positively surprised by the personal and cultural diversity I encountered at university). Forging lasting friendly and professional relationships are exciting prospects.

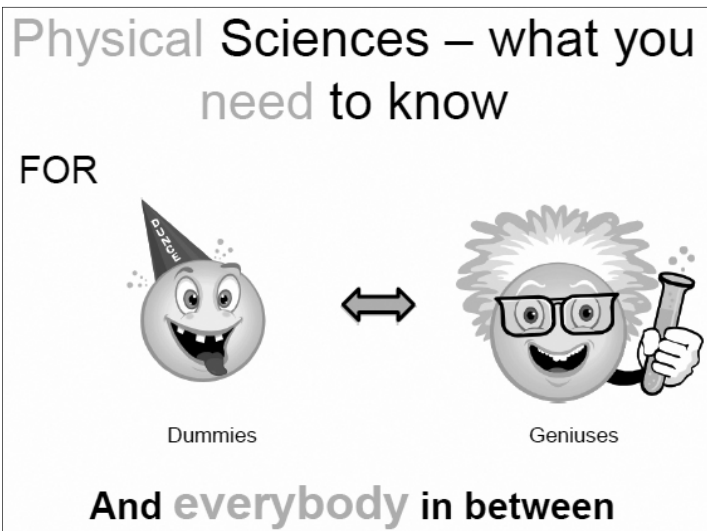
- *Learning 'outside the classroom'*
A university is, evidently, an institution for academics. Next to studying his subject, Albert will be able to talk to renowned lecturers, may consider attending some lectures outside of his course, and can engage in discussions with other students in order to broaden his knowledge.

- *Preparing for life beyond university*
Experiencing university life for several years would be intrinsically valuable even without a final degree. The skills Albert will pick up (strong work ethic, teamwork, leadership, and communication skills) will be highly beneficial throughout his career.

- *And, the last goal (admittedly very insignificant): Enjoying university life*
Believe it or not, despite all the lectures, practicals, countless hours of study and exams, Albert should be enjoying the university course. Thus, if the work really does threaten to overwhelm him, Albert should not feel guilty taking sometime off. (But if Albert is in the middle of an exam, he might consider postponing his leisure time for just a few hours.)

2. Finding your routine

- *Lectures*
Arguably the defining feature of tertiary education. It is easy to see lectures as a burden (particularly on Saturday mornings). However, Albert is well-advised to experiment with different techniques of attending lectures – for instance, whether to take notes during or after each lecture.



- *Seminars/Supervisions*
At most universities, students will be able to learn and ask questions in small groups with a supervisor. Again, Albert needs to find a way to use that time wisely (supervisors tend to be busy academics) – for example, I have found preparing questions beforehand useful.

- *Practical work*
Albert, like many other students (myself included), habitually forgets that science is based on empiricism. More likely than not, experiments will thus be part of Albert's schedule. Whether he likes them or despises them, he needs to apply himself in order to get the most out of his practical work (even if he is positive he will soon have completed his Theory of Everything).

- *Extracurricular activities*
Balancing studies with other activities (such as sports, drama, or volunteer work) will be another part of Albert's time management. Even if he wanted to, he could not learn efficiently by studying 24 hours each day – additional activities are enjoyable and good for his CV.

Physical Sciences: what you need to know

- *General routine*

At my interview, I was told parents frequently complain that their children do not get enough sleep at university. The interviewer said the staff are proud of that fact as it implies that the students are taking advantage of the many opportunities available to them. Similarly, I have found the best recipe for being successful at university to be 'working hard and playing hard'.

3. Progressing through the years

Time will fly for Albert at university (even if he does not apply Relativity to warp space-time). As mentioned, it is important for him to keep his goals in mind. Setbacks and challenging times are absolutely normal. If he does not experience them, he may either be closing in on his first Nobel Prize or he may have lost touch with reality some time ago.

- *Theoretical versus practical science*

Most university courses will gradually specialise over the years. This also means that Albert has to decide whether to focus on theoretical or practical science. Being flexible to change one's mind (during my course my interests actually shifted) is important here.

- *Internships and future planning*

Even if Albert is still just in his first year, looking at internships and beginning to brainstorm his future career is useful. Most universities offer summer work opportunities – Albert could gain valuable experience and skills in such a program.

4. Graduating and beyond

Albert has been doing well so far. Graduation is still almost a year away so surely he does not yet need to worry too much about the following years?

Albert should be careful. It is, in fact, never too early to begin planning. One does not want to be sending off job applications the night before the final exams. Some of the many resources available are:

- Advice from supervisors, directors of studies, fellow students.
- Advice from family and friends.
- Career books and the internet.
- Advice at internship programs.

One of the benefits of studying a physical science is that Albert will have many career options after completing his course. Similar to his goal-setting before beginning his degree, he needs to think about his options and aims:

- Getting higher degrees in the physical sciences
- Continuing to study, but pursuing a different subject
- Applying for jobs
- Taking some time off

Albert needs to carefully evaluate how motivated he will be to pursue each option. In addition, the cost of the different opportunities may vary widely.

Remember

Success can also be attained in UNCONVENTIONAL ways (as the real Albert E demonstrated).

GOOD LUCK! ■

One of the benefits of studying a physical science is that Albert will have many career options after completing his course.

The skills Albert will pick up (strong work ethic, teamwork, leadership, and communication skills) will be highly beneficial throughout his career.

New Development Projects 2009/10

'Pop-Up: Perceptually and Pedagogically Effective Visualisation of 3-D Molecular Structures' by Dr Ik Soo Lim, Bangor University.

'Data-handling Skills in the Physical Sciences: Development of a Diagnostic Instrument and Supporting Learning Resources' by Prof Simon Bates, University of Edinburgh.

'Teaching and Assessment Resources for Medical Imaging for Physics students' by Dr Silvia Pani, University of Surrey.

'POP Concerts: A New Approach to Engaging Physical Science Students in the Acquisition of Communication Skills' by Dr Fred Currell, University of Belfast.

'The Hulton Abbey Skeletal Digitisation Project – HASDIP2 – Use of Non-Contact Laser Digitisation to Capture Images from Fragile Skeletal Material for Use in Teaching and Research' by Prof John Cassella, Staffordshire University.

'Trial and Error or Strategically Formulated Plan? How our Novice and Expert Students Approach Problem Solving in Chemistry' by Dr Orla Kelly, University of Plymouth.

'Enhancement of Student Conceptual Understanding of Quantum Mechanics Through the Development of Animated Visualisations Based on Outcomes of Educational Research' by Dr Antje Kohnle, University of St Andrews.

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The Physical Sciences Centre is funded by the Higher Education Academy (www.heacademy.ac.uk) and is part of the Academy's Subject Network. The Centre is supported by the Universities of Hull, Liverpool and Surrey.

Offers to contribute to the newsletter are welcomed. Please contact the Centre.

The views expressed by invited authors in this publication do not necessarily represent the views of the Centre.

Events -2009/10-

- New Approaches to Old Physics, 21st October, Warwick
- Making Web 2.0 Work for You, 28th October, Leeds
- New and Aspiring Lecturers' Workshop, 30th/31st October, York
- Changing Academic Practice: Implications for future Physical Sciences academics, 4th November, Oxford
- e-learning SIG/New Technology, 3rd December, Manchester (tbc)
- Back to the future: reflecting on past experiences, 10th February, York
- Teaching problem solving: beyond the single piece jigsaw, 17th February, Edinburgh
- The Future of Technology Enhanced Assessment, 21st April (tbc)
- Developing Professional Skills for Physicists, 12th May, Durham
- e/pbl workshop, May (tbc)
- Departmental Representatives' meeting, 18th/19th May, Leeds

Centre Director receives awards!

The Director of the Physical Sciences Centre, Professor Tina Overton, has recently been awarded two significant honours.

She has been made a Senior Fellow of the Higher Education Academy. The announcement, in June, reads: "The Higher Education Academy has announced the names of six new Senior Fellows. Part of the Academy's Professional Recognition Scheme, Senior Fellowship recognises outstanding champions of teaching and learning in higher education. The scheme is part of the Academy's commitment to raising the status of teaching in HE."

For further details, visit:
<www.heacademy.ac.uk/news/detail/Senior_fellows_spring_2009>

More recently she has received, through the Royal Society of Chemistry, the Nyholm Prize for Education 2009

The citation reads: "Awarded for leadership and initiative in developing areas of chemistry education."

For further details, visit:
<www.rsc.org/ScienceAndTechnology/Awards/NyholmPrizeEducation/2009winner.asp>

Congratulations, Tina! ■

Contact us or visit our
web site for details.