Science Education Enhancement and Development

SEED

Working Paper Series

Development of a work-place based education and training programme in chemistry and applied science: Qualifications Update in Science for Industry (QUSI)

Mike Lister, November 1998

The SEED Programme, Faculty of Science, University of Plymouth. Supported by the Higher Education Funding Council for England, through the Fund for the Development of Teaching and Learning.

AN INTRODUCTION TO SEED

The programme for Science Education Enhancement and Development ('SEED') is based in the Faculty of Science at the University of Plymouth. It is resourced principally by the Higher Education Funding Council for England through its Fund for the Development of Teaching and Learning. Additional support has been received from many areas of the University and particularly from Academic and Information Services.
SEED builds on the success of the University of Plymouth Science Faculty in the national Teaching Quality Assessment system where Plymouth achieved 'excellence' in Environmental Science, Geography, Geology and Oceanography.

SEED's overall aim is to develop, document and disseminate good practice in Science teaching and learning. The programme consists of a series of projects in areas such as lab-work, field-work, graduate teaching assistants and computer-aided learning, which are itemised inside the back cover. Most are based in the Science Faculty but some have been taken forward by staff in the University's School of Computing and in Educational Development Services (EDS). All the projects are linked to dissemination partners in other institutions who act as external advisors, ensure that SEED's outputs are capable of being used in other institutions and help to disseminate and embed SEED's end-products.

Anyone wanting further details on the SEED programme is welcome to contact Brian Chalkley or Andy Elmes at the address below. Contact details for the individual project leaders are available inside the back cover.

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Assistant Director of Operations (Science & Engineering), Cornwall College, Redruth.

1.0 Introduction

The Government's Consultation Paper 'The Learning Age' set the scene for a continued change in the way that learning opportunities are provided in the future. In particular, it seeks to promote an approach of life-long learning that is inclusive to all. It emphasises the University for Industry initiative that will enable more employees to update their knowledge, understanding and skills in the workplace at various stages in their careers (see Hillman, 1996).

This SEED Working Paper describes a project that was undertaken by Cornwall College involving the introduction of work-place based HNC and HND programmes in Chemistry and Applied Science.

Cornwall College is the largest provider of Further Education in the south-west region and works in close partnership with the University of Plymouth on courses provided at Higher Education level. The college has maintained close links with the main manufacturing and service industries within Cornwall since its inception seventy years ago. These industries have tended to look to Cornwall College for much of their education and training needs in terms of conventional day-release programmes, bespoke training programmes, corporate training packages and work-place based provision.

Over the past ten years, however, Cornwall College has experienced a decline in the popularity of traditional science-based day-release programmes leading to National Certificate (NC), Higher National Certificate (HNC) and Licentiate of the Royal Society of Chemistry (LRSC) qualifications.

Feedback from industrial partners has indicated that this trend has occurred because traditional day-release programmes are considered inflexible, prescriptive and expensive, in terms of travel and attendance time for the employee.

The rural nature of the region and dispersed nature of its science-based industries have further exacerbated the trend away from campus-based learning.

In 1996, the need was recognised, therefore, to offer science-based programmes that are more in keeping with the needs of industry, where re-training and updating are regularly needed, without the imposition of a rigid curriculum and attendance schedule.

The Centre for Science at Cornwall College accordingly began to consider the possibility of a flexible scheme of education and training (QUSI) that would allow employees in science-based industries to have their existing knowledge and experience formally assessed and accredited and enable them to obtain higher qualifications within the context of their workplace.

In planning the new programme, the course team considered a similar scheme pioneered in 1992 by the Engineering Centre at Cornwall College – the Nanpean Initiative.

The development time for QUSI has been funded through The University of Plymouth SEED Project.

This paper describes the objectives of the project, its outcomes and the characteristics of the HNC/D programmes devised, issues raised during validation of the programmes, the role of industrial partners in the development and management of the programmes (including the role of industrial mentors); it describes how learning in the workplace takes place and provides feedback from candidates and employers; it summarises some of the lessons learned from the process.

2.0 Objectives of Project

The principal objectives were:

To develop new HNC/D programmes in Applied Science and Chemistry that would:

1. Enable employees in science-based industries within the south-west region to develop their skills, knowledge and understanding and gain qualifications relevant to their work, within the workplace.
2. Enable the skills, knowledge and understanding developed in the workplace to be formally accredited.
3. Utilise the skills and specialist resources that exist within industry in the delivery of the programmes.
4. Use industrial mentors to support candidates.
5. Involve industrial representatives in the planning, organisation and delivery of the programmes.
6. Enable, and widen, access to the programmes for employees not currently well served or unable to travel to undertake traditional programmes.

3.0 Outcomes and Characteristics of QUSI

The project has led to the following outcomes:

1. Two HNC/HND programmes have been validated by The University of Plymouth.
2. Staff in science-based industries are now able to gain formal qualifications without leaving the workplace, currently to HNC and HND levels.
3. Traditional day-release programmes have been replaced by flexible, work-based ones.
4. Candidates are able to have their existing knowledge and experience assessed and accredited by academic tutors and industrial mentors.
5. The underpinning knowledge is provided by a combination of academic tutors and industrial mentors.
6. The necessary skills and experience are acquired in the workplace in a context that is relevant to the needs of the employer.

The nature and time-frame of the programmes is negotiable and flexible to take account of the progress of individuals and requirements of the employers.

Other benefits that have arisen from the development and implementation of the programme include:

1. A widened network of industrial partners for the College.
2. Closer links between the College and employers.
3. Improved links between industrial organisations.

The author is not aware of another programme managed and delivered in quite the same way as QUSI, other than the Nanpean Project, on which it was based, and the Solent Initiative (run from Portsmouth) that also developed from the Nanpean Project.

The programme has several distinct advantages over traditional ones:

1. It is responsive to industry's changing needs to update and re-skill staff.
2. It fully involves industry in curriculum writing, planning and delivery.
3. It encourages networking between industries.
4. It makes full use of industrial expertise and resources.
5. It keeps candidates in the workplace.
6. It can accredit knowledge and skills developed in the workplace.
7. It is not limited to the College's immediate catchment area.
8. It readily accommodates use of flexible learning packages, including video-conferencing, CD-ROM and INTERNET based material.

4.0 Validating the Programmes

The College is a partner of the University of Plymouth and runs a large number of HE programmes, mainly at HND level, validated by the University.

The programmes within QUSI are significantly different from the previous day-release offerings in that they involve a combination of industrial mentoring and academic tutorials. Candidates remain based in the work place and there may be a large (up to 50%) element of Accreditation of Prior Experiential Learning (APEL). There are no prescribed dates at which cohorts will start or finish the programmes.

These differences meant that it was particularly important to be able to satisfy the validation panel on issues such as:

- Teaching and learning strategies and the relative emphasis placed on mentoring and tutoring.
- Preparation of industrial mentors for their role.
- Management of the APEL process.
- Management of programmes delivered at a distance.
- The role of the Steering Committee as distinct from a normal Programme Committee.
- The input, generally, of industrial partners.
- Support for candidates that may never visit the College campus.
- Maintenance of academic rigour.
- The timing of Award Assessment Panels and Award Boards.

5.0 Industrial Involvement in the Development of QUSI

QUSI was developed with, and is now operated in partnership with, science-based industries in the region. Because of the rural nature of the county, these tend largely to be geographically dispersed. There are a few SMEs that are specifically science-based and some larger organisations that have a strong scientific perspective, including South West Water, ECCI and the Environment Agency.

Despite the existence of the Nanpean Initiative, QUSI has had to establish its identity and credibility with a range of industries largely distinct from that served by its engineering counterpart.

Much of the early dialogue and planning took place through an established Science Advisory Group comprising academic representatives from The Centre for Science at Cornwall College and representatives from a variety of science-based industries in Cornwall and Devon.

This consultative forum became extended as employers interested in QUSI were identified or made themselves known. Reliance was placed on personal contact by the project manager and industry's innate ability to network between organisations and within larger organisations.

The more involved that industrial partners became, the more committed they became to the idea of QUSI and the more generous they became with time and ideas.

In the developmental stage, industrial partners provided significant help with the following:

1. Advising on the feasibility and viability of the programme.
2. Deciding modules to be offered and the overall shape of the programme.
3. Designing specialist modules.
4. Advising on teaching and learning strategies.
5. Advising on assessment strategies.
6. Advising on key skills components.
7. Advising on the extent to which APEL could be applied.
8. Deciding the part that industry could play in the organisation and delivery of the programme.
9. Supporting the programme at validation.

The following employers assisted in the development of the QUSI scheme:

- ECCI Ltd
- The Environment Agency
- Maybridge Chemicals
- Pall Industrial Hydraulics Ltd
- Sensitisers UK Ltd
- South West Water Services Ltd

6.0 Industrial Involvement in the Management of QUSI

A Steering Committee, which comprises of industrial and academic representatives, manages the programmes and monitors the quality of delivery and the progress and achievement of candidates. The chair of the committee is a member of the College staff but the majority of its members are from industry and have readily accepted their role. This Committee meets once every term.

The Steering Committee has responsibility for the academic overview of the HNC/HND programmes, and specifically:

1. Appoints senior mentors and APEL chairpersons.
2. Receives reports from module leaders on the programme progress within each module, together with any feedback from students.
3. Raises issues relating to these reports and other quality matters requiring action, and identifies persons responsible for action and times-scales to be met.
4. Receives recommendations from the programme team and decides, and initiates, changes to ensure the continued viability of the programme.
5. Keeps the programme team informed of the requirements of industry, enabling the delivery of the programmes to be refined.
6. Acts as a forum for airing concerns of candidates, within the scope of the College's Quality Assurance system.
7. Receives reports from the external examiners and passes comment to the programme teams.

7.0 Industrial Mentors

Each QUSI candidate has the support of an industrial mentor who is responsible for:

1. Assisting candidates in identifying an appropriate pathway relevant to their industrial experience and role.
2. Assisting candidates in identifying relevant prior experience and learning and preparing a portfolio of evidence for the APEL panel.
3. Supporting candidates in their studies and, particularly, in identifying suitable opportunities to undertake projects in the workplace, and assessing such projects.
4. Assisting candidates in identifying evidence for the development of work-based skills.

A substantial body of experienced mentors has been identified. These tend to be first-line managers of the candidates and middle-managers within the industries. So far, there has been no problem in identifying mentors because of the commitment that the industries have to QUSI. If there were such a problem, it is conceivable that a mentor could be provided from another industry within the scheme, at least in the first instance.

New mentors attend a training day organised by a senior mentor identified by the Steering Committee. This will familiarise each new mentor with the operation of QUSI, help to prepare them for the mentoring role and encourage them to support each other by sharing good practice. An effective mentor will help candidates gain access to, and support from, their senior managers.

8.0 Accreditation of Prior Experiential Learning (APEL)

Candidates and their mentors are encouraged to present evidence for APEL which is assessed in accordance with the University of Plymouth's "Assessment of Prior Experiential Learning" regulations. Mentors are suitably prepared for this task during their training day.

Up to 50% of the programme can be accredited. In practice this is likely to be much lower and to date no candidates have wished to submit evidence for APEL.

If a suitable case were to arise, candidates, supported by their mentors, would be interviewed by an APEL panel, comprising industrialists and academics, chaired by an industrialist, with appropriate qualifications and experience, appointed by the Steering Committee. The chairperson is responsible for preparing the panel members for their role, guided by the steering committee.

Suitable evidence takes the form of certificated qualifications, accredited work experience or written statements witnessed by persons of acceptable standing. Candidates may have achieved only partial coverage of a module. In such cases they are required to study the outstanding part(s) and submit evidence of satisfactory completion to the programme manager.

9.0 Learning in the Workplace

Strong emphasis is placed on the benefits of studying in the context of the workplace to make use of the high level of expertise and specialised equipment available within industry. In this sense the programmes illustrate the much wider national trends toward work-based learning and closer ties between the worlds of education and employment (Brennan & Little, 1996).

The programmes recognise that:

1. Industry has much of the expertise needed to train others, in-house.
2. Employees are already gaining knowledge, understanding and skills through their every-day work.
3. Learning is more effective in the context of real practical experience.

If a company were ever considered too small to be able to offer a suitably broad experience for a candidate, this could be arranged within other industries in the scheme.

Suitably qualified and experienced specialists from within industry participate in the delivery of individual modules during evening/weekend tutorials and support their input within the practical context of industry.

The proportion of time spent on mentoring, relative to that in providing theoretical underpinning, varies from module to module. However, equal emphasis is placed on each approach in terms of the value of the contribution and the opportunity for reflection and assessment.

Tutorials provide an opportunity for all candidates within a cohort to meet together in a formal classroom setting. This happens on the premises of one of the industrial partners (usually on a revolving basis) on one or two evenings a week (over a 45 week year) with additional Saturday mornings arranged as necessary.

Tutorials vary in style but the pressure on time tends to lead to a formal approach (lectures with visual aids and hand-outs, and with queries answered as needed). Candidates having significant problems that cannot be resolved within the tutorial setting tend to contact the programme manager who arranges additional support on-campus, in the work-place or by video-conferencing or e-mail.

Mentors are encouraged to build on the knowledge assimilated during tutorials, in the practical context of the workplace, at the time that the learning takes place, so that the relevance and application of the information is fully and readily understood.

For the same reason, tutors are encouraged to draw upon the practical experience of candidates, in the classroom situation.

All candidates are required to undertake investigations and projects in their workplace as part of the assessment and learning activity relating to the content of the main programmes. The project work is the main company-centred activity and is usually focused on an area that can produce gains in effectiveness, efficiency or productivity for the employer. In addition to producing a formal written project report, candidates are required to make a verbal presentation to company managers, and/or other appropriate staff.

The continuing success of project work highlights how the programme is providing the learning and developmental experience that the companies require. Co-operation between staff from different companies brings to candidates the benefits of encountering other company cultures and specialisms.

The programme manager has regular contact with industrial mentors and is readily available to offer advice in order to maintain an appropriate level of academic standard.

10.0 Feedback from Candidates & Employers

The last cohort of day-release science-based HNC students to study at Cornwall College comprised 3 individuals. So far, in 1998, 43 candidates have enrolled on an HNC through QUSI, the majority from laboratory and process operations backgrounds.

The reason for this extraordinary increase in recruitment is simply down to the approach of giving industry what it wants in the way that it wants it. Furthermore, involving industry in the

planning, managing and delivery of the programmes has resulted in a much fuller commitment than would otherwise be the case.

The flexibility of the programmes is particularly attractive to industry. One partner needs a module delivered on Laboratory Quality Control and is in the process of writing it. Once validated, it will be co-delivered by two industrial partners and will benefit other industries as well.

There are no signs that the healthy recruitment is unsustainable; indeed one major partner has indicated that it would wish to widen access to the programmes to other parts of the organisation, if it considers the first phase to be successful.

To date, QUSI has been operating for nine months with two cohorts now established, one based in East Cornwall and one in Exeter, in terms of industrial groupings.

The College always endeavours to organise tutorials so that candidates have a relatively short travelling distance. The venue is occasionally changed so that it is shared between the various partners contributing candidates to a particular cohort.

Feedback on the programmes from candidates is provided through regular review meetings and from employers through the Steering Committee.

The following comments have been made, by candidates and employers, about the programme:

General comments:

1. Candidates and employers are impressed by QUSI; it encourages motivation and organisation; communication with College staff is generally good.
2. Candidates quickly establish a momentum that can leave mentors behind.
3. Candidates find it hard working 2 evenings a week and occasional Saturdays – it can be stressful but enjoyable as well.
4. The programme becomes more interesting as it unfolds.
5. Some communication problems have occurred regarding assessment methods and the timing of assessments – candidates need a better indication of what to expect, and when, because of work commitments.
6. Problems have occurred identifying practical work for less practically oriented (e.g. non-laboratory-based) candidates.
7. There is a danger of candidates putting QUSI before work – a balance is needed.

Comments specifically about mentoring:

1. Employers were initially concerned that mentors would become over-involved but that hasn't proved to be the case.
2. Mentors have an important role in confidence-boosting and occasionally need to encourage candidates to continue.
3. Mentors are generally comfortable with their role; they help to show candidates how workplace and academic aspects fit together, with help from the programme manager; they help candidates find evidence of achievement for non-taught modules.

Generally, the industrial partners are extremely positive about QUSI and the way that it operates. In particular, they approve of the influence that they have on the programme, the part they play in managing and delivering it, and the responsiveness and flexibility of the College.

The shared process of planning, management and delivery has helped to dispel the idea that academics are out of touch with the needs of industry. The rhetoric of the past (if that is all it was) has become a reality in a partnership that looks set to continue and grow.

11.0 Summary and Lessons Learned

The successful recruitment onto QUSI (also mirrored with Nanpean) would indicate that industry wants a greater control over, and involvement with, the retraining and up-skilling of its employees. It requires programmes that are flexible and readily changed.

Given the expertise and equipment invested in industry, it makes it eminently sensible to allow and encourage a much greater involvement in the planning, management and delivery of work-place based programmes. A fuller commitment by industry can only be beneficial in maintaining and improving recruitment and retention of employees.

Furthermore, it fits into the government's vision outlined in 'The Learning Age'.

The following is a summary of the main experiences to date:

- It is not enough to offer a programme that is academically rigorous and thorough in content – it has to be what industry needs, and able to adapt to changing needs.

- The full involvement of industry has been essential at every stage and has led to a full commitment to the concept of QUSI and to its delivery and management. QUSI is industry's programme as much as it is the College's or University's.

- Concerns that industry would short-change candidates proved to be ill-founded. Industrial partners actually want candidates to be more effective, efficient and productive so they are committed to processes that lead to the development of skills and knowledge. The qualification, per se, is not as important to the employer as it is to the candidate. For this reason, the quality of the candidates' work has proved, through first line assessment and internal verification, to be of a very high standard and indicates that the quality of the mentoring is equally good.

- APEL features highly in the Nanpean programme so it came as a surprise to find that no QUSI candidates wished to present evidence for accreditation. It could be that the evidence was less forthcoming than in equivalent engineering-based industries but there is also an indication that candidates want to get as much out of the programme as possible. There is certainly a tendency for candidates to select more modules than are required for the qualification.

- Managing groups from a distance has required a lot of planning and co-ordination and the programme manager makes regular contact with mentors, candidates and tutors. The College is considering using cohort managers who are physically based in each location. Undoubtedly, resource-based materials, the INTERNET, video-conferencing and e-mailing will increasingly feature.

Acknowledgments

I am indebted to Frank Hyde for the idea behind The Nanpean Initiative on which QUSI was based and to Marilyn Gould for her energy, enthusiasm and powers of persuasion that were largely responsible for making QUSI happen.

An enormous debt is owed to those in industry that trusted Cornwall College enough to invest their time and energy during the development of QUSI, and for providing the first candidates.

Finally, I am grateful to Brian Chalkley (SEED Programme Manager), Andy Elmes (SEED Programme Officer) and Judith Gill (SEED Secretary) for all their help, support and encouragement. Particular thanks are due to Brian for his participation in the validation process.

References

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Department for Education & Employment (1998) The Learning Age (London: The Stationery Office Ltd).

Hillman, J. (1996) University for Industry – Creating a National Learning Framework (London: Institute for Policy Research).

THE SEED PROJECTS

Project 1: A web based bibliographic database on Science teaching and learning, designed to support the information requirements of the SEED Projects.
Nigel May, Science Faculty Team Co-ordinator,
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Project 2: An investigation of the potential development of Curriculum Support Teams.
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Project 3a: A handbook on field teaching in the Sciences.
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Project 3b: Field discovery days.
Colin Williams et al, Geological Sciences,
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Project 4: Fieldwork issues and developments.
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and Andy Elmes, SEED Programme,
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Project 5: A handbook on laboratory teaching.
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Project 6: Peer assisted learning strategies (Supplemental Instruction) (P.A.L.S (S.I.).
Stuart Johnston, Educational Development Services,
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Project 7: Development of a framework for the training and management of graduate teaching assistants.
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Project 8: Development of a computer-aided learning package for environmental organic chemistry.
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Project 9: Environmental issues in the Mediterranean: a case study of the Maltese Islands.
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Project 10: Computer based assessment in science: a review of good practice.
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Project 11: CAL and basic Science.
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Project 12: A handbook on employer-links in Science.
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Project 13: Using multimedia for providing feedback to students undertaking concurrent project-based practicals.
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Project 14: An environmental data base for projects in environmental impact assessment (EIA) and conservation.
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Project 15: Webkit - a toolkit to produce interactive web pages in support of CAL.
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Project 16: Qualifications update in applied Science for industry (QUSI).
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Project 17: Baseline assessment of competencies and skills for Science and Computing.
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