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# Using e-learning to deliver professional development training to teachers, in the area of ICT within design and technology

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## Abstract

*This paper discusses the action research that was carried out to deliver continuing professional development materials to design and technology teachers, through e-learning. The focus is the government's New Opportunities Fund 'ICT for Teachers' initiative, which aims to train teachers to use information and communications technology (ICT) within their subject area.*

*Staffordshire ICT for Teachers (SifT), an approved training provider to the scheme, has delivered materials via the Internet, using a virtual learning environment. Such a delivery necessitated research into the instructional design model to be used, the associated pedagogical issues, the ICT software for teachers to access, the design and technology subject materials to be created and the necessary support mechanisms which needed to be put in place, in order to deliver such e-learning. This paper reflects the innovative design and technology training that SifT offers (incorporating a wide range of materials into a co-ordinated system) and the lessons learned, providing suggestions for the way forward with e-learning, in the area of teacher professional development.*

## Keywords

*e-learning, networked learning, design and technology, continuing professional development, teachers*

## Introduction – the New Opportunities Fund initiative and SifT

Continuing professional development (CPD) for teachers has traditionally been delivered through face-to-face training. With the advent of the New Opportunities Fund 'ICT for Teachers' (NOF, 2001) initiative in April 1999, the scale of the delivery task to train all 'serving' teachers to be confident and competent to teach using ICT by the year 2002 (DfEE, 1997), suggested that an alternative delivery format should be considered. In providing the training, the focus was to help teachers to use the technology within their subject area of the curriculum, rather than teaching purely how to use the technology.

The emerging ability to deliver training on-line, via the Internet, as e-learning (electronic learning) or networked learning, appeared to present a solution. Associated issues centred on: the design model to be applied; the pedagogy to be adopted; the content to be delivered; the appropriate support framework required and the technology to be used.

Staffordshire ICT for Teachers (SifT), a collaboration between Staffordshire University and Staffordshire Local Education Authority (LEA), in the UK, became a Government Approved Training Provider, to the 'ICT for Teachers' initiative. SifT was approved as a national provider for England (following a competitive tendering process), to deliver ICT training to secondary teachers (of students aged 11–18), within the subjects of design and technology and geography.

SifT created training materials for secondary teachers, delivered directly into their working environment using a web-based virtual learning environment (VLE), in this instance Lotus Learning Space. Where a VLE is defined as 'an integrated software system, which combines within a package facilities for the delivery of learning materials, communication (synchronous or asynchronous), assessment and student feedback'. (LTSN/THES, 2001)

At the commencement of the SifT development in March 1999, two main problems had to be faced:

- How could learning materials be constructed within a VLE?
- What subject materials should be used?

Whilst there existed extensive research on how people learn (Piaget, 1932; Vygotsky, 1978; Pask, 1976; Kolb, 1984; Gagné, 1985; Knowles, 1970; Laurillard, 1993: 102-105), there appeared little information, as to how this learning might be constructed within a virtual learning environment. In the context of design and technology, on which this paper is based, the question of what subject materials should be used, presented further problems.

The design and technology curriculum requires that students are involved in activities where the main focus is on designing and making, using a variety of materials and components. The diversity that this presents – resistant materials, food, textiles, graphics, electronics, structures and pneumatics, provides a significant challenge to developers of design and technology learning materials, created for teacher CPD. Furthermore, overall funding for CPD nationally has been limited, with most teachers restricted to less than two days of face-to-face training annually, hence teachers' levels of skill with respect to using ICT resources for design and technology, differs greatly. Finally, the variation and availability of software in schools for design and technology purposes, was also an issue for the SIFT development team. Thus in answer to the two main questions 'How could learning materials be constructed within a VLE?' and 'What subject materials should be used?', action research was carried out to develop the SIFT model and materials.

### **SIFT action research**

Action research is about problem solving to extend knowledge (Hult and Lunning, 1980; West et al, 1995: 361-365; McConnell, 2000). The research follows a cyclic developmental process, which involves some planned reaction to a problem, followed by feedback, evaluation, critical reflection and discussion, to redefine the understanding and knowledge and thus inform the next cycle of activity. As Levy (2002) defines, it involves the construction of 'validated 'practical' knowledge' and can draw on and blend 'methodological perspectives and approaches to fit the circumstances and purposes' of the project.

The initial action research centred on instructional design – how to create a design which supported good pedagogy within e-learning, in order to develop the 'SIFT model'. The action research began with the vision and experience of the two main SIFT designers, together with a systems engineering approach. The designers became 'reflective practitioners' as described by Schön (1987), in a process that involved 'constructive' (Vygotsky, 1978) action research. They aimed to take forward the right course of action based on 'technical rationality' (Schön, 1987), with each working as expert practitioner in support of the other.

They adopted a cyclic approach, driven by the timescales of the NOF programme and their personal positions – grounded more in practice than in theory, whilst drawing on the work of the educational philosophers (Piaget, 1932; Vygotsky, 1978; Pask, 1976; Kolb, 1984; Gagné, 1985; Knowles, 1970; Laurillard, 1993). This work is reported further in Whitehouse et al. (2002a)

Subsequent action research focused on the content to be built within the SIFT design framework, this was initially developed and trialled within the context of geography. (Whitehouse et al, 2002a and 2002b) The materials were then developed and trialled for design and technology, under the expertise of Brotherhood, an LEA Schools Adviser for design and technology (the paper co-author and SIFT design and technology editor). Discussion, trial and evaluation of the prototype took place with subject specialists and teachers, prior to the launch of the SIFT materials under the NOF scheme in January 2000.

Subsequently teacher evaluation of the SIFT programme has continued throughout the delivery period – to improve the model, as has the evaluation from the Teacher Training Agency (TTA) quality assurance process, which monitored the provision of all NOF training providers.

The action research approach thus used to develop the SIFT model, involved five major levels of cyclic activity and evaluation, viz: on paper, involving the designers; in electronic form within the virtual space, with designers and computing personnel; at the prototype phase, with 'selected' teachers; after the 'live' system was launched, with 'paying' teachers and finally, involving the TTA quality assurance process. Within each of these levels however, numerous iterations were processed of planning, action, evaluation, re-interpretation and engagement, to develop the 'SIFT model'.

### **Development of the SIFT '12 unit grid' and 'coursework framework' for design and technology**

The design adopted by SIFT was to create a highly structured model, subject focused to the perceived needs of the users. (Milligan, 1999) Stiles (2000) draws together research that identifies that learning should be in culture and that activities should be 'authentic' and normal to that culture, hence in this instance, set in the culture of teaching and classroom practice, as well as the culture of the technologist. The SIFT training was developed as a '12 unit grid', consisting of four subject strands, each with three levels of ICT capability – beginner, intermediate and advanced. This grid was then implemented for teachers at secondary level (with students aged 11–18 years) for the subjects of geography and for design and technology.

Figure 1 illustrates the implementation of the SIFT design for design and technology, which centres on the four main areas of the subject, providing the headings for the vertical strands: 'CAD/CAM with construction materials', 'Designer textiles', 'Modelling for food technology' and 'In control with electronic systems'. Each of these strands is offered at 'beginner', 'intermediate' and 'advanced' levels of ICT competence, resulting in 12 'units' in all, numbered from 1 to 12. Each unit is broken down into two courseworks, identified as 'coursework A' or 'B', each with a common framework of 'Stimulus', 'Assignment', 'Small steps to success', 'Assessment' and 'Learning outcomes'. The 'Small steps to success' are the learning tutorials within the coursework, which provide the materials for the learner to develop the knowledge and skills to be able to carry out the 'assignment'.

Under the 'ICT for Teachers' scheme, funding is available for teachers to 'buy' four units from a possible 12, thus providing flexibility for teachers to choose the Sift units, which most closely reflect their ICT competence level and subject need. A teacher selecting unit 4 and commencing on coursework A 'making patterns', would thus follow the 'small steps to success' tutorials, identified consecutively as 4A1 to 4A11, to cover materials in the areas of 'teaching, classroom management and ICT skills'.

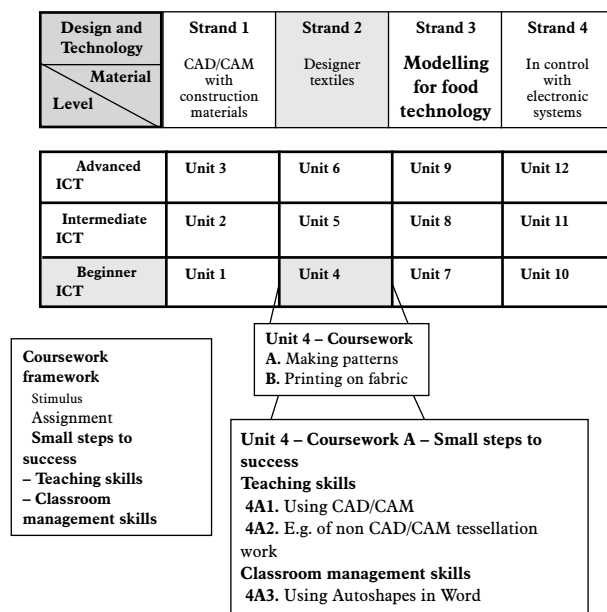


Figure 1: SIFT '12 unit grid' and 'coursework framework', for design and technology  
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The SIFT 12 unit grid and framework were particularly suited to the 'content centred' virtual learning environment (Milligan, 1999), of Lotus

Learning Space (LLS) Version 2.5, which was used for this development. LLS had been acquired by Staffordshire University in December 1997 and had been used by local students from September 1998. Within LLS, the student encounters four main areas – the 'Schedule', 'MediaCenter', 'CourseRoom' and 'Profiles'. The Schedule holds the *outline of the virtual course*, whilst the MediaCenter holds the *course-related material*. The Sift Units and Coursework framework would thus be accommodated within the Schedule area of LLS (Stimulus, Assignment, hyperlink headings to the Small steps to success, Assessment and Learning Outcomes), whilst the SIFT Small steps to success tutorials would reside within the MediaCenter. Of the remaining LLS areas, the CourseRoom would permit on-line discussion, collaboration, assignment creation, submission and feedback, whilst the Profiles area would enable participants to submit their own personal information, relating to their education, experience and interests.

Delivery of e-learning to busy professionals, requires the rethinking of the traditional model. Professional development for teachers typically has consisted of one to two days of face-to-face training, working with a tutor in groups of 8 to 20 people. The new model needs to support 'learning on demand – any time, any place, at your own pace' style of learning and to offer 'bite-sized' or 'granular' learning, to fit the limited timeframe that the teacher might have available. In creating the Sift learning content within the VLE, the aim was not only to produce 'bite-sized' pieces of learning (taking no more than 30 minutes elapsed time), but also to provide material that was pedagogically sound, incorporating qualities of the 'virtual tutor' (Whitehouse et al, 2002a and 2002b). The objective was to create material, which was motivational and friendly, innovative, lively, interactive and dynamic, and to place special emphasis on understanding and accommodating the many requirements of the teachers' daily needs, within the Sift units.

### Teachers' choice of design and technology units and software licensing issues

The choice of the four specialist strands for design and technology was reached after consultation with subject specialists and teachers: resistant materials, textiles, food and control systems. The requirements of the NOF initiative did not include the training of teachers without any knowledge of ICT, nor was it aimed at 'experts' – although a number of teachers with advanced skills are following Sift training. The ability to choose four units provided teachers with an opportunity to broaden their experience of ICT, from the one material in which they majored, to its application in an unfamiliar material. This is in line

with the TTA's aim for teachers' expertise to become more flexible, through the use of alternative design and technology materials.

- A. Teacher experienced in resistant materials and doing some electronics.
- B. Teacher of textiles wishing to sample the use of ICT in food technology.
- C. Teacher of food and textiles and a confident user of ICT.

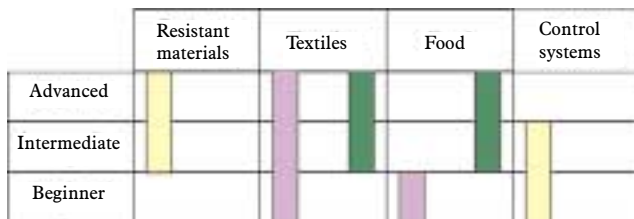


Figure 2: Common patterns of Sift units chosen by design and technology teachers.

Although there is a large range of options that teachers have chosen for their SIFT units, three patterns predominate, as shown in Figure 2. These reflect: teachers who are experienced in resistant materials, but who choose to follow some electronics training; teachers of textiles who wish to sample the use of ICT in food technology and, teachers of both food and textiles, who are confident users of ICT.

Action research involving teachers, identified two common issues for professional development: improving competence using subject specific and/or material dedicated software and the guidance for its use within the classroom. This created tension, as extra costs of acquiring software licenses could not be a requirement. The subsequent choice of software used, was based on the outcome of discussions with software suppliers and with subject specialists, but ultimately was the decision of the SIFT design and technology editor, who had wide experience of supporting schools, over many years.

Initially the most appropriate software for each unit was identified. D&T authors were then asked to develop tasks within the SIFT materials, which could be carried out using free or low cost, trial versions of the chosen software. In all cases suppliers were very co-operative. In the case of food nutritional analysis, fully functioning software was provided, although only a subset of ingredients was available to be used for the tutorial activity. In this way, teachers could use the SIFT experience to test a range of software products, prior to purchase.

The choice of software for the strand 'CAD/CAM with

construction materials' was Pro/DESKTOP. This powerful, industry standard parametric 3D concept modelling software, is part of the DfES 'CAD in Schools' initiative (DfES/DATA, 1999), managed by DATA (the Design and Technology Association). Under this scheme, teachers undertake Pro/DESKTOP training through an accredited trainer, to develop a set of competencies. The SIFT design and technology editor (an accredited trainer), received many enquiries from teachers wishing to use NOF funding to gain competency in Pro/DESKTOP software – this ultimately led to its integration within the first strand of the design and technology materials.

### Teachers use of SIFT design and technology materials

On selection of the chosen units, the SIFT delivery takes the form of a day of face to face training, between tutor and learner, followed by access to the selected units over the Web (facilitated by user password), for a two year period. The initial training, introduces the learner to the SIFT materials within the VLE, develops understanding of the '12 unit grid', 'Coursework framework', 'virtual tutor' and navigational features of the design and gives access to the materials within Lotus Learning Space. The learners familiarise themselves with the content and the VLE, before they are subsequently supported remotely through the CourseRoom, by the SIFT on-line tutor. Only by attending face-to-face training, was it possible to ensure that teachers had experienced all aspects of the materials and had the opportunity to have initial questions fully answered.

As the focus for their assignments, SIFT teachers were asked to apply their new knowledge, understanding and skills. This took the form of either planning a classroom lesson, teaching it and reflecting on its delivery or, carrying out guided research to develop learning materials for use with students. This is in line with the thinking of: Stiles (2000), that activities should be 'authentic' and normal to the culture; Milligan (1999), that activities should impact directly upon the learners' work and ultimately Piaget (1932), with views of cognitive constructivism, that learners internalise their knowledge in such a way, that they are able to use it within new and different situations.

### Teacher evaluation

In delivering the SIFT training, the objectives were three-fold:

- to deliver the NOF expected outcomes (TTA, 1998), for teachers to be confident and competent to teach using ICT within their subject area of the curriculum
- to determine the SIFT design model to be used, when delivering professional development

- training to remote learners, through a VLE
- to provide teachers, with training which met their needs and was usable.

Teacher evaluation data was collected using a focused questionnaire and through informal questioning. Teachers' response to the SIFT model was generally positive. They liked the subject specific nature of SIFT, its ability to meet their training needs and its relevance to their own classroom practice. Teachers identified that SIFT provided them with ideas that could be used with pupils, which were 'well thought out and directly useful to teaching'.

Difficulties encountered were generally associated with a teacher's personal characteristics or situation or their working environment – including personal payment for Internet access and use of their home computer. Issues related to the lack of teacher confidence and support within schools, technophobia and ill health. Problems of access were associated with computers, networks, the Internet and password access to the SIFT materials. Although many liked the flexibility of 'learning on demand', some teachers wished for further face to face training, particularly if they had experienced difficulties of access (for whatever reason) to the SIFT materials. The most overwhelming problem identified by the majority of teachers however, related to the need for school allocated time dedicated to the NOF initiative, to make use of the SIFT remote materials within the VLE and to trial ideas within the classroom.

### Lessons learned and the way forward

Whilst some people may prefer solely face-to-face learning, SIFT believes that the best balance has been reached, given the large number of teachers involved and the NOF funding allocated. Some face-to-face training, plays a significant part in the process of successful e-learning, since it provides the opportunity to set expectations and develop understanding of the e-learning process. Such a 'blended' solution permits a compromise, given the expense of face-to-face training.

It is suggested that further financial resources would have enabled:

- face to face re-enforcement training sessions for a subset of teachers, some four months after training commencement
- separate face to face events for the different levels of learner – beginner, intermediate and advanced and for the alternative subject strands
- face to face training events held regionally
- extra tutor support within the LLS CourseRoom, to aid motivation by stimulating activity and discourse
- a further event at the end of the training to share

- experiences of e-learning and through dialogue to determine further issues for teacher CPD
- provision of a graphics strand as requested by many teachers, which time and resources did not permit.

The TTA said of the SIFT delivery (TTA, 2001):

'The model is actively chosen by schools, mainly because of it's subject specific nature and networking potential. The programme is well constructed and connected, with all the required elements covered ... The elements of each unit within the modules are well constructed to form a complete whole that provides for a diversity of initial ICT ability and teaching experience...'

In delivering the SIFT model through a VLE however, there were many lessons to be learned. The SIFT team is aware of the many difficulties that teachers face. Through continued research, further support mechanisms have been developed with focused intervention, to aid engagement and sustain momentum of the learning, within the virtual learning space.

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