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Electronic Portfolios for Design and Technology

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Abstract

This paper concentrates on the work of students studying design and technology education (DTE) in initial teacher education (ITE) at Sheffield Hallam University. As an early part of their course they study a module that develops their ability to design and manufacture products using a range of skills and processes. This involves the origination, collation and presentation of a portfolio of evidence to support a number of physical product outcomes design and manufactured during the semester. The submission requirements associated with this course component raise a number of teaching and learning issues relating to the generation and use of portfolios of evidence, commonly associated with the assessment of design and technology activity. These issues include:

- *the use of reflective processes by students in the evaluation of their own outcomes and learning is underdeveloped both specifically within DTE*
- *submissions do not necessarily encourage active student reflection or the articulation of thought processes*
- *the contents tend to be entirely two dimensional and do not encourage recording of three dimensional development work undertaken*
- *they are bulky and do not easily lend themselves to display, storage and handling*
- *maintaining the order of contents is difficult and liable to change when accessed*
- *for security reasons, general availability and access to their contents is restricted to a few (usually only tutors) and does not easily facilitate peer scrutiny*
- *presentation can often incur unnecessary cost for students.*

Electronic portfolios are becoming common in the commercial world and in some areas of education. This project examines the potential enhancement of the teaching and learning opportunities brought about by the use of e-learning in ITE as an instrument for developing student capability.

This small-scale study attempts to evaluate the experiences of a group of 41 students in their first year of a two year route into teaching. They were required to submit for assessment an electronic record of their design work. This made use of commonly available software uploaded to their Blackboard e-learning 'site'. Minimum support was given to students in the use of the technology for e-portfolio production. Subsequently the project seeks to examine the contribution to the learning process of students completing this module. The methodology used by the researcher to collect data includes the use of observation, semi-structured interviews and a questionnaire. Evidence is examined to identify occurrence and use of the following:

- *simple annotation of media to improve clarity and emphasis thus enabling reflection*
- *generation of critical dialogue recording the iterative process between thinking and doing associated with designing and making*
- *distillation of thinking and its affect on refining decision making*
- *inclusion of animation techniques*
- *opportunity taken by students to view the work of others made available through the associated Blackboard course*
- *streamlining of submissions alleviating the need for the generation and storage of paper based portfolios.*

Keywords

designing, evidence, ICT, ITE, e-portfolio, reflection, e-learning, assessment

Introduction

Electronic portfolios (e-portfolios) are becoming common in the commercial world and in some areas of education. An e-portfolio is a means of combining textual and visual material together digitally, in a form that can be transmitted and read electronically. The production of portfolios of evidence to support learning in all areas of art, design and technology is well established at all levels of education. They aid communication and also efficiently display an individual's capability. The collection, organisation and presentation of the content are considered to have value for a number of reasons. Observing the use of portfolios by students studying design and technology indicate that these include:

- providing an archive of materials that document the design process leading up to the manufacture of a product
- collecting together resources that arise from research and investigation to inform decision making
- assisting the designer to reflect on both decisions made and their own learning
- providing a focus to inform discussion with others involved in supporting and or assessing the designers work
- providing a record of processes undertaken and skills demonstrated for academic accreditation.

The use of a portfolio to assist the process of designing within design and technology is not understood. However, a greater understanding on the part of the student as to the true value of the process of compiling a portfolio could be advantageous and provide a mechanism for prompting reflection.

> 'Design learning should strive towards the situation where new designers constantly reflect upon and critically examine their design practice. They should regard the design practice itself as a result of a design process and therefore possible to change and redesign.'
>
> (Stolterman, 1994: 458)

The impact and influence of information and communications technology (ICT) on the generation of content to include in portfolios has been considerable. It has increased the range of content media, often the volume and particularly the presentation. Typically a portfolio produced by a student studying design and technology will include evidence of word processing, scanning, digital photography, accessing databases, analysing numerical data, computer aided design, drafting etc. The use of this technology provides the student with the facility and potential to undertake and engage in increasingly sophisticated design activity. It makes possible things that were in the past more difficult (or unrealistic), for example, producing rendered computer aided design (CAD) files, and can also assist them greatly in saving time in presenting their work. Through appropriate use of ICT, students can achieve higher standards when both designing and presenting their work. Although much use is made of digital technology to generate the content of a portfolio, the common perception remains that in order to make it accessible to others and portable, it must first be transferred to paper. It is the authors' contention that this traditional approach may be limiting some of the benefits that can be drawn from the compilation and subsequent use of portfolios documenting design and technology activity.

Whereas the use of ICT is now well established in D&T and intrinsic to supporting design and making, there has been little use made of ICT as a vehicle for organising and presenting individual student's collection of evidence in the form of an 'electronic portfolio'. Various reasons for this have been given. They include:

- lack of appropriate and easily accessible software to organise and structure a portfolio
- lack of sufficient appropriate hardware in sufficient quantity to enable group access
- the difficulty of digitising images created in traditional media
- access to sufficient memory storage needed for handling graphics in quantity.

Increasingly these limitations have less bearing. A standard home computer with commonly available software and associated peripherals is ideally suited to the task and as this facility has become more available, students are able to complete ICT tasks using resources both within their educational establishments and outside.

This small-scale study examines the work of initial teacher education (ITE) students studying a two-year programme in design and technology with Qualified Teacher Status at Sheffield Hallam University. As is common to most courses of this type, the course is divided into distinct but interlinked modules, each of which requires the completion of various outcomes for assessment. Early in their course students study a module that develops their ability to design and manufacture products using a range of skills, processes and resistant materials. This involves the origination, collation and presentation of a portfolio of evidence to support a number of physical product outcomes designed and manufactured during the semester. The development of these projects is

supported by formal teaching inputs relating to designing, modelling, communicating and manufacturing techniques. Generation of material to include in the portfolio is spread across three months and generally results in a substantial submission. The authors have questioned however the effectiveness of this process both in terms of it contributing to the student's learning and providing an efficient and effective way to collate materials to be assessed. Their concerns can be grouped into two categories:

Submission Format: For practical reasons, submissions tend to be entirely two-dimensional and do not encourage recording of three-dimensional development work undertaken including modelling and the use of manufacturing aids. They tend to be bulky, usually presented in A2 format and do not lend easily lend themselves to display, handling and storage. Maintaining the order of contents is difficult and liable to change when accessed. The order of individual components may be significant if the work is to be considered within a chronological context, i.e. to show both the development of an individual project and the associated development of the student. Presentation and mounting of material can often incur considerable cost for students. For reasons of storage, general availability and access to their contents is restricted to a few (usually only tutors) and does not easily facilitate peer scrutiny. As a consequence, students have little opportunity to view their own work in the light of others and also have limited time in which to scrutinise the group's completed products, many of which only come together immediately prior to the submission date. The value of students being able to study the work of their colleagues has been recognised but seldom facilitated.

Reflective processes: Of greater significance is the use of reflective processes by students in the evaluation of their own outcomes and learning. It has been noted that this is commonly underdeveloped. Whereas annotation within the portfolio is encouraged, submissions do not readily lend themselves to the active recording of reflection and hence the articulation of thought processes critical for both reinforcing learning and providing valuable insight to the tutor as to the nature and depth of that learning. Reflection tends to be restricted to short annotations completed as designs are developed in sketch form and does not extend to other activity such as model making and issues considered during more formal drafting stages. The nature of the reflection also tends to be restricted to considerations to do with the product design and not the learning that is taking place.

Through the use of the e-portfolio, the intention was to enable students to address the balance of the content and identify the key decision points in the designing and making process, highlighting the content that illustrated these. This process of 'distillation' is seen as important as it enables the student to highlight for the tutor the components they consider the most significant. Sometimes it is the case that what might appear insignificant to the onlooker has great significance for the creator. This also guards against the temptation to spend more time studying 'presentation' type drawings, which are by their very nature visually appealing.

Aims of the research

As part of their course, students in ITE at Sheffield Hallam University make extensive use of ICT. This study set out to evaluate the experiences of a group of 41 students in their first year of a two-year route into teaching design and technology. Students possessed a variety of previous experience and qualifications ranging from an HND in Electronics to a degree in Fine Art. Some had extensive experience in the use of ICT, others very little. In their first semester, they complete a module of study that develops fundamental principles of designing and making associated with design and technology education and provides for the acquisition of associated practical skills. The group was required to complete three designed and manufactured products in response to briefs that made use of taught skills, processes and a range of resources for assessment. These skills were introduced over a six-week period and products completed during the semester. The briefs involved designing and making:

- a simple chair made from stock material and simple construction techniques
- a mechanical bottle stopper requiring the use of engineering principles and techniques
- an Aroma fan making use of a simple electronic control mechanism.

To accompany these products, as has been the case with previous cohorts, they were asked to compile a portfolio of evidence supporting their activity. Sheffield Hallam University is committed to developing e-learning using web-based virtual learning environments. This involves making available teaching and learning resources via a computer network, also enabling two-way communication between individual, and groups of, students and tutors. The software it uses for this is Blackboard, which allows for easy up and downloading of a wide variety of file types by tutors and students and has sophisticated provision for synchronous and asynchronous discussion. The concept of an 'e-portfolio' was introduced at the outset and the requirement made that they compiled this

ready for submission at the end of the module. This made use of Microsoft PowerPoint software, files of which could be uploaded to a specially created 'Blackboard' e-learning 'site' accessible only to the group through the university website. The site also contained some exemplar material and resources to inform their own design process. Although specialist portfolio packages are available, the decision was made to use PowerPoint as the software for compilation of the portfolio. This is significant. It has a reputation for being easy to use and does not require any particular previous skills or related hardware. It allows for the inclusion of a variety of media. It is also commonly available so students were able to transfer their work between machines both inside and outside the university as necessary. The authors were more concerned with the students' experience, the nature of the learning and the outcomes produced rather than the evaluation of specific software. As all students are intending to teach D&T in schools, it is also anticipated that they in turn will wish to make use of e-portfolios with their students. PowerPoint is in general use in the UK.

Method

The authors were keen that replacement of a traditional portfolio with the e-portfolio should not increase the workload normally associated with this module. Students were deliberately provided with the minimum of support in the use of the technology to produce 'electronic portfolios' but were encouraged to incorporate qualities and aspects not previously associated with submissions made in printed format. Two separate 30-minute sessions were provided to the group that explained the requirements and demonstrated simple use of PowerPoint. Additional advice and support material was provided via the Blackboard site and an instruction sheet. The advantages and simplicity of PowerPoint were illustrated and emphasis was placed on the need to keep presentations simple and not use an excessive array of effects provided within the software. Individual e-portfolios were limited to five slides but by using animation features additional images could be added significantly extending capacity. Students were also asked to annotate each of the five slides providing reflection and comment using the Notes facility available in the software. This important aspect enabled recording of reflection that was to remain private between tutor and student. Access was made available to digital camera and scanning facilities.

Submission of e-portfolios was set two weeks after the handing in date of the products. They were then posted on Blackboard and made available as a PowerPoint Shows thus enabling students to view each other's work but not allowing student access to the reflection and comments contained in the notes pages.

Data collection

A qualitative approach was taken to enquire into the attitudes of the participants in the pilot project. The age range of the group was from 23 to 45, the gender division was roughly equal. Data was collected from multiple sources: questionnaire (see appendix), semi-structured interviews and the portfolio reflections allowing triangulation (Cohen, Manion and Morrison, 2000). The questionnaire was designed with the intention of gathering additional rich data through the opportunity to add comments on each question posed. Respondents indicated their level of agreement on a five-point Likert scale, looking at the themes on the use of the software, reflective process and peer evaluation. 25 questionnaires were returned from the cohort of 41.

The researcher was unknown to the group and was introduced to the group by the module leaders as an independent researcher. Semi-structured interviews were conducted with individuals and small groups in order to give voice of as many participants as possible (Creswell, 1998). The participants came from a variety of backgrounds and the interviews focused on giving context to prior experience and the development of the electronic portfolio. These confidential interviews identified issues not posed in the questionnaire.

Findings and discussion

The process of completing an e-portfolio was seen as a challenging exercise by both staff and students and was approached with some trepidation. However, the process of submitting work for assessment was considerable, streamlined by electronic posting and was well received by students after some early technical problems had been resolved. With the exception of two students, the entire cohort submitted their portfolio by the deadline. The e-portfolio file size ranged in from 555K to 50.4M depending on the number of images and quality of resolution. This presented problems for both to those wishing to upload their files to Blackboard from outside the university due to transmission speed and also to network administrators. File size had not been curbed; available space on the university server had to be increased by 200% to accommodate the majority of files as the average size had been underestimated. Overall, the quality of the presentations was good and was felt by the tutors to represent a significant enhancement to both the quality of learning and presentation when compared to work from previous cohorts. The tutors' task of assessing the submissions was made noticeably easier as they were more easily accessible. They were also more easily navigable and

tended to be better organised than a paper portfolio. Tutors had tried to emphasise the advantage of using PowerPoint, simply emphasizing the danger of being seduced into using excessive animation and effects, but some students still fell in to this trap and used them inappropriately. In discussion, they admitted they knew that they were doing it but the temptation was still too much. There appeared to be an inbuilt desire to overcomplicate presentations and this often detracted from the overall presentation and hindered the user. The use of automatic animation often hindered navigation and consequently the assessment process. In particular, the use of timed animation made it difficult for the viewer to browse through the contents at their own speed.

Previous background and experience

The research acknowledged the different backgrounds and expertise within the cohort of students. This varied considerably both in terms of experience with ICT and experience in designing. Only 40% of respondents to the questionnaire indicated prior experience of PowerPoint but 80% agreed or strongly agreed that it was easy to display their work using the software.

> 'It was easy to display my work using PowerPoint once I understood the package.'
>
> (Student No. 7, questionnaire)

60% of respondents admitted to feeling confident in using the software after they had compiled their portfolio but some felt in need of additional tuition:

> 'I didn't feel that there was enough tuition for people who had never used PowerPoint.'
>
> (Student No. 12, questionnaire)

> 'I felt I had to be selective – pick the ones I 'liked best!'
>
> (Student No. 10, questionnaire)

Use of reflection

The value of reflection and its recording as a tool to enhance learning both as work progresses and summatively is seen as important in the taught module. The authors were interested in examining how production of the e-portfolio contributed to the learning process of students completing this module. Also how students approached it and felt about the process. One student reported that:

> 'I think the realisation that others were going to see your work made me more reflective and critical of my work to date.'
>
> (Student No. 9, questionnaire)

Some felt that working electronically had a positive effect and actively assisted their ability to reflect on their practice. Inexperience in the use of PowerPoint seemed to have little effect on students' perceived ability to be reflective. 68% felt confident in their ability to be reflective and record regardless of their experience

> 'Viewing all of the work done via PowerPoint allowed me to see if I had good continuity [sic]. Something that is hard to do when work is handed in and not seen for a while.'
>
> (Student No. 9, questionnaire)

However the nature of much of the reflective comment tended toward description. The results indicated that additional teaching in the use of reflective techniques would benefit the majority of students. Attention needs drawing to the benefits of generating a critical dialogue, recording the iterative process between thinking and doing associated with designing and making.

Conclusions

The authors consider that the exercise has been largely successful and represents a significant enhancement on the learning experience of the students. A number of conclusions can be drawn from the experience, which will be used to inform future developments in the use of e-portfolios in this course. These have been grouped into six categories:

1. Practical/technical issues

Clear guidance needs to be provided to define file size limitations. Transferring images and subsequent uploading to Blackboard presented problems to those who produced large files. Recommendations to use low-resolution photography and simple presentation techniques need continual reinforcing. Availability of technical infrastructure including cameras and scanners contributes to the positive experience of constructing e-portfolios and has an adverse effect if access is restricted. It is important to anticipate in advance the need for significant file storage to be made available so that posting of work is problem free.

> 'Once procedures were learnt, it became much easier [to use PowerPoint].'
>
> (Student No. 11, questionnaire)

2. ICT training

Those students with limited ICT experience would benefit from additional training in the use of PowerPoint and digital images. Acquisition of these skills would be enhanced by making available exemplar e-portfolios, including reflective notes and comments on the Blackboard site.

3. Format of an e-portfolio
Consideration of the completed e-portfolios gives rise to the question of the extent to which an e-portfolio should be structured. No framework was provided except the stipulation over the number of slides and the need to display a representative range of communication techniques developed during the module. From the interviews it became apparent that some students would have felt more secure if a more structured format had been provided. The intention was not to require students to complete additional work but rather provide them with a mechanism for collecting and presenting it. Some students however did spend more time than had been intended. A lack of clarity about what was expected led to some confusion over the extent to which the portfolio was being assessed for presentation as opposed to reflection. It is the view of the authors that some guidance needs to be provided but it is felt that over-prescribing the structure removes the opportunity for creativity in the compilation of the e-portfolio. It can be seen as a design exercise in its own right and consequently represent additional valuable experience.

4. Use of reflection
At which stage is it to be compiled? This issue needs resolving with students early on and is connected to what purpose it is to be put. Some students displayed a general lack of clarity about the use of reflection and in particular its use in the distillation of thinking and its affect on refining decision-making. As a consequence there was a tendency to leave the compilation of the portfolio electronically to the end. This can be partly explained by the lack of experience and initial confidence in compiling their first e-portfolio. Tomlinson suggests that:

> '... (Consciously) reflective thinking should not just occur before or after the action but if possible also in the midst of it.'
>
> (1999: 408)

They need further educating as to the purpose and value of the e-portfolio and encouragement to spread its compilation to run concurrently with the process of designing and making.

5. Quality of e-portfolios
The quality of submitted work was considered by tutors to represent an improvement on previous cohort's paper-based versions. Students expressed the view that as their work was going to be put on show and viewed by others (peers) they were highly selective as to what they included. In their eyes, digitising their work provided them with the opportunity to improve the presentation quality:

> 'This enabled me to put together a portfolio to be happy with, instead of collecting together all the odd screwed up paper and trying to 'fill it out'. Got rid of the notion of 'more paper equals better work.'
>
> (Student No. 19, interview)

This view was not universally held and was dependent on the background of the student. A small number of students found the exercise less satisfactory:

> 'Where I started on paper and then had to swap to an 'e format', I found I left out huge a mounts of 'messy' development. I mainly chose the attractive pages to display. These items did not necessarily show my learning and brainstorming.'
>
> (Student No. 21, interview)

6. Use of completed e-portfolios
The portability of e-portfolios was commented on, as was the ability to continually update files. As well as providing an easily accessible resource that assists the assessment process, the e-portfolio would be a useful contribution to an electronic curriculum vitae (ECV). Students benefited from being able to view their peers' submissions via Blackboard at the end of the module. This enabled them to see there work in a group context and gain substantially from observing evidence of others design activity including different approaches and subsequent outcomes.

> 'My learning experience has been enhanced by sharing information with my peers. This is an ideal way to see other peoples' work and get an idea of how they feel about the course.'
>
> (Student No. 24, interview)

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Questionnaire
We are interested to discover how you felt about creating and reflecting using the electronic portfolio.
We would very much welcome your views and feedback. It should take no more than five minutes to complete.
From the following statements please indicate your level of agreement by placing a cross in the most appropriate column. Please add any comments which you think will be useful too the evaluation.

Use of ICT	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I have experience of using PowerPoint for presentations Comments:					
I felt confident using PowerPoint Comments:					
It was easy to display my work using PowerPoint Comments:					
I felt confident using Blackboard Comments:					
It was easy to up load the PowerPoint slides to Blackboard Comments:					
Reflection Process Producing the PowerPoint presentation made me focus on the reflection process Comments:					
I felt confident recording my reflection Comments:					
I was able to measure my performance against the module objectives Comments:					
I was able to comment on my performance against the module objectives Comments:					
It was easy to reflect on the design and development process when recording it with the images of my products and graphics Comments:					
Writing my reflection enabled me to review the decisions I made during the creative process Comments:					

Peer evaluation	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I felt comfortable sharing my portfolio with my peers Comments:					
Seeing other students portfolios has enabled me to evaluate my own work better Comments:					
Value of the Electronic Portfolio					
The electronic portfolio has contributed to my learning in this module Comments:					
Electronic portfolios are useful Comments:					
This approach has enabled me to produce a portfolio that portrays my creative capability Comments:					

When did you create the electronic portfolio?

As you finished a product ☐ When all the products were complete ☐

Where did you complete the electronic portfolio?

On campus ☐ Off Campus ☐

Mixture of both ☐

Did you have access to a digital camera?

Own my own camera ☐ Used the department's camera ☐

Did you have access to a scanner?

Own my own scanner ☐ Used the department's scanner ☐

Are there any other comments you would like to add?

Name (Optional): Gender: Age: