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Incorporating technologies into a flexible teaching space

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Abstract
Higher education institutions are increasingly exploring how they can use emerging technologies to develop and enhance the learning experiences offered to students. These activities have mainly focused on developing student-centred facilities. The University of Warwick has taken the next step by developing a space (the Teaching Grid) specifically designed to meet the needs of teaching staff across the institution. This paper describes how the Teaching Grid supports teachers by providing a flexible experimental space together with a rich collection of established and new technologies, and with comprehensive staff support. We analysed the use of the facility during the first 30 months of operation, using data collected from 119 case studies, in order to present a perspective on how they have used the technologies and how this has impacted on their teaching practice. We present a taxonomy that provides a concrete framework to support future analysis of and comparisons between such spaces.

Introduction

The application of technology to the teaching and learning process has generated many initiatives and novel approaches to the delivery of education in universities. Early examples are typified by the use of computer software such as virtual learning environments and computer-based assessment tools. More recently, developments have opened up opportunities for flexible and mobile delivery paradigms through the use of mobile phones and PDAs as delivery and communication platforms, together with richer possibilities for classroom-based activities through highly interactive smartboards and multimedia devices.

Coupled with such technologies is the realisation that appropriate configuration of space allocated to the teaching and learning process is also fundamental to the success of an educational activity (Chism, 2002; Temple, 2007), and many institutions have trialled initiatives in which configurable learning spaces are equipped with up-to-date educational technologies. Much of the focus of such initiatives is learner-centric, providing tools and support to help students maximise their educational experience. However, a formal educational activity involves both students and teachers, and often the teacher receives—or is perceived to receive—less support than the students and fewer opportunities to innovate their teaching practice. Furthermore, students who are exposed in school to up-to-date classroom facilities, and who often engage with cutting-edge technologies outside of class, may be more comfortable with new technologies than their teachers:

Practitioner Notes

What is already known about this topic

- Most support for technological innovation in teaching and learning is student-centric;
- There is an absence of studies exploring the use of technology and space in combination;
- Many academic staff have limited opportunities to develop innovative teaching practice.

What this paper adds

- A descriptive account of one approach to providing a supported, flexible, exploratory teaching space;
- A taxonomy of technological, spatial and pedagogic approaches used within an innovative teaching space;
- Understanding of how teachers in higher education make innovative and experimental use of new technologies.

Implications for practice and/or policy

- Teachers are keen to explore new technology, but provision of a safe and supportive environment for experimentation with this technology is vital;
- Provision of imaginative and flexible teaching space can enable new pedagogic possibilities and engage a wider range of students;
- Students respond very positively to new uses of environment and technology.

> Academic staff are nowadays facing new pedagogical challenges; they have to design learning environments which respond to the changing needs of technology-savvy students; and they have to integrate ICT into their courses to extend the flexibility of educational services in universities. (Schneckenberg, 2009, p. 413)

Despite expectations of student awareness of and demand for technology (as characterised by the concept of "digital native") the nature and extent of how this might affect their approach to learning is still a matter of debate (Bennett, Maton & Kervin, 2008). The skills that students have may be very different to those required in innovative learning sessions, and the way that they view the technology may itself be a barrier. In order to use the technologies effectively themselves and to aid their students in doing so as well, teachers require timely and effective support.

In this paper, we describe a novel facility, the Teaching Grid, developed at the University of Warwick, which supports teachers by synthesis of a flexible experimental space, a rich provision of technologies and high-quality staff support. The Teaching Grid provides academic staff with the opportunity to develop their understanding of new technology and the underpinning pedagogy, which Kirkpatrick (2001) identified as essential in supporting staff to make use of technologies for flexible learning. We report an analysis of the usage of the facility during its first 30 months of operation and present a perspective on the role of technology in that usage using a novel taxonomy.

Related work

There is increasing provision of technology-rich configurable learning spaces for the benefit of students. An early example is the University of Warwick's Learning Grid (Edwards, 2006), opened in 2004, which empowers students to manage their own approaches to study. This 24/7 facility provides wireless-enabled flexible spaces and a range of information and multimedia technologies to facilitate student-led discussions, group problem solving, presentation development and digital multimedia production.

Several institutions have emphasised the importance of collaborative study spaces: Michigan Technological University's Center for Integrated Learning and Information Technology (Urbanek, 2006) provides a variety of small and large group spaces to encourage formal and informal group study; the Flyspace facilities at North Carolina State University (Meeks, 2006) provide meeting spaces containing many flat work areas (such as whiteboards).

Many institutions are now recognising the need to support staff in developing innovative pedagogy incorporating new technologies. For example, Monash University has developed a Web resource providing technology-related professional development material (Brack, Samarawickrema & Benson, 2005). However, there is also a need to provide supported, hands-on use of new technologies in a class setting, this being essential for "fostering positive experiences with and attitudes towards technology use" (Brill & Galloway, 2007).

Building on the success of learning spaces, institutions have started to consider how similar designs can be extended to teaching spaces. For example, San Jose State University's Incubator Classroom (Waters, 2007) offers a configurable space that seats up to 50 students and includes a variety of technologies. Teaching staff are encouraged to use the space to develop innovative practice to support active and collaborative learning.

The development of experimental teaching spaces is further echoed through some of the UK's Centres for Excellence in Teaching and Learning. The Creativity Zone at the University of Sussex, for example, builds on the pedagogy of blended and experiential learning, allowing the lecturer to redesign the dynamics of the tutor–student relationship through the support of flexible space and cutting-edge technologies. Blended learning (Massie, 2002) is often used to describe the learning approach motivating the development of these teaching and learning spaces (Roberts & Weaver, 2007). Focus on teacher–student engagement in the active, collaborative process of knowledge construction, production and dissemination (Lambert, 2007) is further explored through the Reinvention Centre at the Westwood campus of the University of Warwick, an innovative teaching space designed in response to a critical rethink about the spaces in which students learn to explore relationships between research, teaching and learning.

Few studies exist that explore the use of technology and space in combination, despite the increased combination of the two within newly furnished teaching rooms. Technology and its use have for some time featured as central components in managing classroom space (Oblinger, 2006). However, literature has often focused on technical requirements and, as Chism (2002) notes, "Rarely is there any mention. . . of the different purposes that learning spaces need to accommodate." Temple (2007) also reports that there is only limited research into the use of such spaces to support teaching and learning in higher education. There does, however, appear to be agreement that a key feature must be flexibility since modes of usage cannot be predicted initially (JISC, 2006; Thomas, 2010).

Working with adaptable teaching spaces and novel technologies leads teachers to reconsider practice and pedagogy (Harrison, 2009; Warger & Dobbin, 2009). However, the availability of such resources is not in itself enough to encourage widespread use and experimentation. As noted by Annan (2008), one of the main barriers to adoption of technology by academic staff within higher education is the lack of support. This support element is thus vital to help staff interact with both space and technology, and hence on pedagogy.

The current work analyses 119 case studies of usage of a supported, technology-rich teaching space to gain a perspective on the aspects of space, technology and pedagogy that are of importance to teachers and to investigate the interplay between them.

The Warwick Teaching Grid

Recognising the pedagogic importance of teaching space, the University of Warwick's 2015 Strategy includes a commitment to "Consider different uses of spaces to enhance the teaching

and learning process" (University of Warwick, 2007). The "Teaching Grid" was established accordingly in 2008 to provide a flexible and easily reconfigurable space with a wide range of e-learning tools, resources and technologies (both hardware and software), which include the major commercial products together with a selection of novel and innovative material. Its set-up and continuing development involve collaborative input from academic and technical services across the university in liaison with relevant external agencies (HEA, JISC, SEDA). Since its inception, the Grid has been extensively used by a wide range of academic and support staff from all faculties in the university.

A key feature is the high level of support offered, with Teaching Grid staff always available during working hours to provide advice and practical support when needed. Teachers can work in conjunction with support staff to develop teaching sessions in customised spaces and with technologies that they have not previously used or that they would like to incorporate in novel ways. New pedagogies can be developed, and experimental teaching sessions can be trialled. One main aspect of the Grid space is the *collaboration area* where discussion, development and sharing of ideas can take place. Teachers can then bring their class in to the Grid and again benefit from the support available while the session is taught. The second spatial aspect of the Grid is the *experimental teaching* area. More information on the Teaching Grid and its provision and use can be found in University of Warwick (2013).

The Teaching Grid is being used in a variety of ways and for a number of different purposes. This paper investigates usage so far (during the first 3 years of its existence) towards its key purpose of supporting experimental teaching and novel practice. The focus of the paper is to analyse the innovative use of the Grid, to gain an understanding of how the rich provision of new technologies is used by staff and to provide an insight into teachers' views on the effects of space and technology on their practice and pedagogy.

Methodology

We adopted a phenomenological approach, relying on the individual teachers' accounts of their experiences in the Teaching Grid and applying template analysis to the written case studies (Crabtree & Miller, 1999), an iterative approach that allows thematic analysis of qualitative data.

Template analysis commences with developing a "template" that summarises the ideas, or themes, identified by the researchers as important. An initial template is created that summarises the researchers' initial ideas, but as the analysis then proceeds, the themes within the template are modified (and some may be deleted entirely) so that the template reflects the themes found through analysis of the data.

Staff using the Grid to conduct an experimental teaching session were asked to write a report of the experience. These case studies were written by the academics themselves (with guidance from Grid staff) after using the Grid, and thus contained a (possibly subjective) view of their interaction with the facility. This integrated method of data collection was less likely to hinder innovation than what Pearshouse *et al* (2009) suggest might happen if more rigorous evaluation methods are used.

In its first 3 years of operation a total of 119 case studies were recorded. The reports included data under some or all of the following headings:

- *Teaching/learning activity* including details of the type of learners involved, the use of physical space, and the methods, resources and technology employed;
- *Learning outcomes* (personal and/or student) of the activity, and how effective the activity was considered to be in achieving these outcomes;
- *Established practice*—what the usual teaching practice was before running the activity in the Teaching Grid;

- *Teaching development*—what considerations prompted the different/new approach;
- *The teacher's perspective*—what the academic learned from the experience of using the Experimental Teaching Space, and how they thought it would affect their future teaching practice;
- *The students' perspective*—feedback from the students.

The case studies were considered from three perspectives:

- technology;
- space;
- pedagogy.

For each of these perspectives we sought to identify a set of (mutually exclusive) keywords (and phrases) that could be used to classify and describe the activities reported in the case studies. Template analysis (Crabtree & Miller, 1999) was used to create this taxonomy as follows.

As initial template we started with a preliminary set of keywords for each perspective, each one equipped with a definition that could be used to clarify the meaning if any ambiguity were to arise. Each case study was then read by two of the researchers (randomly allocated) and independently coded. If, through analysis of the case study, further themes emerged that were not covered in the existing keyword list, appropriate keywords were added in accordance with template theory methodology. The resulting list is thus driven by the data under analysis and is itself an important aspect of that analysis. Initial keywords that were not found to be relevant in practice were discarded from the list. Further, if the description of a keyword was found to be unclear, a discussion between the researchers took place to resolve the issue, and case studies previously coded with that keyword were rechecked to ensure consistency.

The iterative process continued until all 119 case studies had been coded, the final set of keywords and associated definition forming the final template, as presented in the next section.

Results

The data analysis yielded the following keywords and phrases. The percentages in parentheses indicate the proportion of the 119 case studies to which each keyword/phrase applies.

Technology perspective

Audio/visual (AV)resources (44%)

Materials using sight or sound to present information, for example, videos, sound recordings or pictures (excluding presentations).

Web-based resources (35%)

Information, data or applications made available via a web browser, over the Internet or an intranet.

Touch technologies (29%)

Devices that allow the user to interact with a computer by touching areas on the screen. An interactive whiteboard would be one form of a touch technology.

Hard copy resources (26%)

Printed information, for example, books, journal articles, worksheets or other reference material.

AV recorders (19%)

Devices that capture information in the form of sound or pictures, including cameras, video cameras, tape recorders, mp3 recorders, etc.

Local electronic resources (10%)

Information or data stored locally on a machine or storage device, for example, memory stick.

Specialist software (9%)
A computer program targeted at meeting specific needs, for example, video editing, mind mapping, etc.

Web 2.0 tools (8%)
Web applications that were used for interactive information sharing, interoperability, user-centred design and collaboration. For example, blogs, wikis, podcasting, social book marking.

Database (6%)
A structured set of data held in a computer, especially one that is accessible in various ways.

Interactive response system (3%)
An electronic system that provides instantaneous feedback to facilitators and audience about participants' responses, often used to create interactivity between a presenter and his or her audience.

Virtual worlds (3%)
An online venue that often takes the form of a computer-based simulated environment, through which users can interact with one another and objects within it.

Mobile technology (1%)
Technology that allows people to use IT without being tied to a single location, for example, mobile phones, PDAs and tablet computers, but excluding laptops (which were, in most instances, hardwired and static within the Grid.)

Space perspective
Collaborative (70%)
Designed for two or more individuals to work together. Not just where there are discussion activities.

Flexible (50%)
A physical space that supports multiple learning environments within a single session. The environments may be employed consecutively or concurrently.

Formal (17%)
A controlled space in which areas are specifically designated for the presenter, for example, a formal presentation to an audience similar to that taking place in a lecture theatre.

Partitioned (16%)
When the space is subdivided into two or more sections through use of movable barriers or walls.

Virtual (6%)
An environment created by technology that is often made available over the Internet or an intranet (including videoconferencing).

Teaching perspective
Workshop (54%)
A workshop involves a short introduction in which a specific problem is identified and presented to students by the lecturer or tutor. This is followed by discussion and activities in which students work collaboratively to investigate, analyse and formulate a solution to the problem.

Experiential (41%)
Involving or based on experience and observation.

Presentations by students (23%)
Showing and explaining the content of a topic to an audience by students.

Reflection (18%)
Deep thought or consideration of own experiences in order to learn from them.

Creativity (14%)
The use of the imagination or original ideas, for example, the production of an artistic work.

Team teaching (14%)
A method of coordinated teaching involving two or more teachers working together with a single group of students.

Demonstration (13%)
A practical exhibition and explanation of how something works or is performed.

Role play (13%)
A learning activity in which students assume given roles.

Enquiry (8%)
Systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions.

Critique (7%)
A detailed analysis and assessment of something, for example, a literary, philosophical or political theory.

Peer review (7%)
Students evaluating each other's work.

Evaluation (6%)
Consideration of the merit, worth and significance of something or someone using criteria against a set of standards.

Performance (6%)
An act of staging or presenting a play, concert or other form of entertainment.

Conference (5%)
A formal event including a number of sessions (presentations, activities and workshops) aimed at exchange of information and discussion, often centred on a particular theme.

Lecture (4%)
A lecture is a formal presentation by an academic staff member, usually to a large number of students. Opportunities for discussion are generally limited.

Revision (4%)
Rereading work done previously to improve one's knowledge of a subject, typically to prepare for an examination.

Student led (4%)
Students take the lead in organising all or part of a session, including the choice and design of learning activities.

Analysis of the keywords

The novelty of the Teaching Grid is twofold. First of all, it provides a technology-rich experimental teaching space. Second, it provides a highly flexible and customisable teaching space that allows the teacher to experiment with different room layouts. The space flexibility and the associated pedagogy will be presented elsewhere (King, E., Joy, M. S., Foss, J. G. K., Sinclair, J. E. & Sitthiworachart, J., unpublished data). Here, we restrict our analysis to the pedagogic impact of the technologies made available in the Grid.

An interesting perspective is obtained by analysing how the three most popular technology types (AV, Web and Touch) were deployed. Figure 1 illustrates the seven categories of case studies that relate to using one or more of the three technology types. A total of 83 case studies related to one or more of these technologies, and these are now analysed in greater detail.

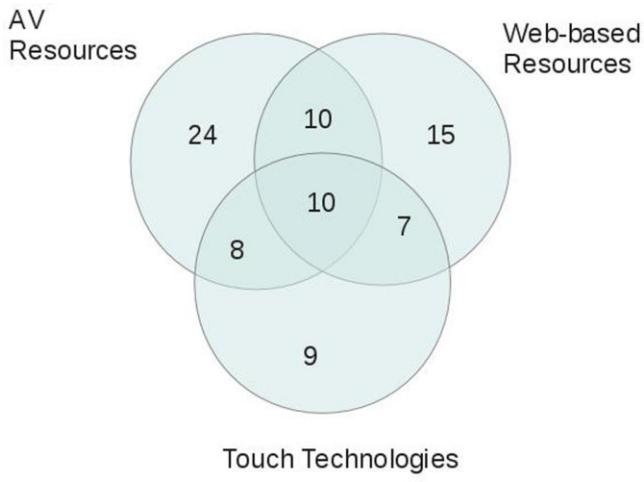

Figure 1: The seven categories of case studies and the three technology types

Table 1 presents the relative frequencies of educational keywords; the categories are shown in the rows and the keywords in the columns. These are calculated as follows.

For each cell, the proportion $p_{c,k}$ is the number of case studies in category c that are described by keyword k. For example, 52 of the 83 case studies are categorised as "AV Resources," and 29 of those are keyworded "Workshop," yielding $p_{AV,Workshop} = 29/52$.

Similarly, for each keyword k, the proportion t_k is the *total* number of the 83 case studies in any of the seven categories that are described by keyword k. For example, the proportion $p_{AV,Workshop}$ of "AV Resources" keyworded "Workshop" is 29/52, but 48 of the total 83 case studies that contain *any* combination of "AV Resources," "Web" or "Touch" are coded "Workshop," thus $t_{Workshop} = 48/83$.

In Table 1, the entry in row c column k is $p_{c,k}/t_k$. For example, the figure in row "AV Resources" column "Workshop" is calculated as the ratio of (29/52) to (48/83), which evaluates to 0.964, and is presented rounded to 1 decimal place. Thus, a figure in Table 1 that is greater than 1 suggests that the educational activity described by that column frequently uses the combination of technology that is described by that row. The final row in the table (n) is the count of case studies with the respective keyword. The columns are sorted in decreasing order of n.

Pedagogic impact of the available technologies

Table 1 provides us with some insights into the pedagogies that are being addressed by the technologies and combinations of technologies. While the columns with low values of n do not provide a large sample size, and should therefore be treated with caution, it is perhaps unsurprising that conferences are the preserve of *AV Resources* alone, and that peer review activities utilise technologies that facilitate group interaction, namely *Touch* and *Web Technologies*. The high value (1.5) for *Lecture* in the *AV* and *Touch* category reflects one case study in which a lecture was given on *AV* and *Touch* technologies, and followed by an *Experiential* activity where the students familiarised themselves "hands on" with the technologies on which they had just been instructed. Student-led sessions all used *AV Resources*, and one might surmise that this reflects on student familiarity with *AV Resources* during their period of study.

Focusing on the columns with higher values of n, we note that the delivery of *Workshops* is fairly consistent across all seven categories. The *Experiential* label also appears technology-agnostic, and this might also be expected because teachers using the facility were encouraged to get students to use the available technologies themselves wherever possible.

Table 1: Relative frequencies of educational keywords

	Work-shop	*Experiential*	*Presentations by students*	*Creativity*	*Team teaching*	*Reflection*	*Demonstration*	*Enquiry*	*Critique*	*Role play*	*Performance*	*Peer review*	*Evaluation*	*Conference*	*Lecture*	*Revision*	*Student led*
AV	1.0	0.9	1.1	1.4	0.9	1.3	0.6	1.2	1.2	1.1	1.6	1.2	0.4	1.6	1.1	1.1	1.6
Touch	1.1	0.9	0.8	0.7	0.5	0.9	1.3	0.5	1.5	0.4	0.0	1.8	0.6	0.0	0.8	0.8	0.0
Web	1.1	1.3	1.2	0.3	1.4	0.4	1.4	1.5	1.2	1.0	0.3	1.5	2.0	0.0	0.7	0.7	0.7
AV+Touch	1.2	1.0	1.2	0.6	0.6	1.3	1.1	1.0	1.7	0.0	0.0	2.3	1.2	0.0	1.5	0.0	0.0
AV+Web	1.0	1.2	1.5	0.6	1.1	0.3	1.0	2.3	2.6	0.7	0.7	2.1	1.0	0.0	0.0	1.4	1.4
Touch+Web	1.1	1.1	1.0	0.7	0.7	0.0	1.9	1.1	1.8	0.8	0.0	2.4	1.2	0.0	0.0	0.0	0.0
All	1.0	1.2	1.7	1.1	0.6	0.0	1.9	1.8	3.1	0.0	0.0	2.1	2.1	0.0	0.0	0.0	0.0
n	*48*	*36*	*19*	*15*	*15*	*14*	*13*	*9*	*8*	*6*	*6*	*4*	*4*	*3*	*3*	*3*	*3*

Presentations by students tended to be coded as combinations of AV resources and Web technologies, since such presentations typically involved students sourcing or researching material on the Internet prior to using the AV resources to perform the presentation. The types of material sourced from the Internet included content for ePortfolios, archived images and film clips.

Creativity was often associated with the use of AV resources alone, rather than in combination with other technologies, suggesting users were more comfortable producing original work in their own discipline without the distractions of multiple technologies. Examples of this included Postgraduate Certificate in Education students who had been developing lesson plans and presenting to their colleagues, and theatre students exploring video production.

Team teaching tended to be associated with Web resources alone and suggests the usefulness of the Web as a communication medium, either to support team teaching (where the teachers are not co-located) or to allow colleagues sharing the same space to easily retrieve and present material stored elsewhere. For example, a session delivered jointly by a lecturer and by library staff would allow the latter to demonstrate the web-based electronic resources provided by the library.

The didactic nature of many Web resources goes some way to explain the lack of *Reflective* activities that used web-based resources. Reflection on personal experiences is essentially introspective, and as noted by the leader of a session on career planning, "The space . . . provided the students with silent time to think."

A *Critique* suggests some element of interactivity by the participant, and this is reflected in their predominance on touch technologies and combined technologies. *Presentations by students*, on the other hand, use all three technologies, alone and in combination, perhaps suggesting student desire to experiment with the resources available to them.

The *Enquiry* label matches the combined *AV Resources* and *Web Technologies*, suggesting Web searching for the "systematic investigation" to be disseminated using *AV Resources*.

It is likely that teachers will move incrementally from technologies and methods they know to explore additional, novel features or extensions. It is therefore not surprising that web-based and AV resources form the most popular technologies used in the Grid. For example, all staff would be expected to work with standard slide presentations so the next step for many is experimenting with how to incorporate video or sound. Other technology may be familiar to staff through their personal interaction with devices but they may not previously have considered how it could be incorporated into teaching and learning. An example of this is touch technology, which was the third most frequently used category within the Grid case studies.

The teachers' perspective

The teachers' reports provide a rich source of information and qualitative assessment of their use of the Grid. They reinforce some of the observations made in the previous section but also provide further detail on how technologies were used. For example, teachers particularly appreciated the facility for exploration of collaborative learning using the AV, Web and Touch technologies. One typical session was a language class in which Grid staff helped the teacher to combine translation technology with use of standard Web resources (terminological searches, delicious.com resource bank) to support collaborative working and presentation. Previously the work would have been done individually with limited opportunity for discussion. The teacher comments, "I've always lamented the lack of space capable of supporting technology effectively while fostering collaborative thinking and I am very excited to have found such an inspirational space."

Another teacher who experimented with the collaborative use of electronic whiteboards noted that his traditional teaching approach with a flip chart tended to give control to individual students whereas "smart boards . . . allowed for equal participation by all group members."

Many teachers noted the effect of the new technology on students and on the way they work. One social studies lecturer said that use of touch technology "did pull in students that had been more reticent in the past." Many other reports also noted the inclusiveness promoted by the technology reinforced by its situation within a less formal working space.

Another common theme was the fact that students are often familiar with technology and by introducing it into teaching and learning the students are more comfortable and feel that learning becomes a more integrated part of their "normal" life. A teacher of law observed that "students are familiar with such matters and are able to use them to enhance their own learning."

Teachers were clear that the Grid is enabling valuable activity that would not otherwise be possible. Some pointed very specifically to the interaction of technology and space to enable pedagogic innovation. For example, a theatre studies lecturer who worked with Grid staff to develop a series of sessions using e-versions of original texts and incorporating the use of electronic whiteboard and AV facilities stated that "the sessions would have been impossible without the Teaching Grid resources in so far as they enabled multi-tasking and a far more complex demonstration of possibilities than a normal classroom would have permitted."

The main dissatisfaction arising was that, having developed sessions with the support and resources of the Grid, staff wanted to be able to take this back and incorporate the innovation in everyday teaching. A history tutor who ran a very successful class using visual and online media commented that it would "require some rethinking for a less fully adaptable, low tech standard teaching space." Some teachers stated their commitment "to agitate for better space where working normally."

Both the quantitative and qualitative perspectives indicate that the Grid is proving to be a valuable and enabling resource and that it is supporting new approaches to teaching and learning which, in many cases, bring together different technologies to support a wide variety of pedagogic strategies.

Conclusion

There is a clear need for further collaboration between educationalists and learning technologists to explore in more depth issues surrounding academics' use of technology-enhanced flexible teaching spaces, their impact on teaching and learning, and appropriate support mechanisms to scaffold adoption of new pedagogies within these spaces. The work reported here provides some insight into the way that such a facility is used, reflecting the perspective of both staff and students. Experience within the Warwick Teaching Grid shows that, when such resources are provided and supported, academic staff are keen to make use of them and to explore new approaches to teaching and learning. Follow-up on the case studies indicates that innovations trialled in the Grid are now being used in practice in academic departments, demonstrating the cross-campus spread of novel methods and pedagogies. The support provided in the Grid is clearly helping build staff understanding and confidence in the use of both space and technology.

Students' reactions to participating in innovative teaching and learning sessions in the Grid were also overwhelmingly positive. Often, steps that are innovations to the teacher involve technologies well understood by the student who therefore sees it as merely meeting their expectations of what university teaching should involve. However, while use of technology and space can help engage students, using it for effective teaching and learning is an area requiring further investigation. In the worst case, inappropriate use can distract from educational goals, and further work is needed to develop pedagogy.

It is to be expected that teachers would start their explorations by pushing the boundaries of what they already know, introducing a new feature to a familiar technology or trying an application they have seen others use. It will be interesting to see how usage develops and to chart adoption

at individual and departmental levels. Currently, the majority of Grid users employ at most one technology for their teaching session. Another area for further consideration is the effective use of multiple technologies.

A cautionary note for institutions is that a Grid facility serves to whet the appetite of both staff and students. Those who have experienced how effective the environment can be are now very keen to see similar facilities provided throughout the university. One "special" area is not enough!

Technologies evolve constantly, as does a university's infrastructure and the social and political environment in which it functions. The ultimate judgment of the success (or otherwise) of such a facility will be its ability to adapt and to continue to be relevant over the coming few years by supporting the development of pedagogies that are relevant within the context of the facility.

The contribution of this study is an understanding of the different ways in which academics have already interacted with the technologies in the Teaching Grid. A principal result is the taxonomy of spatial, technological and pedagogical approaches, which expose the dominant concerns and perspectives of Grid users. Analysis of the resulting keywords identifies relationships between technology and pedagogy, and together with reflective contributions from the staff involved, gives a picture of current use and highlights emerging issues.

This results presented here provide an insight into how such a facility might subsequently be developed, in a way that addresses both the technical and pedagogical challenges presented by technology-enhanced flexible teaching spaces. The taxonomy provides a concrete framework that will support future analyses of and comparisons between such spaces.

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