Innovations in Education and Teaching International

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/riie20

Exploring the impact of a flexible, technology-enhanced teaching space on pedagogy

Emma King[a], Mike Joy[b], Jonathan Foss[b], Jane Sinclair[b] & Jirarat Sitthiworachart[c]

[a] Learning and Development Centre, University of Warwick, Coventry, UK

[b] Department of Computer Science, University of Warwick, Coventry, UK

[c] School of Informatics, Walailak University, Nakhon Si Thammarat, Thailand

Published online: 18 Mar 2014.

To cite this article: Emma King, Mike Joy, Jonathan Foss, Jane Sinclair & Jirarat Sitthiworachart (2014): Exploring the impact of a flexible, technology-enhanced teaching space on pedagogy, Innovations in Education and Teaching International, DOI: 10.1080/14703297.2014.896222

To link to this article: http://dx.doi.org/10.1080/14703297.2014.896222

Innovations in Education and Teaching International, 2014
http://dx.doi.org/10.1080/14703297.2014.896222

Routledge
Taylor & Francis Group

Exploring the impact of a flexible, technology-enhanced teaching space on pedagogy

Emma King[a]*, Mike Joy[b], Jonathan Foss[b], Jane Sinclair[b] and Jirarat Sitthiworachart[c]

[a]*Learning and Development Centre, University of Warwick, Coventry, UK;* [b]*Department of Computer Science, University of Warwick, Coventry, UK;* [c]*School of Informatics, Walailak University, Nakhon Si Thammarat, Thailand*

Approaches to teaching and learning are increasingly influenced by the introduction of new technologies and innovative use of space. Recognising the need to keep up to date many institutions has created technology-rich, flexible spaces. Studies so far have concentrated on how students use such facilities; however, their availability also strongly impacts on teaching staff, presenting new possibilities and challenges. To encourage the development of activities that make the most of these resources, the University of Warwick launched the Teaching Grid (2008), a flexible space with state-of-the-art technology. Advisers support colleagues in developing and delivering novel, experimental teaching sessions. This paper reports on use of the facility during its first three years, considering the effects on pedagogy of experimental use of space and technology; this is correlated to an increase in number and variety of teaching and learning activities which, it is suggested, enhances the student experience.

Keywords: teaching spaces; educational technology; innovation; continuing professional development; Higher Education

Introduction

Universities are under increasing pressure to provide teaching environments that are responsive to a variety of learning styles.

> With the increasingly diverse student body and fast socio-economic changes affecting every aspect of life, including the way we teach and learn, there is a growing need to provide spaces that satisfy various needs, accommodate different learning styles, influence students' attention, motivation to learn, and their way of thinking. (Jankowska & Atlay, 2008, p. 276)

As well as responding to these varied needs Schneckenberg (2009) suggests that academics are faced with the challenge of responding to students' demands for activities that incorporate technology. This study explores how a novel facility at the University of Warwick allows staff to respond to these needs through flexible use of space and technology.

The University's 2015 Strategy (University of Warwick, 2007) contains an explicit goal to 'Consider different uses of spaces to enhance the teaching and learning

*Corresponding author. Email: e.l.king@warwick.ac.uk

process'; in support of this agenda, the University created the 'Teaching Grid' as a space for teaching staff to explore emerging ideas, methods and techniques (Edwards, 2006).

The Teaching Grid aims to support the University's strategic objectives to enhance teaching quality and develop excellence by:

- enabling staff to explore new teaching methods in a safe and supported environment;
- facilitating innovative approaches to support teaching and learning;
- offering a flexible environment to respond to changing needs within a blended learning context and
- providing a locus to encourage collaborative working between Service departments that support teaching activities.

The Teaching Grid offers staff two physical spaces:

- a collaboration area in which colleagues can meet to explore new technologies and develop teaching strategies;
- an experimental teaching space (ETS) where technologies and teaching ideas can be actively tried out with students.

This study focuses specifically on the ETS (Figure 1), which offers:

- *A customisable physical space*, allowing staff to create a variety of teaching environments to support different patterns of interaction.
- *A rich collection of technologies* – to support different levels of active student involvement.

Figure 1. The layout of the Teaching Grid.

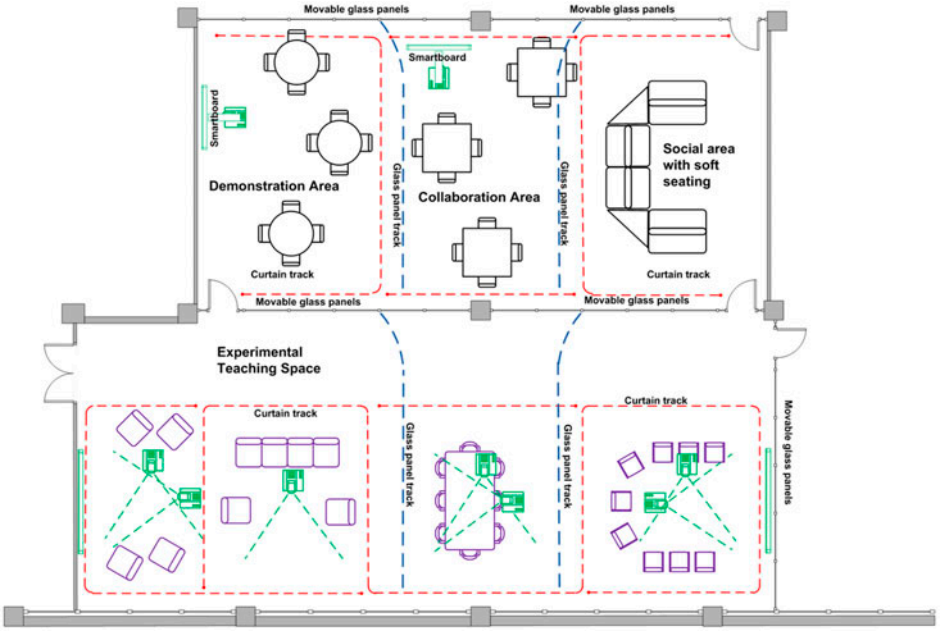

Figure 2. The Teaching Grid in use.

Kirkpatrick (2001) identifies the importance of allowing staff to share and learn from one another about emerging pedagogies and their relationship to new technologies and reconfigurable spaces, and this is reflected in the Teaching Grid's philosophy. The ETS provides an environment in which academics feel able and confident to experiment, as necessary to allow individuals to develop their teaching practice (Errington, 2004; Pajo & Wallace, 2001). Providing such a space clearly demonstrates the University's support for experimentation (Figure 2).

One of the barriers to the adoption of technology by academic staff, as identified by Annan (2008), is the lack of appropriate support. Critical to the Teaching Grid model is the *support* component, in the form of a team of advisers who can offer guidance around effective use of resources and help to ensure that time in the facility is spent valuably.

The design and continuing development of the Teaching Grid have been informed by liaison with academic and technical services in the University, as well as with external Higher Education teaching development agencies (HEA, JISC and SEDA).

Why this study

Temple (2007) highlights limited research into the use of flexible spaces to support teaching and learning in Higher Education. Similarly, despite a positive viewpoint, few institutions have been able to provide detailed evidence about successful implementation of e-learning and its impact on teaching practice (Blin & Munro, 2008). If these innovations are to be adopted staff require time and opportunity to experiment (Rogers, 2003). This study reports on the use of the Teaching Grid during the

first three years of opening, exploring whether a flexible space and availability of multiple technologies impacts on pedagogies adopted by teachers. The findings of this study can help inform whether investment in these spaces, both in terms of institutional funding and individuals' time, are effective in developing teaching and learning practices.

Flexible space

JISC (2006, p. 3) suggests that:

> … a learning space should be able to motivate learners and promote learning as an activity, support collaborative as well as formal practice, provide a personalised and inclusive environment, and be flexible in the face of changing needs.

Flexible spaces have the potential to impact on pedagogy, with different learning environments being used to support different types of activities (Fisher, 2005). Warger and Dobbin (2009) suggest that these spaces force academics to reconsider the roles and relationships between staff and students, shifting practice from a teacher-centric to a student-centric approach. Flexible spaces support a shift from didactic approaches to active learning (Harrison, 2009) by:

- allowing teachers to move beyond a standard classroom configuration in which there are fixed places for teachers and learners and
- supporting creative pedagogies in which learners takes active roles in discovery and creation of knowledge.

> Frequently, therefore, what emerges – almost by accident, or naturally – from these OSL [Open Space Learning] environments is a facilitated ensemble in which students, working in groups, create their own knowledge. (Monk, Chillington Rutter, Neelands, & Heron, 2011, p. 120)

However, Thomas (2010) reports that not all the strengths of how a learning space will be used to improve learning can be identified at the start. This suggests that a flexible space provides opportunities for innovative teaching and learning development unconstrained by preconceptions.

> … learning spaces need to be adaptive, malleable – almost fluid. (Thomas, 2010, p. 209)

The Teaching Grid aims to accomplish this by offering the ETS a flexible space that can be adapted for each session, or even within a session to meet evolving needs of learners.

Evidence suggests that we can expect to see a difference between the methods adopted by academics making use of the flexible aspects of the ETS compared to those using the room in a more static or traditional manner.

Technology

Breslow (2007) suggests that integrating technology into teaching and learning supports a shift from passive to active pedagogies in which the student–teacher

relationship is redefined. This is echoed by Laurillard (2008) and Norton, McRobbie, and Cooper (2000) who reflect that technologies can support teachers to deliver flexible opportunities that actively involve students through a constructivist approach.

Further to this, Norton et al. (2000) report that a mismatch between teaching methods and technology can lead to non-adoption; in order to support teachers to make regular use of technology, academics need to be given the opportunity to consider how it matches their chosen pedagogies. The ETS aims to address this need by providing the chance for staff to explore the applicability of new technology to their pedagogical approach.

Research aim

This study builds on previous research that suggests that flexible space and integrated technologies impact on the nature of teaching and learning activities, moving towards a more active student-centric approach. The aim was to explore whether the availability of resources within the Teaching Grid, principally a flexible space and varied technology, impacts on the pedagogies chosen by academics.

Methodology

Staff using the Teaching Grid were asked to provide a written case study reflecting on the innovative teaching session undertaken. Focusing on these reports, we adopted a phenomenological approach in which descriptions of lived experience are central. The case studies were analysed to identify emergent themes, providing a coding framework to explore key features. Further details of the process used are given in Joy et al. (2014). The case study and thematic analysis approach strikes the necessary balance between conducting effective evaluation and not overburdening staff with overly demanding, rigorous evaluation procedures which may hinder innovation (Pearshouse et al., 2009).

Case studies

The case studies were written by academics (with guidance from Grid staff) after using the Grid, and thus contained a possibly subjective view of their interaction with the facility. Each case study included some or all of the following:

- *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 ETS, and how they thought it would affect their future practice.
- *The students' perspective* – feedback from students.[1]

Table 1. Case studies by faculty.

Faculty	No. of case studies
Arts	41
Social Sciences	32
Sciences	5
Medicine	2
Service departments	39

The data-set included 119 case studies and spanned all faculties within the University (Table 1).

The predominant users of the space were the faculties of Arts and Social Sciences, and Service departments. Services included the Learning and Development Centre (who are responsible for staff training), Student Careers and Skills, and IT Services.

Analysis

We adopted a grounded theory-based approach to analysis (Bryman, 2004) identifying three core categories: *resources*, *space* and *teaching and learning* activities. We then took a sample of 20% of the case studies and used these to iteratively develop keywords for each category that addressed the emergent themes (reported in Tables 2, 3 and 4).[2]

Table 2. Resource keywords.

Keyword	Definition
Audio/visual recorder	Devices that capture information as sound or pictures, including cameras, video cameras, tape/mp3 recorders, etc.
Audio/visual material	Materials using sight or sound to present information, e.g. videos, audio recordings or pictures *Excluding*: presentations
Database	A structured set of data held in a computer, especially one that is accessible in various ways
Hard copy resources	Printed information e.g. books, journal articles, worksheets or other reference material
Interactive response system	An electronic system that provides instantaneous feedback to facilitators and audience about participants' responses, often used to create interactivity between a presenter and his/her audience
Local electronic resources	Information or data stored locally on a machine or storage device (e.g. memory stick)
Mobile technology	Technology which allows people to use IT without being tied to a single location
Specialist software	A computer programme targeted at meeting specific needs, e.g. video editing, mind mapping
Touch technologies	Devices that allow the user to interact with a computer by touching areas on the screen, e.g. an interactive whiteboard
Virtual worlds	An online community that often takes the form of a computer-based simulated environment, through which users can interact with one another and objects within it
Web 2.0 tools	Web applications that facilitate interactive information sharing, interoperability, user-centred design and collaboration, e.g. blogs, wikis, podcasting and social book marking
Web-based resources	Information, data or applications made available via a web browser, over the Internet or an intranet

Table 3. Space keywords.

Keyword	Definition
Collaborative	Designed for two or more individuals to work together *Excluding*: sessions in which the only collaboration were discussion activities
Flexible	A physical space that supports multiple learning environments within a single session. The environments might be employed consecutively or concurrently
Formal/fixed	A controlled space in which areas are specifically designated for the presenter and the audience, e.g. a formal presentation similar to that taking place in a lecture theatre
Partitioned	A space which is sub-divided into two or more sections through use of movable barriers or walls
Virtual	An environment created by technology which is often made available over the Internet or an intranet *Including*: video conferencing

Table 4. Teaching and learning activity keywords.

Keyword	Definition
Conference	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
Creativity	The use of the imagination or original ideas, e.g. the production of an artistic work
Critique	A detailed analysis and assessment of something, e.g. a literary, philosophical or political theory
Demonstration	A practical exhibition and explanation of how something works or is performed
Enquiry	Systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions
Evaluation	Consideration of the merit, worth and significance of something, or someone, using criteria against a set of standards
Experiential	Involving, or based on, experience and observation
Lecture	A lecture is a formal presentation by an academic, usually to a large number of students. Opportunities for discussion are generally limited
Peer review	Students evaluating each other's work
Performance	An act of staging or presenting a play, concert or other form of entertainment
Presentations by students	Showing and explaining the content of a topic to an audience by students
Reflection	Deep thought or consideration of own experiences in order to learn from them (by students)
Revision	Re-reading work done previously to improve one's knowledge of a subject, typically to prepare for an examination
Role-play	A learning activity in which students assume given roles
Student led	Students take the lead in organising all or part of a session, including the choice and design of learning activities
Team teaching	A method of co-ordinated teaching involving a two or more teachers working together with a single group of students
Workshop	A workshop usually 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

These keywords were refined to ensure no duplicates, check consistency in definitions and exclude features considered constituent to a majority of teaching sessions within Higher Education, such as teacher presentations. The keywords were applied double blind to all case studies and inconsistencies resolved, drawing on a third impartial coder if necessary.

Findings

The defining characteristics of the Teaching Grid are the flexible space and available technologies. This study explores the impact of these features on teaching and learning by investigating patterns and correlations evidenced by the case studies, and conveyed by the keywords.

This study shows that:

- flexible use of space correlates with an increase in the number of teaching and learning activities within a single session;
- flexible use of space correlates with collaborative use of space;
- collaborative use of space correlates with an increase in the number of teaching and learning activities and
- number of technologies used correlates with the number of teaching and learning activities.

Flexible use of space correlates with an increase in the number of teaching and learning activities within a single session

Out of the 119 case studies, 59 were identified as making use of the flexible space to provide more than one layout within the session, while 60 of the case studies did not make use of this feature (Table 5). Perhaps unsurprisingly, the mean number of teaching and learning activities when the space was used flexibly was significantly higher than the number reported when it was not ($T = -2.463$, $p = .015$).

The teaching and learning activities were filtered to those that were found to occur in at least 10% of the case studies, and the distribution of the use of flexible space in each of these categories examined (Table 6).

The results showed that many of the teaching and learning activities were equally distributed between the use of flexible space and no flexible use of space. However, the case studies making use of the flexible space also made more use of experiential activities, role-play, team teaching and workshops. These activities suggest a more interactive and student-centric approach which may not have been possible in a traditional classroom. Staff took advantage of being able to adapt the space to offer different learning environments appropriate for the practicalities of the activity. For example, in a session exploring quantitative research methods and statistical analysis software, screens were arranged in a 'U' shape with students sitting in the

Table 5. Number of teaching and learning activities by flexible use of space.

	N	Mean	Std. deviation
No use of flexible space	60	2.0667	1.17699
Use of flexible space	59	2.6441	1.37418

Table 6. Teaching and learning activities by flexible use of space.

Teaching and learning activity	Flexible use of space No.	No flexible use of space No.
Creativity	9	8
Demonstration	8	7
Experiential	29	20
Presentations by students	13	14
Reflection	10	12
Role-play	9	6
Team teaching	12	5
Workshop	39	25

Table 7. Case studies by collaborative and flexible use of space.

	Flexible use of space No.	No flexible use of space No.
Collaborative use of space	51	32
No collaborative use of space	8	28

centre in order to provide a clear view of all the screens. In another activity, concentrating on using Second Life, students were arranged in pairs with each pair physically separated as much as possible, in order to ensure students communicated through Second Life rather than physically.

The ability to dynamically change the layout of the space was strongly identified as practically beneficial:

> The tutors found that if they had an idea for a new layout during the course – or if a new idea was suggested to them – it ALWAYS worked to modify what we expected to do and go with the flow. In this way you can move with the way the groups work instead of interrupting their thinking. (Student Careers and Skills)

Flexible use of space correlates with collaborative use of space

This study also found that when the space was used flexibly it was also likely to be used collaboratively (Table 7).

The benefits were exhibited in terms of flexibility of the space for groups. For example, activities in the space may dynamically change through a session, such as between group activity and plenary sessions (Theatre Studies). The groups might take advantage of the space to arrange themselves according to preferences:

> Groups with a predominantly egalitarian and informal style could use 'soft' areas and those who were more formal could use desks. Interestingly, when 'soft' areas were available, groups used them for more creative and balanced tasks. (Student Careers and Skills)

Collaborative use of space correlates with an increase in the number of teaching and learning activities

Out of the 119 case studies, 83 were identified as making use of the space to provide students with the opportunity to work collaboratively, while 36 of the case studies did not make use of this feature.

Table 8. Teaching and learning activities by collaborative use of space.

Method	Collaborative use of space No.	No collaborative use of space No.
Creativity	15	2
Demonstration	11	4
Experiential	36	13
Presentations by students	21	6
Reflection	16	6
Role-play	8	7
Team teaching	13	4
Workshop	54	10

The teaching and learning activities were filtered to those that were found to occur in at least 10% of case studies. The case studies where the space was used collaboratively showed higher incidences of many of the teaching and learning activities, particularly with the more interactive and student-centred approaches (Table 8).

Most of the case studies stated that the success of activities depended on the ability to configure the ETS so that it could support student groups. In some cases, there was an immediate positive impact on the activity. 'The room layout with its various activity zones had an energising effect on the session' (Learning and Development Centre). In others the effect was viewed as logistic, such as the ability for the teacher to move between groups to provide support (Warwick Medical School, Theatre Studies).

The interaction between groups was also perceived as important:

> What worked nicely with the space was that they were able to see the outcomes at the same time and hear one another which was important as they were reflecting on their own performance and contrasting that with the other teams. (Centre for Cultural Policy Studies)

Number of technologies used correlates with the number of teaching and learning activities

The results showed a significant correlation between the number of technologies used in a session and the number of teaching and learning activities ($r = .189$, $p = .039$). An increased number of technologies was correlated with an increased number of teaching and learning activities (Table 9).[3]

One activity, delivered to Theatre Studies students exploring stage design, demonstrates a particularly rich use of the space and a variety of technologies with a very clear educational purpose:

> I took the opportunity to use the full rectangular space in the Teaching Grid, plus all seven ceiling-mounted projectors and one of mobile, large, flat-screen units. Four of the projectors were used to project full-set images, from four seminal productions, onto four of the large, wall-sized, white curtain-screens around the long space. These images remained visible throughout the seminar while, beside each of these, a series of further images were projected allowing me to demonstrate key moments in the use of the theatre space, costumes, properties and lighting. (Theatre Studies)

Table 9. No. of technologies by no. of teaching and learning activities.

		No. of teaching and learning activities					
		0	1	2	3	4	5
No. of technologies	0	2	12	4	7	3	2
	1	1	12	15	7	5	4
	2	2	6	8	10	2	1
	3	0	2	1	6	0	1
	4	0	0	1	1	2	1
	5	0	0	0	0	1	0

One of the strengths of a facility such as the Teaching Grid is that it allows the teacher to explore technologies in an environment unconstrained by the limits imposed by a traditional teaching space, and with support staff available to offer advice. This potentially enables technologies to be used in a deeper, more effective way. There was strong support for the effectiveness of technology combination, including an unequivocal 'I would definitely alter my structure of the session so as to maximise the uses of all the technologies' (Systems Biology).

Further to this one tutor articulated that it was the combination of space and technology that was central to the benefits offered by the ETS, reporting that it allowed '… tutors to match the students' learning styles to the motivations of the class'.

Conclusion

The Teaching Grid provides a space in which colleagues from across the University can experiment with new teaching ideas that make effective use of space and technology, and identify what works within their context. Academics made use of this flexible, collaborative and technology-rich space provided to explore a range of teaching strategies and support a wide range of student needs. Staff valued the flexibility for supporting group work. They displayed enthusiasm for making the most of the technology and commented on the value of being able to combine the use of flexible space and multiple technologies.

The findings from this study echo Temple's (2007, p. 239) view that 'The university, space and learning are intimately connected …' and '… it seems possible that relatively small improvements may be amply rewarded in learning benefits'. The flexible spaces provided in the Teaching Grid allow staff to adopt a range of pedagogies catering for all learning styles, as suggested by Monk et al. (2011). In combination with this flexible space, the range of technologies creates opportunities for teachers to develop multiple opportunities in response to individual learning needs (Laurillard, 2008).

The Teaching Grid is a unique teaching development resource, nationally and internationally. The contribution of this study is an understanding of the different ways in which teaching practice has been influenced by the resources available within the Teaching Grid. This provides an insight into the benefits offered by developing such a facility within Higher Education institutions in support of enhancing the student experience. Follow-up of Teaching Grid users suggests that the facility is already successful in influencing academics' teaching practice beyond its walls.

Already we know that use of the Grid has influenced the provision of teaching and learning technologies in the Arts faculty and the refurbishment of teaching spaces across the institution. In the following few years we expect that process to accelerate, supported by a meaningful evidence base provided by the Teaching Grid.

Areas for further research

There are a number of areas emerging from this study for further exploration including:

- a comparison between the nature and number of teaching and learning activities used in sessions within the ETS with those used in a traditional teaching space;
- the relationship between number of technologies and number of teaching and learning activities to discover if each technology is used to support a single activity or if these are being used in combination and
- students' attitudes towards the sessions held within this new teaching space.

Acknowledgement

The authors are grateful to James Mears for the floor plan of the Teaching Grid.

Notes

1. This framework is also reported in Joy et al. (2014).
2. These keywords and definitions are also reported in Joy et al. (2014).
3. A more detailed exploration of insights into the combination of technologies and teaching and learning activities can be found in Joy et al. (2014).

Notes on contributors

Emma King is a learning and development adviser at the University of Warwick. After training as a teacher she worked as a senior research manager at the Centre for Use of Research and Evidence in Education and then joined the University of Warwick as manager of the Teaching Grid and the Learning Grid. She has more recently completed an MSc in e-learning with the University of Edinburgh. Her research interests include staff and educational development, technology enhanced learning and the impact of space on teaching and learning. She has published in the British Journal of Educational Technology and made significant contributions to publications for school focused organisations including the National College for School Leadership and the National Union of Teachers.

Mike Joy is an associate professor (Reader) in Computer Science at the University of Warwick. After studying mathematics at Cambridge University and training as a schoolteacher, he completed a PhD in Computer Science at the University of East Anglia and subsequently undertook an MA in Post-Compulsory Education at the University of Warwick. His research interests have included declarative languages and software engineering, but currently focused on educational technology and computer science education, and he has published extensively in international peer-reviewed journals and conferences in the fields.

Jonathan Foss is a post-doctoral researcher in the Department of Computer Science at the University of Warwick. His PhD focused on the authoring of Adaptive Hypermedia and was based on his work on the EU FP7 'GRAPPLE' project. After completing his PhD he was awarded an Early Career Fellowship from the Institute of Advanced Study at the University

of Warwick. He is currently working on a variety of interdisciplinary projects involving research areas including web personalisation, technology enhanced learning and the usage of teaching and learning spaces.

Jane Sinclair is an associate professor in the Department of Computer Science at the University of Warwick where she is a member of the Intelligent and Adaptive Systems research group. She obtained the MA degree in mathematics and philosophy from the University of Oxford and the PhD degree in computer science from the Open University. Her main research interests are in educational technology and formal methods. She has published over 50 refereed journal and conference papers on these areas and is co-author of a widely-used text book on the Z development method. She is currently involved in research relating to MOOC provision for UK teachers of Computer Science funded by Google.

Jirarat Sitthiworachart is a lecturer in the School of Informatics at Walailak University, Thailand. Her research focuses on educational technology, deep learning and e-assessment.

References

Annan, L. (2008). Facilitating adoption of technology in higher education. *Distance Learning, 5*, 13–17.

Blin, F., & Munro, M. (2008). Why hasn't technology disrupted academics' teaching practices? Understanding resistance to change through the lens of activity theory. *Computers and Education, 50*, 475–490.

Breslow, L. (2007). Lessons learned: Findings from MIT initiatives in educational technology (2000–2005). *Journal of Science Education and Technology, 16*, 283–297.

Bryman, A. (2004). *Social research methods*. Oxford: Oxford University Press.

Edwards, R. (2006). The learning grid at the University of Warwick: A library innovation to support learning in higher education. *SCONUL Focus, 38*, 4–7.

Errington, E. (2004). The impact of teacher beliefs on flexible learning innovation: Some practices and possibilities for academic developers. *Innovations in Education and Teaching International, 41*, 39–47.

Fisher, K. (2005). *Linking pedagogy and space*. Retrieved from http://www.eduweb.vic.gov.au/edulibrary/public/assetman/bf/Linking_Pedagogy_and_Space.pdf

Harrison, A. (2009). *Emerging technology and learning spaces*. London: DEGW.

Jankowska, M., & Atlay, M. (2008). Use of creative space in enhancing students' engagement. *Innovations in Education and Teaching International, 45*, 271–279.

JISC. (2006). *Designing spaces for effective learning: A guide to 21st century learning space design*. Bristol: HEFCE.

Joy, M. S., Foss, J. G. K., King, E. L., Sinclair, J. E., Sitthiworachart, J., & Davis, R. (2014). Incorporating technologies into a flexible teaching space. *British Journal of Educational Technology, 45*, 272–284.

Kirkpatrick, D. (2001). Staff development for flexible learning. *International Journal for Academic Development, 6*, 168–176.

Laurillard, D. (2008). Technology enhanced learning as a tool for pedagogical innovation. *Journal of Philosophy of Education, 42*, 521–533.

Monk, N., Chillington Rutter, C., Neelands, J., & Heron, J. (2011). *Open-space learning: A study in transdisciplinary pedagogy*. London: Bloomsbury Academic.

Norton, S., McRobbie, C. J., & Cooper, T. J. (2000). Exploring secondary mathematics teachers' reasons for not using computers in their teaching: Five case studies. *Journal of Research on Computing in Education, 33*, 87–109.

Pajo, K., & Wallace, C. (2001). Barriers to the uptake of web-based technology by university teachers. *Journal of Distance Education, 16*, 70–84.

Pearshouse, P., Bligh, B., Brown, E., Laithwaite, S., Graber, R., Hartnell-Young, E., & Sharples, M. (2009). *A study of effective evaluation models and practices for technology supported physical learning spaces*. Bristol: JISC.

Rogers, E. M. (2003). *Diffusion of innovations*. New York, NY: Free Press.

Schneckenberg, D. (2009). Understanding the real barriers to technology-enhanced innovation in higher education. *Educational Research, 51*, 411–424.

Temple, P. (2007). *Learning spaces for the 21st century: A review of the literature*. York: The Higher Education Academy.
Thomas, H. (2010). Learning spaces, learning environments and the dis'placement' of learning. *British Journal of Educational Technology, 41*, 502–511.
University of Warwick. (2007). *Vision 2015: Teaching and learning*. Retrieved from University of Warwick: http://www2.warwick.ac.uk/about/vision2015/student_experience/
Warger, T., & Dobbin, G. (2009). *Learning environments: Where space, technology, and culture converge*. Educause Learning Initiative White Paper 1. Washington, DC: Educause. Retrieved from https://net.educause.edu/ir/library/pdf/ELI3021.pdf