Planning for Success in Introducing and Embedding Technology to Enhance Learning

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Abstract: The authors reflect on the outcomes of recent change management projects for introducing technology into Higher Education in the UK and discuss key aspects which have led to success in the increasing use and subsequent embedding of learning technologies in the classroom. They focus on three areas where it is suggested that institutions need to 'get it right' in terms of justifying the expensive introduction of technology into the learning environment: the building and maintaining of the technical infrastructure; the provision of appropriate initial and continuing user support, which includes relating the use of technology to pedagogy; and the management of the impact of change on those who are faced with adapting to different ways of learning and teaching. These are mapped to a set of critical success factors by the authors.

The paper investigate these firstly, via a case-study within a technology-focussed university, where its commitment to the enhancement of the student experience through using technology to support assessment and feedback mechanisms has increased. The authors explore how academics were encouraged to become further engaged within the process. Consequently, the use of technology in the classroom was no longer seen as being the preserve of a group of 'enthusiasts' or 'early adopters' but was perceived to be relevant to a wider user group. A further case-study shows how the critical success factors were applied to develop a flexible learning module within a more traditional teaching environment.

This paper explores the importance of balancing underlying pedagogical approaches to the introduction of new technologies. It is proposed that while technology can be an excellent tool it should not drive the pedagogy. The aim finally is to ensure that throughout and following a period of change both academics and students can benefit from the appropriate use of technology to enhance learning.

Key Words: Learning Technology, Change Management, Critical Success Factors; Case Studies

1. Background to evaluating learning technology in HE in the UK

The UK has seen significant investment in the use of learning technologies in the HE classroom in the past decade. Alongside this investment, much research has been undertaken to determine the best ways to introduce technology for supporting changing pedagogy whilst noting the general increase in class-sizes seen in many UK Higher Education Institutions (HEI). As money has been made available to extend the use of technology from the support of the Higher Education Funding Council for England (HEFCE) in 2005 for the Centres for Excellence in Learning and teaching, (CETLs) it is important to consider whether there has been a reasonable return on investment. As noted by Kirkwood and Price:

Using technology can be costly, not only in terms of the financial investment made by institutions for infrastructure, equipment and technical support staff, but also in relation to the personal investment made by staff and students in using the technology for teaching and learning.'(2013:2)

In addition to other funding made available to HE institutions, the Joint Information Systems Committee (JISC) part funded by Universities UK, has been supporting a number of projects since 2006 firstly through their Learners' Experiences of E-Learning Programmes (JISC, 2007) and more recently through their funding of programmes for supporting large-scale changes in Assessment and

Feedback practice, supported by technologies. Since summer 2011 JISC has overall provided funding towards 20 projects at UK universities with the aim of developing wider use of technology across institutions and support the changing learning landscape in HE,(JISC Design Studio, 2011). Final delivery of these outcomes is planned for summer 2014. In summer 2011 JISC also provided funding for 12 university research teams to explore the development of digital literacies across different student demographic groups. Much of this work builds on their earlier programme of developing digital literacies among students and encouraging universities to research their practice, (JISC, 2011)

Ensuring that the introduction of technology is going to be a success both financially and in the human cost of accepting new systems, will rely on the end-users, both the academics and the students seeing its benefit and relevance to their practice and studies. Alongside much generous funding for research, it is critical that the introduction of technology into HEIs is undertaken in a manner which will as far as possible ensure its success. Within the period of rapid technological change in the past decade and a half, through changing processes, changing culture and changing practices experienced, there is, practically speaking, no return to an age before technology was used to support learning. For those who are supporting HE staff and students through a period of technological change and embedding, it is vital to also consider the impact of changing technology on their living and learning. Not all of the students are the so-called 'net geners' (Oblinger, 2006) and many of them appear more comfortable with being 'digital residents' (White and Le Cornu, 2011).

Geoghegan (1994) has used the term 'compelling value' when considering the introduction of technology into a commercial organisation, and recommended measuring whether it performs an existing task in a better way, or if it performs a new task in a way that adds a major benefit. In investigating the wider issues of technology introduction he suggests that the inherent value is seen beyond the basic use of technology and the associated hardware and software provision and in the value-added to the learning and teaching experience for both students and academics. In determining what might lead to a successful introduction of technology in HE, defining how the value-added is measured presents difficulties as it is not necessarily linearly quantifiable and can appear transient, dependent on convenience and comfort factors that academics and students associate with using technology. Some of the difficulties in evaluating the effects of the impact of e-learning are further discussed by Conole & Oliver (2006).

Within the authors' own university there was a major institutional investment during 2010 to 2012 into the purchase and introduction of Electronic Voting Systems (EVS), also known as Personal Response Systems (PRS) as a technology to support assessment and feedback with an associated evaluation of the issues surrounding the technology introduction and its perceived benefit for students and the institution. While a number of academics have praised the use of EVS for adding a significant pedagogical value in the areas of deep learning, feedback and engagement, there is still a proportion of staff less willing to engage with the new technology (Jefferies, Cubric & Russell, 2013). This suggests that the 'compelling value' factor may be more difficult to assess as it depends not only on personal needs, but also on intangibles including the quality of previous experience with new technologies.

The authors first consider some general guidelines for ensuring success for a change management project when introducing technology into a university and then address in more detail the broad issues of:

- the building and maintaining of the technical infrastructure;
- the provision of appropriate initial and continuing user support,
- the management of the impact of change on those who are faced with adapting to different ways of supporting learning for their students.

In order to succeed in embedding technology for supporting learning the authors believe it is crucial to emphasise at the outset the importance of considering the underlying pedagogy of how, what and why material is being taught. The pedagogical decisions should be made first, prior to the decisions on which technology is most appropriate. This ensures that the 'technology cart' is not placed before the 'pedagogical horse'.

2. A background to change management

There has been extensive research into models of change management and technology adoption, which the authors will refer to just in passing here. Alongside the multiple theories for technology introduction and adoption, (e.g. Davis,1987 *inter alia*) recent work by Venkatesh, et al. (2003) has led to the proposal of a Unified Theory of Acceptance and Use of Technology (UTAUT). This theory has been formulated in an attempt to unify the various technology acceptance models and theories and also to provide key decision makers with a useful tool for assessing the likelihood of success for new technology introduction and help them in devising the strategies and interventions for wider technology adoption. The theory has been empirically validated and found to outperform an original eight models researched. UTAUT identifies four significant factors, which act as direct determinants of behavioural intentions and thus the actual personal usage of technology. These are:

- performance expectancy,
- effort expectancy,
- social influence and
- facilitating conditions

As will be seen below these four factors have been woven into the development of a series of critical success factors in the authors' own institution. It is of vital importance that those responsible for introducing new technology in HEIs consider the impact on current academics and their existing and future students. It is from the background of reflecting on the introduction of technology across their own university which has led the authors to draw up a short list of those factors which are critical to the success for introducing technology across an HEI.

The critical success factors introduced below were drawn up by the authors following their involvement in evaluating the introduction of electronic voting systems (EVS) across their own university (Jefferies & Cubric, 2012). While the use of EVS has been fairly widespread and popular throughout the school system in the US for some years, their use in HEIs and in the school systems in the UK and Europe tends to be somewhat 'ad hoc'. The authors evaluated the outcomes of this project, which saw nearly 5,000 EVS handsets provided to mainly undergraduate students as well as the introduction of supporting hardware and software across teaching classrooms on multiple campuses. Additionally an extensive programme of staff and student support was initiated. The driver for this project was a generous investment from their own university into technologies to support assessment and feedback mechanisms, with the facility for immediate feedback through the EVS handsets for either formative or summative tests.

Their evaluation processes also reflected on lessons learnt from a previous major university investment in learning technology when the institution-wide use of an LMS, was introduced in 2001 (Thornton, et al.,2004). Additionally EVS had been used on a small-scale across some of the university's schools and faculties since 2004. The research question was therefore – how can the key benefits and processes that the HEI underwent previously be fully articulated, to ensure that the current technology introduction will proceed smoothly and be effective in supporting and enhancing the students' learning?

Within the broader areas of change outlined above the authors developed and refined a set of critical success factors which further explore the issues to consider when planning for successful change:

- A top-down initiative must be supported throughout at local level i.e. by senior management and grass roots.

- Reliable software and hardware should be readily available (and facilitated in all teaching rooms for campus-based programmes)
- Sufficient initial and on-going staff development must be provided
- Support should be provided for developing a changing pedagogy
- Building variety into the use of technology for learning supports student engagement
- Responsibility for learning should rest with the student

The mapping of the broad change areas onto the authors' critical success factors is shown in Figure 1 below.

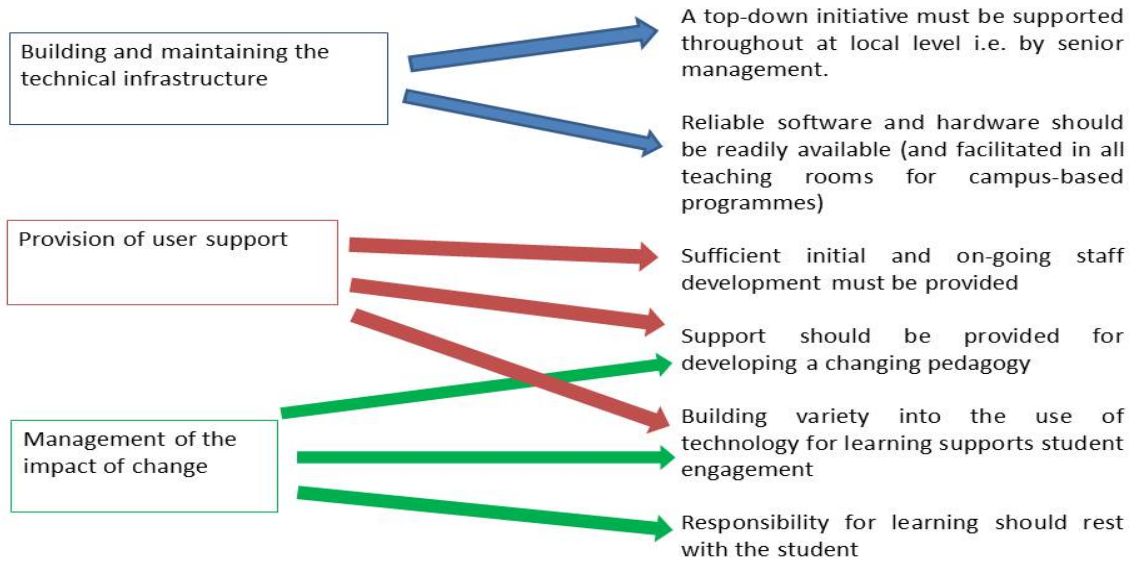

Figure 1 Mapping of strategic change areas to critical success factors

3. Critical success factors in relation to the first case study – a blended learning campus-based university

3.1 A top-down initiative supported throughout at local level – from senior management to grass roots
A change management initiative must be supported by the Senior Management if radical technology adoption is going to be successful. By radical technology adoption the authors mean the large-scale institutional wide adoption of a specific technology which impacts across the whole HEI. Requiring the top-down support from the management for a technology project which affects teaching and learning as a core part of the university's business will ensure that the change aligns with the university vision and can be planned for. Within business it is always seen to be critical that the IT strategy should align with the business strategy since so much of the budget is now typically spent on IS/IT. The same is true of an HEI since the success of an integrated technology will impact across the institution and needs to be supported throughout and include top-level technical decision-makers. Most HEIs now include their educational technology strategy in their university strategic plan, recognising the crucial importance that the provision of reliable and relevant technology plays in the daily lives of staff and students.

The commitment of a Senior Manager for the success of the overall project will ensure that all stakeholders with a relevant interest in introducing new technologies for supporting learning and

teaching, i.e. technical infrastructure and support and educational technologists would be included in the decision making alongside the academics. The importance of those at a local level 'buying in' to support the project cannot be over-estimated either, since it is their workload which will be impacted and their day-to-day meeting with students in the classroom which will see the real impact of the technology adoption into their pedagogy. The local 'gatekeepers' and influencers among technicians and academics should be identified early on and drawn in to discussions. This will help to ensure a smooth transition and avoid the gathering of academics and support staff into 'silos' of support or rejection.

3.2 Reliable software and hardware should be readily available (and facilitated in all teaching rooms for campus-based programmes)

The authors recommend that there should be a sound and reliable technology infrastructure. This will allow academics to think about what and how they are teaching instead of worrying about whether the technology will be working.

The local hardware should ideally be supported centrally so that back-ups happen automatically outside teaching time. Thus, academics can arrive and set up 'just in time' for teaching without having to take along extra 'kit' or perform lengthy start-ups in the classroom. The infrastructure should be designed and tested with the teaching academics in mind and preferably taking into account their regular feedback on what is required. This will ensure that a priority is given to the teaching and learning taking place in the classroom, instead of letting the technology distract and draw attention away from the pedagogy.

Within the example of using EVS that the authors researched, their university has developed a standard pattern of notices, which are posted in every teaching classroom. These remind academic staff and technologists how to set up and use EVS from the in-room computer, and remind students about the local channel for the EVS and if necessary how to change channels. It is this close attention to detail from those supporting the embedding of the technology which has helped to instil confidence in academic staff that the system is reliable and robust, whether they use the EVS system weekly or more occasionally.

3.3 Sufficient initial and on-going staff development must be provided

Drawing on their reflections from the earlier introduction of an LMS and the extensive research into evaluating its embedding with staff and students (see above, and also Yeh and Tao, 2013) the authors worked with the wider team across the university for technology introduction and embedding to ensure that sufficient staff support was available on an initial and on-going basis. This support embraced two aspects, firstly the changing pedagogy that using EVS introduced. The greater use of formative and summative testing was considered and how this could form part of the ordinary curriculum. From a research perspective the authors drew on the work of Mazur (1997) *inter alia*, who had previously demonstrated the importance of constructive student engagement in class, and thus a moving away from the centrality of the didactic lecture as the foremost means of instruction for university students. The staff introduction sessions discussed and shared ways in which the EVS handsets could be used creatively to support student understanding. A key lesson learnt from the earlier introduction of the LMS had been to provide staff support in terms of regular instruction sessions which continued for a year or more after the first introduction of the technology. During the second year of their introduction there was a sharing of tips from 'experienced' users and a series of workshops which catered for beginners as well as intermediate users and a regular 'drop-in session' for support. A further support for the embedding of the technology was the recruitment of 'local champions'. An important lesson learnt from the earlier LMS introduction had been that those Schools who appointed staff to help and advise each other had been more successful in the take-up and embedding of technology across their modules. Once again feedback evaluated by the authors from all staff indicated the importance that the role of a 'local' change leader had played in supporting

them. Some Schools introduced their own staff self-support group; this was not seen as merely a quick fix for issues but as an on-going pedagogic requirement to discuss innovative ways to use EVS. The on-going training and local support was needed to move the use of technologies on from those categorized by Moore (1991) as 'innovators' and 'early adopters' to a greater acceptance and willingness for their use by the 'early' and 'late majorities' and encourage widespread use in faculties and schools. This is not a fast process and may take several years to see the full benefit of academics using this technology confidently and regularly in appropriate ways. Staff development may be organised at an institutional level but it should be reinforced by extra support at the local level for administrators as well as for academics.

3.4 Support should be provided for developing a changing pedagogy which is learner-centred

Where technology is introduced to support student learning and assessment it may differ from a more traditional teacher-centric pedagogy, indicating a move away from what is described as 'the sage on the stage' approach to a 'guide on the side'. Following examples from Mazur et al and the developing examples of in-house practice (e.g. Lorimer and Hilliard, 2007), the centralised Learning and Teaching Institute (LTI) provided a series of workshops on developing a more student-centred approach to learning to fit alongside the embedding of technology across the university. Much of this was already in place prior to the introduction of EVS, to support wider online engagement through the LMS and ensure it was not just used as an online repository for teaching materials. Developing and applying different approaches to pedagogy aimed to encourage discussion between students about the knowledge gained, with a more constructivist approach to building their understanding. This benefitted students in their use of technology on-campus and academics were encouraged to consider how they could further blend the online and face-to-face learning. Local champions supported those who wanted to experiment with more technology-based student-centred approaches and extensive Continuing Staff Development (CPD) was provided. This area has also seen extensive research through other JISC funded programmes such as ESCAPE (2011) and REAP (Nicol et al. 2010).

3.5 Building variety into the use of technology for learning supports student engagement

Within the example of using EVS technology the research showed (Jefferies & Cubric, 2012), that in line with other research projects most students were enthusiastic about the use of the technology for testing their understanding and knowledge. They noted and appreciated the changing classroom pedagogies that this often led to, in terms of more opportunity for discussion and for recapping material. They were enthusiastic about the speed with which they received relevant feedback, noting that this showed them in a formative situation what they had understood or what they needed to spend further time on learning. They recognised that using the handsets in every teaching session could lead to the same onset of boredom and lack of interest through 'death by EVS' that can happen when PowerPoint is overused. The use of the same style of teaching and assessing can ultimately lead to a lack of engagement with the material in the same way that didactic lectures may lead to students lacking concentration. It has been suggested that placing all materials online can lead to falling attendance figures and this may well be true if the student (often incorrectly) cannot see the benefit of attending in person when everything is available for downloading online. The alternative is to vary the patterns and require the student to engage in different ways online so that the face to face sessions are used to support learning instead of delivering the same material already available to them. The recent examples of 'flipped classrooms' show that students can benefit from a greater variety in their learning through the judicious design of online materials (e.g. Martin, 2012).

3.6 Responsibility for learning should rest with the student

The authors suggest that one should not consider the introduction of new technologies in HE without considering the impact on students and have spent significant time researching the impact of new technologies on students (Jefferies, Cubric, Russell, 2013) and gathering their views alongside the necessary change management approaches from industry.

The latest research into student ownership of their own computer identifies high world-wide levels of personal ownership of laptops at around 83% (Educause, 2012 p.13) and alongside a 5545% increase in the ownership of smartphones in the U.S. since 2004 (ibid p.15). It is clear that while few universities mandate the ownership of computers and continue to provide desktop computer access to students, it is now seen as an essential technology to own to stay connected with their studies and an indication of serious commitment to accessing their learning.

Within the EVS example used above it was decided that those students in schools where EVS technologies were being used should be given personal ownership to an EVS handset, this was linked through an online database to the student's unique ID number. This allowed academics to use the EVS to schedule formative and summative tests and record the students' achievements immediately. After moderating the marks student received confirmation swiftly. Any issues over handset ownership could be resolved promptly as staff had access to the central EVS ownership database. Other examples of universities with a single point of loan such as the library from which students borrowed handsets have proved less flexible in their use. This format relied on sufficient handsets being always available and did not include a database where student IDs were linked with a unique handset.

4. An exploration of the critical success factors with traditional campus-based institution

In another much shorter study undertaken by the first author, a traditional, campus-based research-focussed institution embarked on the introduction of technology for a flexible online learning programme for mature students embarking on post-graduate study. This HEI had an in-house LMS with a small team of dedicated technologists working to support and develop its use. While most academics were technically competent, few of them were using the LMS to a great extent and many had not previously experienced directly editing and uploading materials, nor using the discussion fora available. With an emphasis on face to face contact in small classes there had been less incentive to embed technology to enhance student learning and engagement.

With regard to the critical success factors suggested above, each is now described with its relevance to this second case study:

4.1 A top-down initiative must be supported throughout at local level i.e. by senior management and grass roots.

The project had been proposed by a small team of 'early adopters' of technology for receiving external funding and this had included a letter of support from a Pro-Vice-Chancellor. At Faculty level there were definite pockets of enthusiasm and the small team identified early on those 'gatekeepers' who controlled opinion, working with them individually to share project plans and identify the potential of online learning. In retrospect the team members reflected that a tangible commitment from the senior management to a small reduction in working hours, while they were developing the materials would have resulted in the project moving ahead faster and at a regular pace.

4.2 Reliable software and hardware should be readily available (and facilitated in all teaching rooms for campus-based programmes)

The thrust of this case study was to set learning in an online context and the academics all relied on the LMS being easily available on and off-campus to accommodate new ways of working as they developed an appropriate pedagogy for online learning. This required more engagement remotely with students and a reliable and easy way for students to access their materials.

4.3 Sufficient initial and on-going staff development must be provided

The staff development in the second case study related to introducing academic and administrative staff to working effectively online. Some of this support was offered in small tutorial-like settings or a

one to one basis. As the development team prepared to launch the flexible learning programme they identified the on-going support issues that should be built in to the delivery of the programme through the academic year and started to recruit student change agents. These mature students would be available online to support the new students embarking on the programme. At the same time they identified local champions who could support the academics in each faculty.

4.4 Support should be provided for developing a changing pedagogy
The requirements for changing the pedagogical design by moving from a campus-based and face-to-face delivery to a flexible online learning programme were discussed at length as the generic programme was designed and built. The team spent time reflecting on what the pedagogical drivers were in order to avoid merely transferring existing material from a face-to-face environment to an online one. In their design, extensive use was made of opportunities for students to engage with each other and academics in 'chatrooms' and find support online.

4.5 Building variety into the use of technology for learning supports student engagement
An intrinsic part of the design for using technology meant that academics sought out a variety of media, including video clips and podcasts and drew up a programme which allowed some face-to-face engagement alongside synchronous and asynchronous sessions online.

4.6 Responsibility for learning should rest with the student
There was no doubt in this smaller case study that students would be engaging with technology for learning, and the team involved in the project design were confident that this critical success factor was already a certainty. The student demographics which expected a cohort of mature students to enrol also considered how to support students who were less confident with learning technologies and this was addressed by the induction programme designed to ensure they could start off from a level playing-field.

5. Reflections on building success into the introduction of technology to enhance learning

In this section the authors reflect on the broad areas of introducing technology to enhance learning. The first imperative to 'get it right' was for the building and maintaining of the technical infrastructure. As has been shown this requires senior management support to ensure the technology and educational strategies are aligned within the university's strategic plan; funding technology investment is expensive and requires clear commitment throughout from the management. The provision of local and centralised technical support for academic staff was shown to be very necessary in this survey and this is further reinforced by the findings from the UCISA TEL (Technology Enhanced Learning) Survey for 2012, which noted that:

> *'Availability of TEL support staff' remains the leading factor in encouraging the development of TEL, followed by 'central university and school/departmental senior management support'.* (Walker, Voce, Ahmed, 2012:2)

Reflecting on examples of technology introduction in recent research and the authors' own experience, the support for staff at all levels has been essential to ensure the embedding of technologies within the HEI and alongside this support for learners. This does not require that all academics must be using identical technologies, but that they all have access to full support for those which they need to use and know how and where they can find the necessary support in person or online.

The management of the impact of change which technology brings affects users at each level and within the university sector it will also affect the changing pedagogy as academics discover the opportunities for engagement with additional materials that technology can offer their students. Recent pedagogic developments have noted a shift away from students as passive learners in a

didactic process and towards the expectation of greater engagement and ownership of their learning by students as exemplified in the case studies explored above.

Planning for success in introducing the wider use of technologies and their embedding within the pedagogy of HE entails careful attention to the design and close engagement with academics and students and full evaluation of technology use with students (e.g. Twetten et al,2007). Without the commitment of the stakeholders throughout the institution and their understanding of the benefits that technology can bring then the authors suggest that 'innovators' may introduce technology but will fail to embed it successfully.

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