RESEARCH PAPERS

A FILTERING APPROACH TO IMPROVING THE LEARNING BLEND

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ABSTRACT

The effectiveness of blended learning is dependent upon the combination of learning activities, complemented by information communication technologies and the availability of opportunities for face-to-face communication. This paper proposes a filtering approach to assist lecturers in combining learning activities within a blended learning environment. The filters focus on improving both the richness and smoothness of the learning blend. The filtering approach is demonstrated with examples taken from a module supporting the teaching and learning of postgraduate research training. Changing the blend of activities in this module has improved the richness of the learning experience for both students and staff. The evolution of the blend is discussed and further issues to be addressed in the future of blended learning are identified.

Keywords: blended learning, e-learning, research training.

INTRODUCTION

The aim of blended learning is to meet the requirements of the learner, their company, the business objectives and the organisational culture by providing a mix of learning media (Trasler, 2002) and information communication technologies (ICT).

In this paper, blended learning is defined as a programme of learning events that are facilitated by a combination of face-to-face and ICT-based delivery mechanisms (which can be used both on and off campus). Here, the analysis of the blend focuses on the accessibility of the lecturer and the range of opportunities for direct communication between the lecturer and the student.

Cox et al., (2004) suggest that 'e-learning can empower the learner as they take control and responsibility for their learning'. However, any learning technology, whether web-based or not must be adaptive to the individual and their preferred learning styles to avoid risk of rejection (Byrne, 2002). Students should therefore be given more options in the way material is presented (Karuppan, 2001). Whilst technology offers potential to reconstruct learning environments around specific learning styles (Buch & Bartley, 2002), there is a danger of using technology 'for technology's sake' and neglecting the role of people in learning (Trasler, 2002). Phelps et al. (2005) criticise current teaching practice for being too teacher-centred and viewing teaching as a system of cause and effect. They support the view that student learning is an emergent process as knowledge is constructed through interactions.

Blended learning provides further flexibility to tailor learning to individual needs and recognises the critical role of people in facilitating, supporting and enhancing learning. This paper discusses the critical issue of the quality of the blend. A filtering approach is proposed to improve the richness and smoothness of blended learning. The approach is then demonstrated and discussed. The paper concludes by outlining critical success factors in blended learning and identifying further issues to be addressed within the evolution of blended deliveries.

Quality of the Blend

Blended learning has achieved mixed results with the critical success factor being of 'finding the right blend' (Trasler, 2002). This paper proposes that in assessing blended courses, the *smoothness* and the *richness* of the blend needs to be considered.

Smoothness is defined here as the relationship between learning activities. There is a risk that in mapping technologies to components of a course the relationship between the components can become overlooked, resulting in a disjoint and 'lumpy' blend. For example, if a course consists of on-line lectures and attended class-based exercise activities, explicit links need to be made between the on-line and attended components. This ensures a smooth flowing learning experience as opposed to a series of disjoint events.

Richness is defined here as the individual learning experience; it considers an individual's commitment, involvement and engagement in the learning experience.

A rich blend will support a broad range of learning activities and opportunities for communication and interaction. In addition, it will facilitate high levels of flexibility to allow different students to achieve the same learning outcomes through a personalised combination of activities that meets their needs.

In traditional lesson planning, the lecturer will devise a set of learning activities to meet the learning outcomes which give consideration to different learning preferences (for example, the needs of visual, auditory and kinaesthetic learners). During delivery, the lecturer will then seek direct and indirect feedback from the class and modify their delivery in response. As the lecturer becomes more distant from the immediate learning environment, more work is needed in the preparation of learning activities to provide flexibility for the learner. Sufficient learning opportunities need to be included to help the learner to self-select their ideal combination of learning activities and to initiate feedback from the learner to ensure that the learning outcomes have been achieved.

The ultimate blended course enables every individual learner to take a tailored programme of study that meets their individual needs and that recognises that these needs may change during the programme. An example of this is provided by Barclays who have recognised learning as being a strategic business resource and have implemented a network of learning hubs. These hubs facilitate flexibility, variety and adaptability in committed lifelong learning (Trasler, 2002) and offer rich personalised blends.

Marygaryan et al. (2004) reports a similar example where activity-based learning based on the participants own workplace situations facilitates knowledge sharing and enhances the likelihood of knowledge transfer in the learning process.

Approaches to Blended Learning

Approaches to create blended learning generally focus on two main stages. These include

Stage 1: Decompose existing programme into constituent parts.

Stage 2: Map different learning mediums to the constituent parts.

Such approaches force attention to be focused on the method of delivery, specifically the choice of technological components that can be incorporated into a blended course. This view is supported by Reynolds (2002) who agrees that too much attention is given to the way in which training is delivered rather than how it affects people. Focusing on technology can reduce the attention given to the underlying rationale for the teaching and learning.

The strategic application of ICT can complement learning activities and offer new opportunities both for the delivery of the learning activities and the overall learning environment. However, whilst seeking applications for ICT in the learning process, the learning objectives must not be overlooked. Bottino (2004) emphasises that ICT must be considered within the context of the whole learning environment rather than the mere application of ICT to support discrete tasks.

In an attempt to redress the balance, Staley (2004) has developed a tool to map the five teaching and learning activities of information transfer, communication, learning activities, assessment and module evaluation against a range of ICT and non-ICT based components. The tool aims to assist lecturers to consider a range of ways in which learning can be enhanced by changing the balance of class attendance and ICT-based components.

Cox et al., (2004) suggest that ICT-based design components can be categorised as: presentation elements that refer to the way the content is displayed (such as video steaming) and functional elements that refer to learner interaction (such as quizzes). They also raise the question that "although these components have the capability to increase the educational value… which components enhance learning?"

Previous research in e-business identified a plethora of e-business projects combining ICT-based components that did not support the objectives of the company and did not enhance the business operations. Cox et al., (2001) propose that the rationale for the application of ICT should be founded in aligning e-business activities with business objectives. They propose that before considering the deployment of ICT, three key questions need to be addressed. These are:

- What needs to be delivered?

- How can it be delivered?

- Why does it need to be delivered?

In an educational context, the rationale for deploying ICT must be aligned with specific learning objectives. The following section proposes a filtering approach to create a blended course. Each filter repeatedly focuses on these three key questions to provide the rationale for incorporating ICT into the learning blend.

Filtering Approach to Blended Courses

An approach (shown in table 1) has been developed to improve the smoothness of blended courses through the sequential application of three filters:

- **Filter 1** explores the learning theories that provide the underlying foundation for the course or learning module.

- **Filter 2** analyses the application of the learning theory and defines learning activities to support the achievement of learning objectives within the learning process. It develops a broad lesson plan for the module.

- **Filter 3** identifies learning events supported by ICT and opportunities for face-to-face communication to facilitate the learning activities defined within the lesson plan.

systems to supplement classroom learning; the participative model based on principles of social interaction within ICT mediated learning environments.

Figure 1 shows these three learning models with increasing levels of participation on the vertical axis. Three broad categories of process, skills and context are listed along the horizontal axis. A range of educational theorists are mapped within the grid (note that this not is not an exhaustive list of theories; for more theories refer to Kearsley, 1994). For example, Bloom (1953) focuses on the stages of the learning process; moving along the axis, greater attention is paid to the skills, intelligences and preferences of the individual learner. For example, Gardner (1983) identifies eight intelligences that correspond to eight learning styles of the linguistic learner, logical/mathematical learner, spatial learner, musical learner, kinaesthetic learner, naturalistic learner, interpersonal learner, intrapersonal learner.

The lecturer's choice of learning model and learning theory provides the underlying frame of reference for the delivery of the course. The view of the learning process and the view adopted of the learner together support the creation of the conceptual learning environment. This first filter defines the philosophy within which the components of the course are blended.

Filters	Why?	What?	How?
Filter 1: Learning Frame of Reference	Learning Models	Learning Theories	Learning Objectives
Filter 2: Lesson Plan	Learning Objectives	Learning Process	Learning Activities
Filter 3: Learning Components	Learning Activities	Learning Interactions	Learning Events

Table 1: *Outline of Filtering Approach*

Filter 1: Learning Frame of Reference

Bottino (2004) identifies three models that form the basis of many educational ICT systems and provide criteria with which to compare systems. These are: the transmission model based on the principles of behavourism, providing drill and practice systems to reinforce learning; the learner centred model based on consructivist principles that learners construct their own knowledge based on interaction with their environment, providing context-based

Figure 1: Filter 1: *Learning Frame of Reference*

Filter 2: Lesson Plan

The second filter focuses on identifying the learning activities needed to implement the frame of reference chosen from filter one. The filter lists the learning objectives which are identified from the selected learning theory, on the vertical axis. Along the horizontal axis, consideration is given to the degrees of communication and interaction between lecturer and students. This axis is based on work by Cox *et al,.* (2001). In developing a model for the strategic application of ICT in e-business they found that it was important to differentiate between the type of business activity being undertaken within each trading relationship. A scale was devised to represent the complexity of the communication being supported by the e-business activity, differentiating between: one-way, two-way and interactive communication (i.e. sending information via static web site; sending and receiving information via forms; interactive negotiation via collaborative systems). These interaction categories correspond to the complexity levels for using ICT within inter-company relationships identified by Ward & Peppard (2002). These are: transaction processing, enquiry or information exchange, transaction driven interaction and interactive processing.

The first category considers the one-way *delivery* of information by the lecturer; the second category includes two-way synchronous communication between the lecturer and student(s) through opportunities for *enquiry* and *debate;* the third category incorporates two-way asynchronous *discussion* between students and between lecturer and students. Learning activities are then positioned in terms of the complexity of the interaction in the learning process (on the x axis) against the learning objectives supported by the activity (based on the theory shown on the y axis). Figure 2 shows some examples of possible learning activities that could be considered in implementing Bloom's theory in order to create a lesson plan.

A similar approach is reported by Marygaryan *et al.* (2004). A blended programme by the Open University Shell International Exploration and Production is based on the learner-centred model of social interactions and Merrill's (2003) five principles of instruction. Marygaryan *et al.* (2004) position 21 learning activities against the learning processes that are needed to implement the learning objectives of Merrill that provides the underlying frame of reference for the course.

Learning Objectives			
Evaluation	compare theories	test limitations	critique theories
			workshops
Synthesis	relate to similar examples	reflect on examples	build on theories share experiences role play
Analysis	explain example	explain answers	review examples
			case study
Application	example of theory	set problem exercise	test theory develop products
Comprehension	demonstrate theory	ask questions quiz polls	discuss theory questionnaires
Knowledge	define content based resources define theory	learning agreements	seek definitions collect information
	Delivery	Debate / Enquiry	Discovery / Discussion
	Learning Process		

Figure 2: Filter 2: *Lesson Plan*

Filter 3: Learning Components

In filter three, learning components are identified in order to implement the lesson plan identified in filter two (based on the frame of reference from filter one). The learning activities from filter two are listed along the vertical axis. The horizontal axis again focuses on the degrees of communication and interaction between lecturer and students. Learning events can then be mapped into the framework. The example shown in figure 3, lists four activities along the vertical axis which require increasing levels of depth of understanding and analysis of the subject. The arrow cutting through the origin of the graph indicates the increasing importance of opportunities for individual students to have access to the lecturer as the complexity of the subject and the student's engagement, involvement and interaction in the subject increases. All of the activities identified from filter two could be delivered using traditional classroom attendance events, or by events facilitated by ICT, or by a combination. In figure 3, traditional events are listed above the lecturer availability line and ICT events are listed below the lecturer access line.
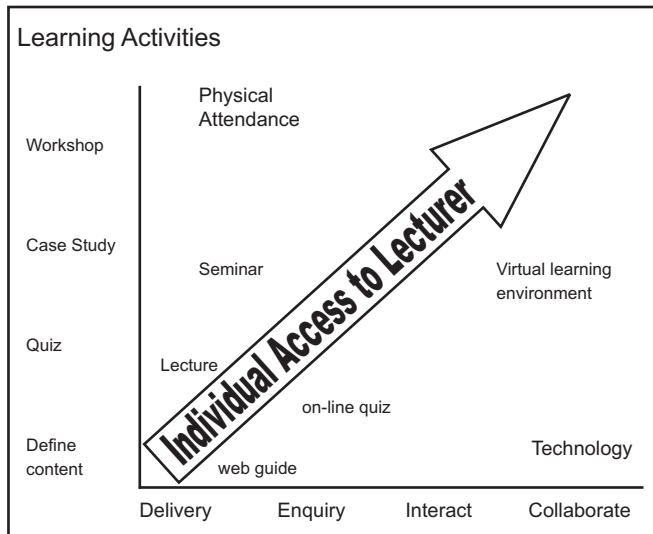
Figure 3: Filter 3: *Learning Components*

Figure 3: *Communication Mechanisms*

Figure 4 identifies a number of communication mechanisms with which students can typically contact a lecturer. Opportunities for a group of students to contact a lecturer as a group usually have to be planned in advance, for example, a scheduled seminar activity, however, this may also be facilitated by an on-line discussion forum. In contrast, although students may schedule individual tutorials with a lecturer, the requirements of individual students to contact a lecturer are largely unplanned (e.g. telephone, email, personal postings in virtual learning environments). As the events are unplanned, the lecturer's response to the student can be delayed and communications can become protracted as misunderstandings may take longer to identify and rectify.

As the distance between the student and lecturer increases, the quantity and quality of opportunities for a student to seek individual feedback and reassurance from the lecturer also needs to increase. This is demonstrated in the following example.
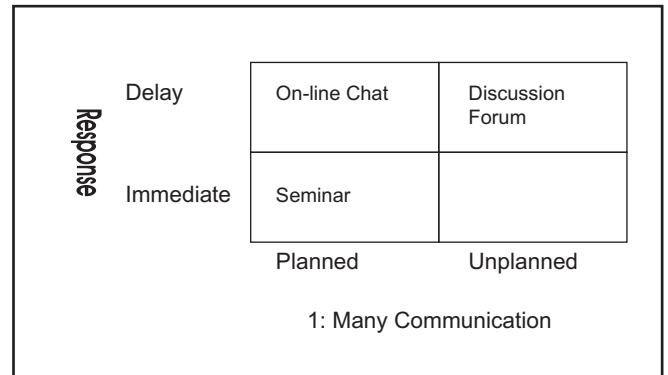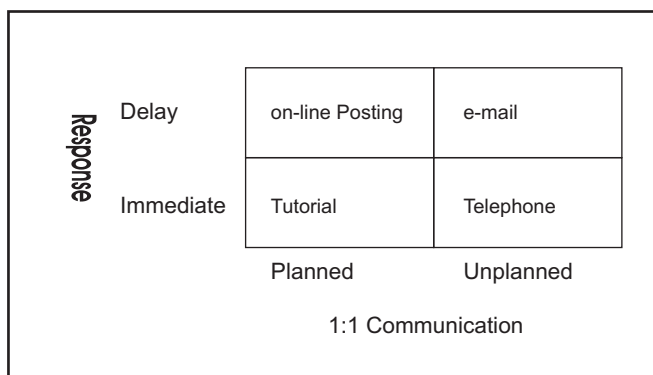

Example of the Filters

The module 'Introduction to Masters Level Study' is a core module on all the postgraduate courses in the Department of Computing. The aim of the module is to provide students with the skills they require in order to successfully complete a programme of study at Masters level. The module was initially delivered using traditional classroom based activities. The following sections report the continuous development of the module using the three filters to modify the blend.

Filter 1: The underlying philosophy of the module is founded in behaviourism, specifically through the application of Bloom's (1953) model. This is influenced by the compulsory staff training programme for the University. In addition, Kolb's (1984) theory of experiential learning was a driving force in the module design as its emphasis on experiential learning and critical reflection supports the aim of the module to develop the skills of students.

Filter 2: In implementing the theories of Bloom and Kolb, four main learning activities were identified in figure 5: content-based resources to present the theories, criteria and guidelines for Masters level study; exercises for students to practice the theories taught; feedback and reflective activities to improve individual skill performance; and critical discussion of academic papers to develop skills in critical analysis and to generate project ideas for later in the course.
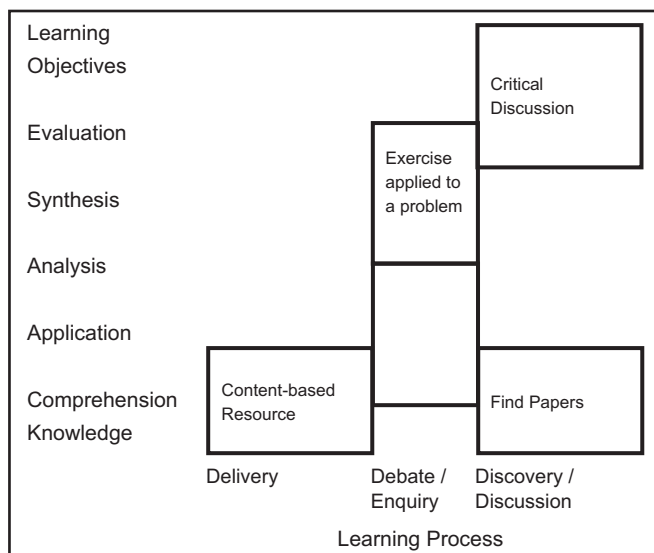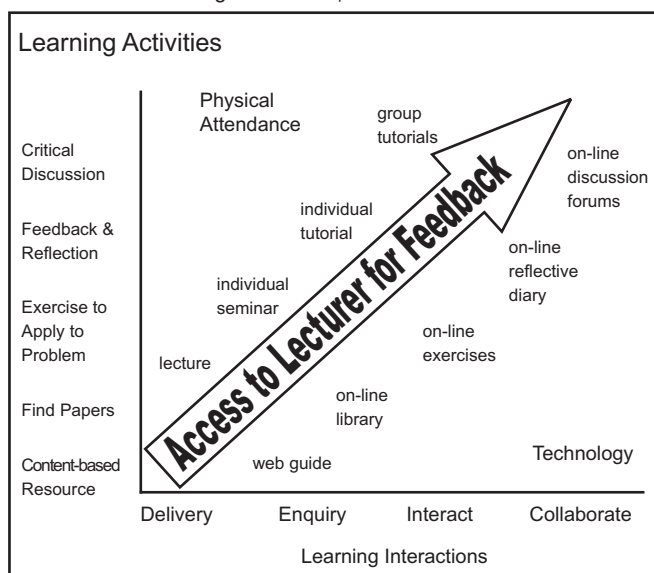
Figure 3: *Examples of Filter 2*

Figure 6: *Example of Filter 3*

Filter 3: Figure 6 shows how the learning activities identified from filter two could be implemented. Initially the learning activities were implemented through learning events within a traditional classroom context (shown above the lecturer interaction line). After the first delivery of the 12 week module, the learning experience was critically reviewed. The focus of the module was on developing the skills of individual students in areas such as conducting and writing a literature review; referencing and critical appraisal. The lecturer 'delivery' of the core content of guidelines in Masters study was necessary, however, the most valuable learning events were

the opportunities for students to gain detailed and personal feedback on their own performance so that they could further develop their skills.

In the second delivery of the module, the core theories and skill guidelines were provided in the form of a comprehensive guide. The guide was made available in both paper and electronic formats. The change in delivery method freed up time to increase the opportunities for students to gain personal feedback on their skill development. The evaluation of this module in its second delivery again identified the opportunities for individual feedback as being a critical success factor for the module. It was recognised that the participation of part-time students was poor and that this group of students were missing out on the opportunities for feedback and discussion. This was further hindered by their sessions timetabled in the evening when they were too tired to actively engage in challenging activities.

As the one-to-one tutorials between the student and lecturer increased, it provided a wealth of material on how skills were developed. It became possible to extract key stages and processes from the individual tutorials which provided systematic guidance in what had initially been viewed as the systemic development of soft research skills (e.g. informative writing and critical appraisal).

In the third delivery of the module, the core theories were again provided in a paper and electronic guide. In addition, a series of exercises were made available on-line with criteria to support self-assessment of the activities. Staff were also available both during pre-arranged sessions and via telephone, email and requested tutorials to give more detailed feedback on the exercises attempted. The cohort continued to attend classroom based sessions to discuss set reading of academic papers. The greater flexibility provided by the revised delivery enabled part-time students to actively participate in the module at times convenient to them rather than ritually attending an evening class without actively participating in it.

In the fourth delivery of the module all the teaching material and learning exercises were administered in a virtual learning environment (shown below the lecturer interaction line in figure 6). The lecturer was available during a timetabled 3 hour drop-in session. Feedback was also given via email, telephone and individual tutorials.

Students continued to gain detailed personalised feedback but the feeling of belonging to a cohort and the benefits of learning sets were lost. Previously students had attended a weekly one hour session to discuss an academic paper. This session provided opportunities to develop skills in critical appraisal, opportunities for synthesis of ideas taught elsewhere on the course and the development of ideas for potential projects later in the course. These sessions had previously provided a deep and rich learning opportunity. Discussion forums were set up to replicate this activity on-line. Whilst in theory the forum facilitated greater participation, in practice the richness of the social interaction and collaboration that emerged in the classroom was lost. Students commented that the discussions were more 'clinical' and 'more like work' as they felt they had to 'work hard to think of something to contribute'. Despite efforts to move the discussion to on-line chat rooms and scheduled times for participants to log on, the discussion lacked the spontaneity and facilitation of the classroom. Ellis & Calvo (2004) and Gilbert & Dabbagh (2005) emphasise the need for considerable work in the preparation of meaningful discussions on-line. In developing a personalised experience for individual students to develop their skills, the module lost the social and collaborative elements in this delivery. This is an area that will be developed in the next delivery of the module.

The evolution of this module has been from teaching Masters skill to the facilitation of skill development. ICT has acted as an enabler for learning, empowering the student to take responsibility for developing rather than learning skills. The key to this blended module has been increasing the perceived availability of the lecturer. Initially some students resented the reduction in attendance sessions but later appreciated that the 'attended lecture' was being replaced by the opportunity for flexible individual 'attended tutorials'. The increased perceived availability of the lecturer became more important as its value was recognised. It is important to note the 'perceived availability'; the lecturer spent the same total number of hours in the revised delivery of the module, however, the students perceived the lecturer to be more available as the lecturer was seen as being more able to engage in tutorials and provide personal feedback via telephone and email when the student required it, rather than in scheduled blocks of time. It is also important to note that despite the student perception, the lecturer was not 100%

available to the students; regular shorter periods of time were scheduled for the module throughout the week as opposed to one longer block of time scheduled for one day a week.

The smoothness of the blend is maintained by the range of events supported within the context of the static content-based guide. In addition, the structure of material in the guide and the structure of exercises reflects that of the module assessment. Explicit links are made between the 'lecture' content and the exercises. Tresler (2002) advocates that static information should be paper-based and that dynamic information should be maintained on the web. In contrast, in this example, the static information of the guide and the exercises for self evaluation are maintained on the web, providing a constant source of reference. Dynamic activities are maintained with attended tutorials.

The module is significantly rich in that a student is empowered to plan their own attendance and on-line activity (although participation is also monitored by the lecturer). At the moment, the range of learning activities is quite narrow, however, this is overcome by the large number of opportunities for communication and interaction with lecturers and peers. It allows flexibility for different students to achieve the same learning outcomes through a personalised combination of activities that meets their specific needs in relation to developing the skills for Masters level study. The individualisation recognises that each student will be starting from a different skill level and will progress through the module at different rates. The following section discusses the evolution of blended learning demonstrated in this example and in the wider educational environment.

Evolution of Blended Learning and Future Issues

Maturity models have been established to plot the sequential integration of ICT in organisations. Wilson (2000) proposes a four phase maturity model for e-business, mapping a company's progress from the provision of a non-interactive web page through on-line ordering to the automation of back office processes. This represents an inversion of traditional maturity models such as Nolan (1973) which progress from back office to front office ICT applications; e-business moves from customer-focused applications to back-office (Cox, et al., 2001). The development of the module 'Introduction to Masters Level

Study' progressed through the phases of: non-interactive on-line content through to on-line exercises. The 'back office' processes of course administration, including monitoring 'attendance' and engagement in the module are also supported on-line.

The application and management of ICT in education organisations does seem to follow Nolan's (1973) stages hypothesis. For example, initially, only those committed to use ICT started to experiment with it in their classes, there were no standards, controls, management or reporting requirements (initiation stage). As the take up (and expenditure) of ICT in education increased, this was met by a surge of guidelines of how it could be used and managed in organisations (contagion stage). The proliferation of guidelines has led to the increasing need for standards and policies to manage the ICT-based portfolio (control stage). A more strategic view of ICT now needs to be adopted to align ICT with learning objectives (integration stage). In the future, controls will need to be established to assess the value of ICT based delivery and the future requirements of ICT in learning and teaching (data administration stage). As ICT becomes more established it will require greater links with the development of business and be integrated within knowledge transfer and innovation initiatives. In the same way that the 'e' of e-business has become removed to be accepted as 'business as usual' (Cox et al., 2001), the 'e' will be removed in e-learning and blended programmes will be the accepted form of delivery (maturity stage).

Further issues that need to be considered as blended learning matures include:

- The evolution of learning opportunities.

- The development of learning repositories.

- Understanding of collaborative processes.

These issues are discussed in the following sections.

Evolution of Learning Opportunities

Bottino (2004) recognises that "Technological progress is constantly opening up new opportunities… whose potential for educational purposes has yet to be fully exploited…". This was evident in the research training module reported. ICT changed the way in which the module was delivered and in turn, changed the way in which staff and students engaged in the module, making it more enjoyable focusing on the higher levels of analysis, synthesis and critical discussion.

This demonstrates Carroll's (1995) theory of the task-artefact cycle. Carroll states that "The tasks people actually engage in … and those they wish to engage in… define requirements for future technology… These artifacts, in turn, open up new possibilities for human tasks, new ways to do familiar things, entirely new kinds of things to do" Detailed analysis of how ICT can support, enhance and change teaching and learning will provide a range of directions for the evolution of learning opportunities.

Learning Repositories

As the creation of ICT based learning resources increases, duplication of effort also increases. Rising costs of investment will ensure that greater controls are imposed and that opportunities for reuse are maximised. This will require issues surrounding the creation and accessing of reusable learning objects and the creation and population of learning repositories to be addressed (Malcolm, 2005). These issues challenge cultural practices within the teaching and learning profession.

This paper has focused on education based blended courses, however, blended programmes provide perhaps the greatest opportunity as part of knowledge management and knowledge transfer programmes in the workplace. Cases reported by Tresler (2002) and Marygaryan *et al.,* (2004) demonstrate how embedding blended courses in work-based learning can be used to develop reusable learning objects and promote life-long learning. This requires teaching and learning to focus on the development of capabilities rather than competences (Phelps *et al.*, 2005); capabilities demonstrate current skills whereas capabilities promote the ability to function in the unknown.

Understanding of Collaborative Processes

It is recognised that ICT can facilitate collaboration in the learning environment but Chin & Carroll (2000) suggest that there are different kinds of collaboration in the classroom, requiring a closer examination. Aspden & Helm (2004) report that blending provides a range of opportunities to facilitate collaboration and engagement, and that its strength is in the breadth of opportunities within one environment. This breadth enables individual needs and preferences to be satisfied by enabling 'broken connections to be patched' (Aspden & Helm, 2004), for example, students who miss a class can contribute online and vice versa.

For blending to support this degree of breadth and durability, further consideration must be given to the learner's strategy (Sadler-Smith & Smith, 2004). The filtering approach proposed considers the learner's strategies initially in filter one, however, in evaluating a blend it is important to continually review the range of learning events to ensure that a range of learner's strategies can be supported.

Allen (2001) identified eight challenges of creating a technological infrastructure for e-business. These are: time to market, business fit, quality, cost savings, adaptability, scalability, consistency and integration. It is proposed that these challenges also remain for blended learning and identify the following areas where further work is needed:

Time to Market reducing the time needed to develop learning components

Business Fit: the effective application of ICT to enhance delivery of learning objectives and that meet learner needs.

Quality: ensuring that the 'company' image and reputation is maintained within the distributed environment.

Cost Savings: through the creation of reusable learning components and the effective use of people and ICT-based resources.

Adaptability: through ease of maintenance and flexibility of learning components.

Scalability: of operations through learning networks.

Consistency: of learning outcomes and delivery across mediums.

Integration: of learning components within a coherent programme.

Critical Success Factors

The following critical success factors for effective blended learning are proposed:

1. Forming the 'right blend' for the students and their learning environment.

2. Facilitating scheduled and unscheduled access to the lecturer.

3. Defining relationships between learning activities to present a smooth flowing learning experience.

4. Enabling a rich range of learning to meet diverse learning styles and learning needs.

5. Supporting flexibility to allow different students to achieve the same learning outcomes through a personalised combination of activities.

Conclusion

This paper has proposed a filtering approach to help lecturers formulate the 'right' blend for the needs of their learners. It is suggested that consideration needs to be given to the smoothness (that is the relationship between learning activities) and the richness (that is the individual learning experience) of the blend. The experience of the blending reported suggests that the perceived accessibility of the lecturer is of primary concern to the student. Opportunities for scheduled and unscheduled direct communication between the lecturer and the student need to be transparent for blended courses to be accepted. This overcomes the student's concern that blending is being offered as a cheap substitute to full attendance.

ICT can influence and transform learning. Further work is needed to understand the opportunities and challenges that ICT poses to established learning practices. The role of ICT needs to be considered within the broader context of actors and activities within the construction and transfer of knowledge. If learning is to be regarded as a strategic resource for business, then it needs to be managed strategically and aligned with business objectives. In an educational context, the rationale for deploying ICT within a learning blend must be aligned with specific learning objectives. This requires attention to be given to learning theories as well as technological components. There is a danger that ICT can be treated as a 'sweet-shop' of exciting learning events without considering its ability to effectively support learning objectives and strategies. Learning is people-centred; rather than considering the quantity and range of ICT to be incorporated, blending needs to focus on the quality of people-centred interactions.

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