A design-based research approach to an educational challenge: Developing independent learners using a blended learning environment.

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Abstract

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The transition from school to higher education in the UK has been highlighted as becoming challenging for a number of students. The contrast between the learning experience of students at school and in higher education has been seen as problematic, with supportive small group experiences at school and commonly large impersonal teaching structures at university. Upon entry to higher education, many students are perceived to have a ‘skills deficit’ in those areas important for success. These skills have been summarised in this study under the term ‘independent learning’.

This study follows a design research approach into the course re-design of an A level (university entrance) science course. A ‘traditionally’ taught course was re-designed into a blended learning environment, using an open source virtual learning environment. The course design was informed by principles from a variety of sources and underlying theoretical concepts including the Conversational Framework and the Community of Inquiry, emphasising changes in pedagogical approach above technological issues.

The research approach followed the main processes of educational design research, however rather than repeat iterations of the same course; the study was structured into developmental stages of progress towards the final blended learning environment. The study employed a mixed methods strategy, including a quantitative measure of self-regulation (MSLQ), a student course evaluation using Q methodology as well as observations, staff and student interviews and course data analysis.

The results indicated a significant improvement in self-regulated behaviours according to the MSLQ survey against a non-intervention class. In the course evaluation of the blended learning environment, the students presented into three groups with contrasting attitudes to blending learning; the ‘pragmatists, the enthusiasts and the conservatives’. The study concludes with some principles to guide the design of blended learning courses in order to encourage independent learning, implications for educational policy, and recommendations for further research. These generic design principles emphasise the value of the educational design-research approach as a realistic and effective method for reflective researchers and practitioners.

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What is already known about this topic:

- The transition from school to higher education is problematic in terms of skills and expectations.
- ICTs can support the development of independent learning skills in HE.
- TELEs have not made ‘transformative’ impacts on schools in the UK.
- There is evidence that using learning designs can help teachers make the best use of VLEs to support teaching, learning, assessment and feedback in HE.

What this project adds

- This projects takes a number of theories and ideas from HE e-learning pedagogy and applies them to the school sixth form learning environment
- There has been very little research into the impact of planned pedagogy for e-learning in school sixth forms, indeed there is little evidence of planned pedagogy for e-learning in school sixth forms.
- This project used ‘pedagogical patterns’, informed by learning theories to structure the learning experience of classes of sixth form students

Implications for practice/policy

- Teachers have collaborated in developing learning designs that use the school’s VLE to support their teaching and students’ learning.
- These design principles are available to other practitioners to use in similar contexts

(Format taken from BJET paper publication notes)

Chapter 1. Introduction

This chapter sets the scene for the thesis by introducing the context of the study and identifying the central problem to be investigated. This essential process of identifying a significant educational problem is a crucial first step in the chosen research approach. "It is the problem that creates a purpose for the research, and it is the creation and evaluation of a potential solution to this problem that will form the focus of the entire study" (Herrington et al., 2007). Having established the research problem, the chapter proceeds to contextualise the area under investigation and describe the research approach chosen. Choosing a design-research approach brings to the researcher an emerging field of research with a large range of literature sources to guide the process. One of the elements of this new field is the identification of a theoretical framework to underpin the study. Having outlined the context and research process, the chapter summarises how the thesis contributes to the field of study and makes an original contribution to knowledge. The chapter concludes with a summary of the structure of the thesis.

1.1 Exploring the context and identifying the problem

The transition from schools to higher education has been highlighted in a number of studies as becoming more problematic (Murtagh, 2010; Currant and Keenan, 2009; Crabtree et al., 2007:3; Green, 2007). Many of these issues have arisen from the education policies of past governments in attempting to widen participation in higher education. This has led to an increase in the diversity of students applying to higher education from a greater variety of educational routes. One of the issues was concern over the retention of students, particularly during the first year of studying at a university (Harvey et al., 2006). These early reports found common concerns; social and academic integration; a mismatch between student expectations and experience; lack of appropriate study skills, in particular independent learning skills. Leese (2010), uses Bourdieu's concepts of *habitus* and *cultural capital* to explain some of the problems of transition to higher education for students from 'less traditional' backgrounds. One of the biggest obstacles facing the 'new students' is the expectation that they should become 'autonomous learners' on entry to university. In her review, Leese shows how the gap between expectations of students and lecturers can be explained by the difference in *cultural capital* and how this impacts on students' access to resources and achievement in their courses (ibid).

Part of the drive to wider participation in higher education was the implementation of Curriculum 2000. This was a reform to the A level specifications aiming to increase the breadth of A level study and to create a qualification after the first year of study in the sixth form. In addition, it was planned to raise the status of vocational qualifications, enabling them to be combined with traditional academic A levels. The traditional two year A level course was replaced by six module courses, the first three becoming the new AS qualification, followed by A2 in the second year. Schools have been very successful and adaptable in responding to specification changes, hence the rapid growth in top grades and predictable howls of ‘grade inflation’ and ‘dumbing down’ from sections of the media and politicians. Since these reforms, there have been a number of reviews and changes, most notably the reduction in the number of modules at A level from six to four from 2008 and the removal of coursework from A levels except in practical and expressive subjects.

Several reviews of the impact of Curriculum 2000 have agreed that in general they have narrowed teaching and learning and reduced opportunities for independent learning (Crabtree et al., 2007; Fisher, 2007). Fisher reports that courses tend to be rushed, particularly at AS, with more didactic teaching and fewer opportunities for independent work. Some of the teachers have also built up an instrumental attitude: “*why would I waste time on anything not 100 per cent related to the syllabus?*” Head of sixth form quoted in Fisher (2007:110).

Schools and teachers have responded to the changes in specifications and assessment arrangements, and to training in new pedagogical ideas. Some of these changes have widened the gap between the experience of learners in school and higher education even further. It is clear that students’ background and prior experience heavily mould their expectations of learning in higher education. Teachers at sixth form level in schools commonly have fairly small classes; have close relationships with their students; closely monitor their work and progress, have probably been heavily influenced by educational ideas by Black and Wiliam (1998) concerning formative assessment (having posters on classroom walls extolling the virtues of assessment for learning); have established transparent assessment criteria with which to assess students; provide feedback to students on their work recognising success and guiding them to progress; encourage peer assessment through open assessment criteria. This and the increasingly open criteria that examination boards use for marking and grade awards can largely explain the improvement in A level grades. These processes have been termed 'spoon feeding' by critics.

Research from first year students at university would suggest that 'traditional' modes of teaching and assessment have changed little over a number of years (Murtagh, 2010; Green, 2007; Perry and Allard, 2003); lectures with large numbers of students; reading lists; declining small group or individual tutorials; little personal contact between lecturers and students; few formative assessment or feedback opportunities; and the assumption that lack of student success is the result of some deficit in the student.

Marriott (2007) and Green (2007), reviewing the experiences from university students and lecturers in geography and English respectively, established lists of discontinuity in the expectations of student skills that were remarkably consistent. Students and lecturers perceived the 'skills gap' to be much more important than any lack in subject knowledge. It is not surprising to note than none of these skills are part of A level marking criteria:

- essay writing
- ability to formulate, and sustain and develop an argument
- dedication and motivation
- note-taking and note making abilities
- independent learning
- wide reading

In their discussions with university lecturers, it became clear that lecturers did not seem to be aware that traditional essay writing has more or less disappeared from many A level courses. Coping with working independently without interactive support was also mentioned as very important, particularly the lack of lecturers' willingness to read drafts of coursework prior to submission (see note about formative assessment above).

As in other transitions in education, both parties tend to see the responsibility for induction residing with other. Schools contend that their efforts must be devoted to enabling students to get the highest grades possible, while universities want ready-made students eager to study from day one. There are a number of initiatives among higher education establishments working to study and ease the transition for students between school and university. One of these is STAR (Student Transition and Retention), an initiative involving the universities of Ulster, Brighton, Liverpool Hope, Manchester and Sunderland (STAR, 2012). This project has looked at issues relating to a number of stages in the process; prior to entry, induction processes, curriculum development and staff development. The project has produced a number of case studies and guidelines for all of these stages with the aim of improving support for new students and monitoring the institution itself for maintaining accessibility to new students.

The universities of Bradford and Bournemouth have developed induction resources that are made available to students before the commencement of their courses. These resources are available online as soon as a student's application has been finalised (Currant and Keenan, 2009). The projects both use on-line activities based on social networking layouts and principles, covering themes such as; developing competence and confidence, understanding skills and identifying and managing expectations. Findings were positive and students felt welcomed and engaged with the process of starting at a new institution, without extensive capital investment.

The effectiveness of generic skills courses sometimes termed 'learning to learn' courses that are part of many university's induction programmes, has been questioned by Wingate (2007). She maintains that traditional expectations towards students have not changed despite the increasing diversity in the student population. These generic courses do not fill the 'skills gap' because students will only really benefit from skills based on the understanding of the nature of knowledge in specific disciplines. One answer suggested by Wingate's framework is for universities to involve subject departments more in the development of transitional skills despite the fact that many university lecturers are unwilling to support students' learning as part their teaching (ibid: 395). Wingate suggests that in addition to the personal development of students supported by a pastoral system, subject lecturers need to explicitly demonstrate and model their discipline's process of constructing knowledge.

A second driver for the development of independent learning skills in students is the trend towards the use of technology enhanced learning environments in higher education and, more recently in schools. Despite being in the so-called 'digital native' generation, modern students find that demands of 'e-learning', however defined, and new modes of interaction between tutors and other students, are very challenging (Parkes et al., 2015). Parkes et al. who surveyed university staff and students in Australia found that students were largely ill-prepared for the challenge of new modes of learning including e-learning. In particular, students found difficulty in managing their study time, had a low level of what staff defined as ‘academic-type’ competencies, including reading and writing new types of material, lacked some basic competencies in using technology for tasks more demanding than browsing and social networking and found working with other students in collaborative tasks challenging. Similar results have been reported from other studies of first year university students, ((Ellis et al., 2013; Mitchell and Forer, 2010; Oliver, 2008; Nicol, 2006) are just a few examples.

An approach at bridging the gap is illustrated by a project where higher education colleges themselves have become involved in the teaching of modules to sixth form students before entry to university (Harnisch and Taylor-Murison, 2011). This project was one of the Higher Education Modules in Schools and Colleges (HEMiS). In this programme at Wolverhampton University, sixth form students attended lectures and practicals once a week, supported by online resources. This is an attempt to move away from the student deficiency model and move towards actively preparing students for university. Harnisch and Taylor-Murison use the paper to explore the development of a blended learning programme using the university’s virtual learning environment (VLE). In this example ‘blended learning’ is defined as “..using technologies to extend and enhance the student learning opportunities through the provision of tasks and materials which enrich, and are aligned with face-to-face learning” (ibid: 3). The aim was “..to provide electronic access to all lecturer provided content, appropriate electronic assessment feedback, collaborative learning opportunities ...., opportunities to submit assessments online .. in addition to engage in interactive learning during face-to-face sessions” (ibid: 5).   This use contrasts with the examples above where the VLE has been used for familiarisation and socialisation rather than the explicit teaching of academic modules. The results for the modules were positive, with a clear link between the graded outcomes for students and the number of formative assessments submitted via the VLE.

While this type of pilot study is a valuable exercise in school/HE linking, there is no reason why schools themselves cannot initiate this form of proactive curriculum design. The routine use of progressive learning skills development across the sixth form might alleviate many of the concerns surrounding this aspect of the transition process, including more explicit discussions of subject knowledge within school subject teaching.

The identification of the significant problem of 'independent learning' in the transition of school students to higher education and in the transition to new forms of learning increasingly involving technology has become the context of this research study. In this study, the researcher approached a number of schools with a very general outline of the issues described above. After a series of negotiations, meetings and discussions, a research relationship was formed to take the project further and the detailed definition of the problem and the resulting research questions were defined in close collaboration with the practitioners in the participating school.

Having considered the resources, assets and limitations of the incipient research team, the following research questions emerged:

Research question 1. What are the characteristics of:

a) blended learning sequences that can develop independent learning behaviours in an A level science course?
b) a TELE that will promote student engagement in the new course?
c) an educational context that encourages the effective use of educational technology?

As part of the literature search on the topic, the researcher selected an appropriate instrument to measure changes in the behaviours of students that reflected considered interpretations of aspects of independent learning or self-regulated learning, giving rise to the second research question:

Research question 2:

Do students learning from a blended learning re-design improve SRL as measured by the motivational strategies learning questionnaire (MSLQ)?

In addition to the pedagogical aims of the project, the validity and effectiveness of the research approach itself was addressed:

Research question 3:

How effective is the chosen collaborative educational design-research approach in investigating an authentic educational challenge in a living educational context?

Having identified the problem, considered the context and defined the research questions, the resulting aim for this research was to support the practitioners in developing a learning environment to support independent learning.

> "The ideal for many teachers in schools, colleges and universities is to develop such independent learners, but when the institutional focus is on passing exams, rather than on ways of thinking and practicing, the responsibility rests with the individual teacher to provide the scaffolding environment that develops independent learning" (Laurillard, 2012: 104).

The name for the learning environment was Blended Learning and Sixth-form Teaching (BLAST). Measuring student outcomes and attempting to relate these to the intervention was not part of this study.

1.2 Research strategy

Educational design research (EDR) is now regarded as the favourite approach in the field of educational technology by a growing number of commentators (McKenney and Reeves, 2012; Plomp, 2009; Barab and Squire, 2004; van den Akker, 1999; Brown, 1992), emphasising collaboration between researchers and participants and the integration of theory and practice. The chosen research strategy, educational design research involves a clear sequence of phases. The first phase involves the identification of the problem as outlined above, followed by definition of the research questions and the subsequent literature review. The second phase involves the selection of the 'lens' through which the study will operate. In this case the theoretical notions underpinning the study are the Conversational Framework (Laurillard, 2012) for the detailed design and sequence work, and the Community of Inquiry (Garrison, 2011) for an overarching view of the process. This phase also includes an initial selection of design principles from previous studies to inform the prototype intervention. The third phase, the iterative cycles of testing and refinement, is the implementation of the intervention itself, described in narrative form to provide context for the subsequent design principles. Phase four involves the reflection on the design and the production of design principles – which constitute the knowledge claims of this research approach.

1.3 Significance and original contribution of the study

Educational design research "is the systematic study of designing, developing and evaluating educational interventions .. as solutions for complex problems in educational practice, which also aims at advancing our knowledge about the characteristics of these interventions and the processes of designing and developing them" (Plomp, 2009:13).

It follows that the contributions can be described at two levels, the characteristics of the interventions, otherwise known as design principles, and the process of design, in this case the narrative of the intervention and the research process itself underpinned by the theoretical frameworks chosen.

One of the central roles of research is to contribute new knowledge to the field of study. Knowledge about 'how to do education successfully' is located in a number of places; inside the educators' heads and in their hands and habits, inside artefacts of teaching, the language and culture, real-time patterns of engagement and in the groups and communities engaged in educational activity (Wilson, 2014). Wilson describes a number of knowledge related discourse contexts; the professional discourse knowledge, closely related to context, discussing standards and suggesting ways of improving practice, academic discourse, found in refereed academic journals, pedagogy-in-action discourse Wilson describes as the talk teachers engage in with their students, intended to build knowledge in the learner, finally public discourse consisting of the discussions among non-specialists intended to debate values and political positions. Individuals will cross the boundaries of these discourses depending on the context.

Design-based research may produce knowledge for all of the audiences referred to above. From studies such as these, "knowledge is best viewed as contingent on a particular time, place and context" (ibid: 6). Knowledge contribution for this field of research has been termed 'humble', 'modest', or 'limited', theory with a small 't' aimed at furthering understanding and improving practice but not pretending to be to be a grand explanation (Wilson, 2014; Cobb et al., 2003). As such, outcomes from design-based research might usefully be judged by relevance, usability, equity and social justice, sustainability, impact and empowerment as well as traditional expectations of rigour and validity (Wilson, 2014; Reeves, 2011).

In the terms discussed above, the original contribution to knowledge of this study of a cohort of students studying a course in a secondary school is located in the following:

1. The artefact of the BLAST learning environment, containing the resources, activities and assessments of the teaching and learning designs.
2. The design principles emerging from the intervention, these are generic, heuristic principles intended to support practitioners and designers working in similar contexts. These principles are related to the educational challenge being investigated.

3. New practices and pedagogical knowledge in the context school, which were not familiar to the teachers prior to the intervention.
4. A model of co-design and collaboration between researcher and practitioners in a living educational context that provided realistic, generic design principles available to the educational community in response to an authentic educational challenge.

Individual case studies such as this rarely produce new, detailed theory. "Rather, individual studies contribute to theoretical understanding by providing scientific insights which constitute the building blocks of theory" (McKenney and Reeves, 2012: 37).

In terms of the research environment, the study has been original and significant in the following ways:

1. The BLAST project undertook an educational design research approach in a context integrating several theoretical frameworks not usually associated with the phase of education.
2. The research approach drew together practitioners, researchers and students in a joint enterprise to improve practice and develop principles to 'solve' a current, widespread educational challenge, in an original way that would be accessible to the community of teachers.
3. The practitioners' knowledge of research methods and their potential for improving practice has been significantly developed.

The evaluation of these outcomes is discussed further in Chapter 6.

1.4 Overview of the thesis

This chapter has identified the 'significant educational problem' to be investigated, described the research approach to be taken in the study and summarised the original contribution this study makes to field. The structure of the main body of the thesis is outlined below in order to assist the reader in navigating their way through the work.

Chapter 2: The literature review

The analysis of the literature informing the study defines the central concepts of independent learning and trends in the use of educational technology, as well as examining the controversial issue of the 'digital native' student. The chapter looks critically at how technology, although having a huge impact on all areas of society, has largely bypassed education. Some models are discussed as to how technology has been introduced into schools in the USA and UK. This is followed by a summary of the theoretical frameworks underpinning the study that have informed the design of the intervention.

Chapter 4: Methodology

Here, the research approach (EDR) and methods are described and justified. Since the approach is emerging and immature, it faces a number of challenges and critics. The main justification for the approach is the failure of other traditions to impact directly on practice in educational institutions. This chapter describes the process of undertaking a design-research study through a number of models of good practice. The data collection programme is described and the two quantitative methods are discussed.

Chapter 5: The intervention

The intervention itself is described here in a narrative form (Mor, 2011; Hoadley, 2002). In traditional research studies, the actual design, process and implementation is often left as a 'black box' that denies other practitioners the benefit of understanding the design process. The resulting narrative provides a selection of detailed aspects of the design and implementation of the intervention, incorporating some of the evaluative responses of students and teachers at the same time.

Chapter 6: Findings from the quantitative instruments

In the multiple and mixed data collection programme, two instruments were used to gather quantifiable information, the MSLQ to ascertain whether students had changed beliefs and attitudes regarding self-regulated learning, and the results of a Q methodology survey that asked students to evaluate aspects of the blended learning re-design of the course. The results are analysed and summarised.

Chapter 7: Discussion

This discussion relates the overall research study to aspects in the literature, answering the research questions set by the study. The outcomes of an EDR study are threefold; the intervention artefact itself, the design principles produced and the professional development of the participants. All these are described in some detail. This is followed by a discussion that looks at the case study institution in the context of educational change at a larger scale and considers possible developments. The chapter concludes with some suggestions for areas of further research.

Chapter 2. Literature Review

This chapter will locate this study within the current literature. Much of the literature will relate to the interaction/connection of learning, learning design and technology. The essential integration of technology into this study and the inevitable changing nature of technology means that by the time established sources come to publication, technology and indeed education policy may have moved on. For this reason, throughout this study, as well as established traditional publications, such as books, edited books, handbooks and the wide variety of journals relating to education and technology, there will be reference to what has become known as 'grey' literature. This is the world of 'blogs' and newspaper articles and features that although not passing the rigorous tests of the peer-reviewed article, can be a valuable window into current trends and speculation in the field. The literature review will attempt to provide a context in terms of theoretical basis and research findings relevant to this study. In order to do this, the literature review will start by defining some of the central terms of independent learning and the conceptual background used in this project.

This is followed by a discussion of the contested area of the use of technology to support teaching and learning. A brief history of technology in education is reviewed, together with a discussion of current trends in the use of 'technology enhanced' learning. The introduction of 'blended learning' models is considered and some of the developing scenarios are critically reviewed, especially in the light of changing and volatile education policy in the UK. The means of creating 'blended learning' opportunities through the use of Virtual Learning Environments is reviewed in a context of developments in the UK.

An important discussion follows regarding some of the 'myths' that have become established around the nature of today's students and teachers. The concepts of 'digital natives' and 'digital immigrants' are critically reviewed and some of the more simplistic notions of the digital divide given a more nuanced discussion. This section moves on to the more general issue of why the use of technology has not been a transformative element in teaching and learning.

Having established the complex context of independent learning, the nature of educational technology and changing educational policy, the review turns to the (somewhat more prosaic) task of discussing what it takes to design successful teaching and learning, in this case with the integration of technology. One of the key notions of this section is the use of the term ‘design’ in referring to pedagogical planning. An important part of this development is the representation of the design process and product. Two models are discussed and will be used in the intervention that is the centrepiece of this study. The literature review concludes with a consideration of two of the most important and useful theoretical models for describing, planning and explaining the process of using technology to support learning. This review is necessarily selective, there are many other valuable ideas, models and theories that will not be referred to, this section will take those ideas that seem to be the most valuable and appropriate to this study at this time.

2.1 Independent learning

This section will outline the various terms and definitions used in the context of ‘Independent Learning’. It will also explain why this concept has become important in all areas of education. It will conclude by justifying the approach taken to independent learning within this study, and how this will underpin the interventions and learning designs described.

In many schools’ prospectuses, it is likely that somewhere there is a reference to ‘independent’, ‘self-sufficient’, ‘autonomous’ learners. Schools claim they are preparing students for 21st century skills. The concept of ‘lifelong learning’ in Europe and America, has permeated academic and non-academic domains as demands for a flexible workforce increase and self-regulatory skills are in demand (Steffens, 2008). However, there is considerable controversy between research and policy in the UK and US over assessment and teaching and learning approaches. Clark (2012) argues that the emphasis on standardised testing threatens the internal states of students (e.g. confidence, self-efficacy, and interest) demanded by self-regulation of learning, undermining research evidence of the benefits of SRL through formative assessment (Nicol and Macfarlane-Dick, 2006; Black and Wiliam, 1998).

There is evidence that most schools and colleges create *dependent* students, who commonly struggle when faced with any independent task, particularly when moving on to higher education. Sources from the US and Europe refer to education structures and practices that perpetuate dependency (Meyer et al., 2008; Grow, 1991). Whole class teaching, traditional teaching methods and assessment systems create dependent students and a risk-averse teaching profession. The challenge for this study is whether an intervention based on learning designs aimed at increasing students' skills of self-regulation in a course redesign of a high stakes university entrance level examination can make a difference.

2.1.1 Definitions and processes

There are a number of different terms used to describe independent learning. The most common term, used in most of the literature cited here is 'self-regulated learning' (SRL). Other terms, including self-control, self-management etc. have been around since the 1980s (Boekaerts et al., 2000a; Zeidner et al., 2000), but the term self-regulated learning will be used in this study as synonymous with independent learning.

Although this study concerns the possible impact of technologically enhanced learning environments (TELEs), much of the original work predates the development of the widespread use of ICT in education (Mikroyannidis et al., 2012). One of the main interests of those developing theories of SRL was the apparent 'paradigm shift' in the late 1980s and 1990s in higher education to a more 'learner-centred approach'. This rise in interest in constructivist learning theories was accompanied by the development of ideas and definitions of SRL, (Clark, 2012; Boekaerts, 2002; Zimmerman, 2002; Pintrich, 2000). Central to these ideas was the notion of student control over behaviour, motivation, cognition and context in working towards a learning goal. Pintrich (2000:453), described SRL as;

> "an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate and control their cognition, motivation and behaviour, guided and constrained by their goals and the contextual features in the environment."

Zimmerman imagined three distinct and sequential phases; forethought, performance or volitional control and self-reflection (Table 2.1).

	Cyclical self-regulatory phases	
Forethought	Performance/volitional control	Self-reflection
Task analysis Goal setting Strategic planning	Self-control Self-instruction Imagery Attention focussing Task strategies	Self-judgement Self-evaluation Causal attribution
Self-motivation beliefs Self-efficacy Outcome expectations Intrinsic interest/value Goal orientation	Self-observation Self-recording Self-experimentation	Self-reaction Self-satisfaction/affect Adaptive defensive

Table 2.1 Phase structure and sub processes of self-regulation (Zimmerman, 1999:16)

Zimmerman stated that rather than self-regulation being a singular internal state, it should be "defined in terms of context specific processes that are used cyclically to achieve personal goals" (1999:34). Zimmerman's social-constructivist definition placed particular emphasis on the "socializing agents in the development of self-regulation, such as parents, teachers, coaches and peers" (ibid:34). Social support is regarded as being especially important in the early stages of self-regulation. Zimmerman described these levels as regulatory skills (Table 2.2).

Level	Name	Description
1	Observation	Vicarious induction of a skill from a proficient model
2	Emulation	Imitative performance of the general pattern or style of a model's skill with social assistance
3	Self-control	Independent display of the model's skill under structured conditions
4	Self-regulation	Adaptive use of skills across changing personal and environmental conditions

Table 2.2 Developmental Levels of Regulatory Skill (Zimmerman, 1999:29)

The levels described in Table 2.2, cover the broad progression from a dependent learner to a more independent learner. The strategies employed in this study relate directly to these ideas; observation through modelling of exemplar materials; the expectation that learners will imitate or emulate these models, and be able to differentiate content from structures; the third level, self-control is achieved when the skills inherent in the model are becoming learned and can be practiced within the context of a structure learning environment – in this case a blended or hybrid learning environment comprising face to face and online environments. Most of the research into SRL has been in the context of higher education and the final level in this model describes the later stages of higher education courses. In the context of this study, attention will be focussed on interventions that support the progress at the first three levels. In school settings certainly, the notion of self-regulation is used in a narrow sense, where students follow prescribed syllabuses and schemes of work designed by their teachers (Steffens, 2008).

Pintrich's ideas share a great deal of common ground with Zimmerman. He emphasised the importance of behaviour and monitoring, but also included motivation and goal setting (Pintrich, 2000). Pintrich described four phases of self-regulation; planning, monitoring, exercising control and reaction and reflection. He envisaged appropriate actions in each of the phases; cognition, motivation/affect, behaviour and context. Pintrich developed an instrument – Motivated Strategies for Learning Questionnaire

(MSLQ) to assess learners' use of these actions. This measure has become well used in research into this field (Svinicki, 2010; Artino, 2005).

Since Zimmerman and Pintrich's work, research into SRL has moved forward in a number of directions. Most notable of these are; measurement of SRL; linking with other theories and beliefs about learning e.g. Dweck (1999), and the search for effective interventions to encourage self-regulation in students. The issues about "what to teach, whom to teach, whether to do it within the context of a content course or as a separate, stand alone course and how to encourage students to transfer what they learned to other settings" have still not been resolved (Svinicki, 2010:79).

2.1.2 Self-Regulation and feedback

One area that has received a great deal of attention is that of feedback. Hattie (2009), in his meta-analyses of influences on student outcomes reported that effective feedback scored amongst the highest effect sizes in his survey. High effect sizes are recorded when students are given 'formative feedback', where students are given feedback on how to improve performance, and lower effect sizes where students are just praised or punished. Hattie and Temperley (2007) suggest three questions that feedback should attempt to answer: (a) Feed-up – where is the learner going? (b) Feed-back – how well is the learner progressing? and (c) Feed-forward – where to next? This structure parallels the work of Zimmerman (Zimmerman and Schunk, 2001) and Black and Wiliam (2009) see Table 2.3, among others.

	Where the learner is going	Where the learner is right now	How to get there
Teacher	1 Clarifying learning intentions and criteria for success	2 Engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding	3 Providing feedback that moves learners forward
Peer	Understanding and sharing learning intentions and criteria for success	4 Activating students as instructional resources for one another	
Learner	Understanding and sharing learning intentions and criteria for success	5 Activating students as the owners of their own learning	

Table 2.3 Aspects of formative assessment (Black and Wiliam, 2009:8)

In moving forward from their earlier work on formative assessment, Black and Wiliam (2009) linked common formative assessment activities (sharing success criteria with learners, classroom questioning, comment only marking, peer- and self-assessment) with three key processes of learning and teaching; establishing where the learners are in their learning; establishing where they are going and establishing what needs to be done to get them there. Table 2.4 identifies the links between the activities and processes and at the same time identifying key strategies for effective development.

Main activity types	Key strategies of formative assessment
Sharing success criteria with learners	Clarifying and sharing learning intentions and criteria for success
Classroom questioning	Engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding
Comment-only marking	Providing feedback that moves learners forward
Peer- and self- assessment	Activating students as instructional resources for one another
(Formative use of summative tests)	Activating students as the owners of their own learning

Table 2.4 (Possible) links between types of activity developed in normal classroom work, and the formalised key strategies (Black and Wiliam, 2009)

There is considerable common ground between writers concentrating on SRL, formative assessment and activities and strategies that affect student outcomes. Nicol and Macfarlane-Dick (2006), developed a model of self-regulated learning that had formative feedback at the centre of the process (Butler and Winne, 1995). The basic ideas are consistent with the work of Black and Wiliam, Zimmerman and Pintrich, where “self-regulation is manifested in the active monitoring and regulation of a number of processes, e.g. the setting of, and orientation towards, learning goals; the management of resources; the effort exerted; reactions to external feedback; the products produced” (Nicol and Macfarlane-Dick, 2006:199).

Nicol and Macfarlane-Dick (2006), claimed to have identified a gap in the research literature concerning how to enhance feedback in support of self-regulation by proposing seven (later expanded to twelve (Nicol, 2009)) principles of good feedback practice in order to improve SRL in students. As previously mentioned, the increased interest in teaching and learning within higher education and the move towards the active involvement of students with their learning away from a purely transmissive mode of instruction has led to further research into formative assessment and feedback.

Nicol and Macfarlane-Dick (2006), in their study of higher education in the UK, identified four problems with traditional transmissive feedback messages; firstly, seeing feedback as just a one-way communication from the teacher does little to develop self-regulatory skills; secondly, feedback messages without opportunities for discussion and action can often be misunderstood or ignored; thirdly, the interaction between the mode of feedback with motivation has been shown to influence students' self-belief and attitude to learning (Black and Wiliam, 2009; Dweck, 1999); and lastly, the increase in numbers of students and class sizes in higher education has meant that new approaches to feedback are required. These aspects mirror the importance of the shared responsibility for SRL between teacher and learners illustrated in Table 2.4.

Both Hattie and Timperley (2007) and Nicol and Macfarlane-Dick (2006), in their quest for practical strategies to encourage independent learning in students, cite Butler and Winne's (1995) model that defined feedback as an inherent catalyst to self-regulated activities.

The basic model (Figure 2.1) follows a task set by the teacher (1). This sets in motion a series of self-regulatory processes required by the student. In order to complete the task, the student must engage with the task (2), construct task goals of his own (3), decide on the strategies (4) to produce the outcomes, both internal (5) and external (6), this could be an essay, presentation or report. The model differentiates between internal feedback generated from progress towards the identified goals, and external feedback (7) provided by the teacher, peer-assessment, computer, etc. A common idea noted by all the writers cited so far emphasises the importance of the students' engagement and congruence with the goals and feedback, which have to be understood, and internalised by the student if progress is to be made, consistent with elements of the Conversational Framework discussed later.

A considerable amount of work has been done on the effects of feedback in the secondary school sector (Black and Wiliam, 2009; Hattie, 2009; Hattie and Timperley, 2007; Black and Wiliam, 1998), showing that high quality feedback can improve student outcomes. What Nicol and Macfarlane-Dick (2006) add to this is the beginning of a set of principles of good feedback practice to facilitate self-regulation. These principles intervene at those critical moments identified in the model (Figure 2.1).

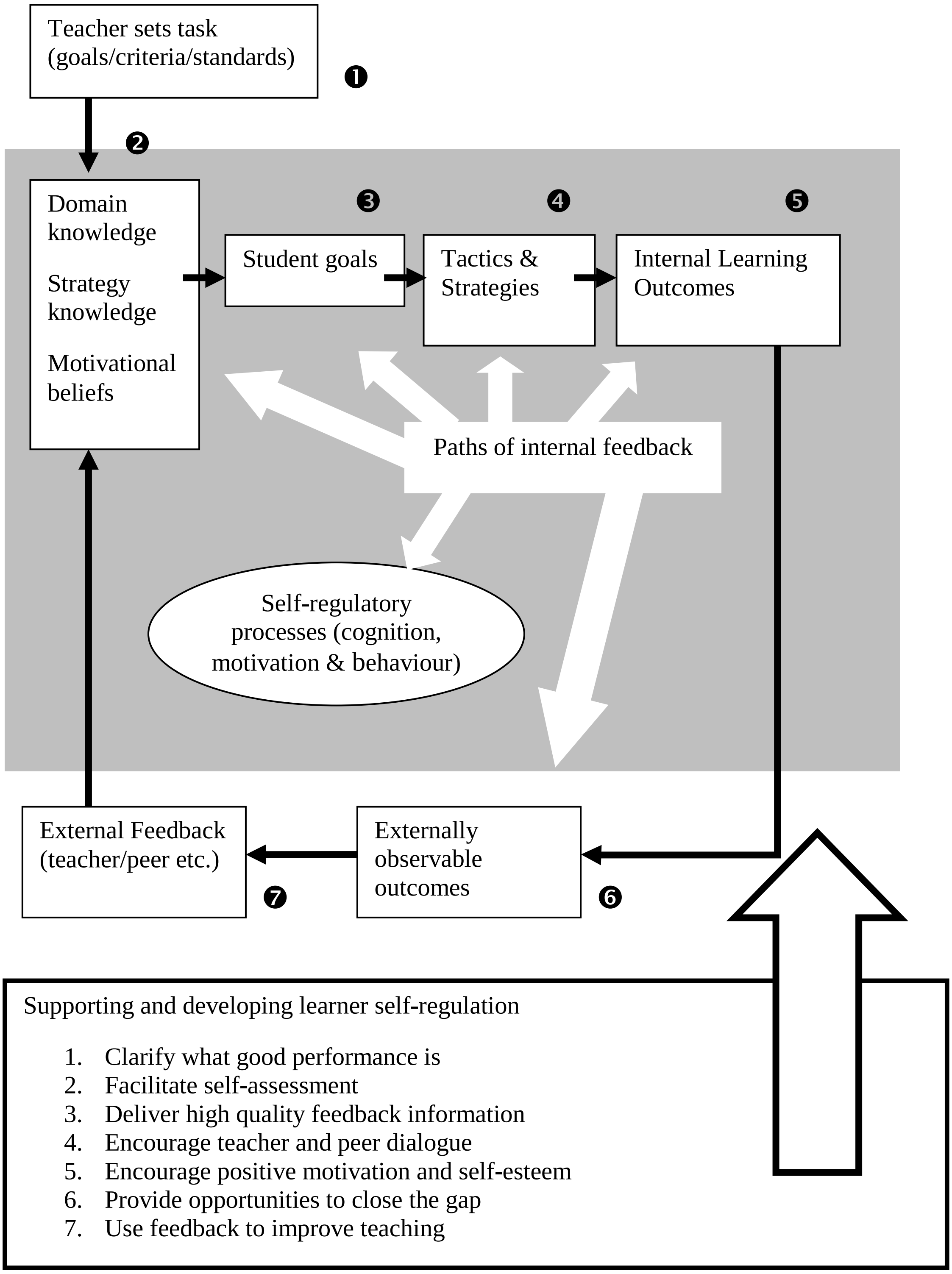


Figure 2.1 A model of self-regulated learning and the feedback principles that support and develop self-regulation in students (Nicol and Macfarlane-Dick, 2006:203)

In a later report, concerned with improving the learning experiences of first year university students, Nicol (2009) further developed the principles into a 'framework for engagement' of students, involving twelve principles.

Good assessment and feedback practice should:

1. *Help to clarify what good performance is (goals, criteria, standards)
   To what extent do students on your course have opportunities to engage actively with goals, criteria and standards before, during and after an assessment task?
2. *Encourage 'time and effort' on challenging learning tasks
   To what extent do your assessment tasks encourage regular study in and out of class and deep rather than surface learning?
3. *Deliver high-quality feedback information that helps learners to self-correct
   What kind of teacher feedback do you provide, and in what ways does it help students to self-assess and self-correct?
4. *Provide opportunities to act on feedback (to close any gap between current and desired performance)
   To what extent is feedback attended to and acted upon by students in your course and, if so, in what ways?
5. Ensure that summative assessment has a positive impact on learning
   To what extent are your summative and formative assessments aligned and supportive of the development of valued qualities, skills and understanding?
6. *Encourage interaction and dialogue around learning (peer and teacher-student)
   What opportunities are there for feedback dialogue (peer and/or tutor-student) around assessment tasks in your course?
7. *Facilitate the development of self-assessment and reflection in learning
   To what extent are there formal opportunities for reflection, self-assessment or peer assessment in your course?
8. Give choice in the topic, method, criteria, weighting or timing of assessments
   To what extent do students have choices in the topics, methods, criteria, weighting and/or timing of learning and assessment tasks in your course?
9. Involve students in decision-making about assessment policy and practice
   To what extent are students in your course kept informed or engaged in consultations regarding assessment policy decisions?
10. *Support the development of learning groups and communities
    To what extent do your assessment and feedback processes help to encourage social bonding and the development of learning communities?
11. *Encourage positive motivational beliefs and self-esteem
    To what extent do your assessment and feedback processes enhance your students' motivation to learn and be successful?
12. *Provide information to teachers that can be used to help shape their teaching
    To what extent do your assessment and feedback processes inform and shape your teaching?

Figure 2.2 Principles of good formative assessment and feedback and questions teachers might ask about their current practice (Nicol, 2009:5)

Those principles marked in Figure 2.2 with an asterisk have been deemed most appropriate for this study when designing the tasks and support for sixth form students following an A level course in Biology. Items 5, 8 and 9, while being suitable at higher education level relate to matters of assessment policy that are mostly set by external examination boards. This is described by Steffens and Underwood as being part of the definition of SRL in a wide or narrow sense. In the wider sense students could be said to be self-regulating their learning if they can choose what, when and where to learn. However, in the context of this study, the term applies to situations where students have to follow a course of study and self-regulation refers to how the student responds to the learning process (Steffens and Underwood, 2008).

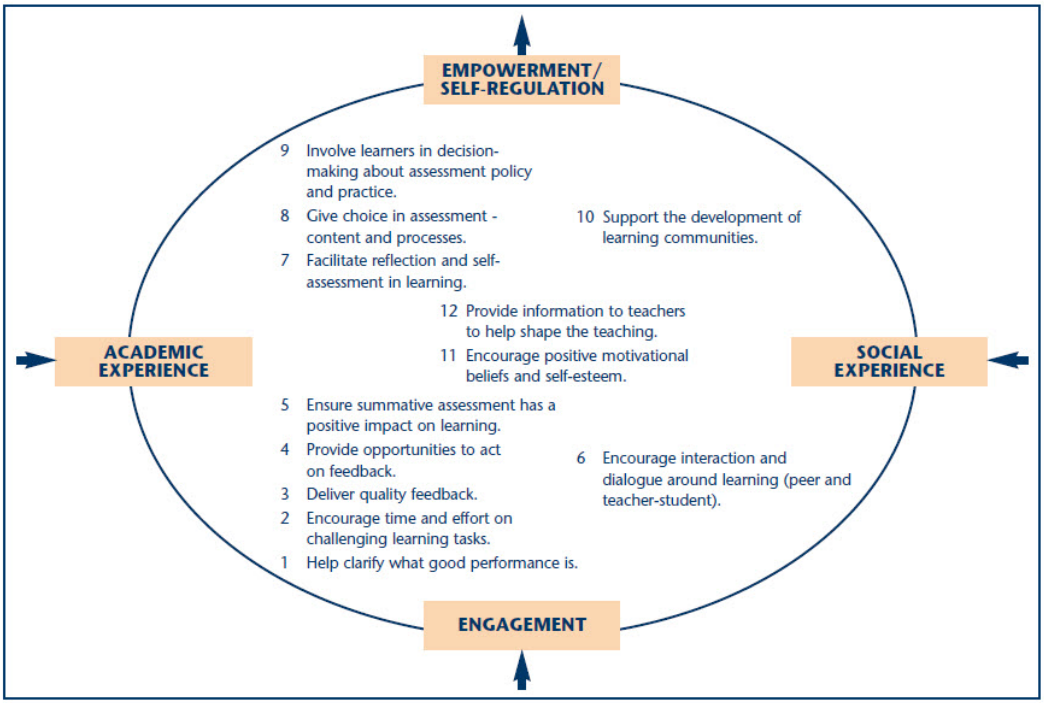


Figure 2.3 Assessment principles and dimensions of implementation (Nicol, 2009:21)

In Figure 2.3, Nicol (2009) has organised the feedback principles into two dimensions, the vertical engagement – empowerment/self-regulation dimension and the horizontal academic-social dimension. The vertical axis reflects the extent to which students might be given opportunities for more independent learning by moving from the lower to the upper reaches of the axis. The horizontal dimension describes the extent to which the academic and social experiences combine to support the students' learning experiences. In this case the arrows point towards each other as both are exerting influences at the same time.

While Nicol was documenting principles to help transform the assessment and feedback experiences of students in the first year of study at colleges of higher education in the UK, the transition from GCSE to A level study at secondary school could be seen to mirror certain aspects of this shift, certainly in terms of academic expectation, if not in social and cultural upheaval. As a result, this analysis is relevant to the design of courses and experiences of students who are not very different in age.

The model in Figure 2.3 is further broken down by Nicol into four quadrants, representing different stages in the progression of the courses designed for students. The most important quadrant is the lower-left or ‘academic engagement’ section, which he regards as being critical to student success in the first year of study. Nicol suggests:

- A number of small learning tasks that engage students regularly in learning activities.
- Tasks should be sequenced progressively to challenge students.
- Teachers should use formative assessment and frequent feedback to enable students to understand what good performance is.

The lower right quadrant links academic and social engagement through the development of learning tasks that support dialogue between teachers and students and students with each other. These ideas are consistent with the many papers on formative assessment in all phases of education (Black et al., 2007; Nicol and Macfarlane-Dick, 2006; Chickering and Gamson, 1999), emphasising the importance of dialogue between actors in the education process.

The upper two quadrants in the diagram relate to empowering students to have a much more participatory role in their learning. While some of the ideas about students choosing topics, assessments, and learning activities are clearly beyond the scope of a study concerning A level students, there are opportunities to be developed in self- and peer- assessment.

All of the above principles or ‘design principles’, are what Laurillard has termed “abstractions of good practice, distilled for the purpose of enabling generic support for the design process” (2011b:88). According to Laurillard, research literature abounds with such principles of good practice, mostly coming from empirical work. However, the generic nature of these principles can be too abstracted for teachers to apply to their specific cases. Laurillard (ibid:89) cites the ‘seven principles’ of Nicol and MacFarlane-Dick’s (2006) design principles that support student self-regulation as well as Chickering and Gamson’s (1987) ‘seven principles for good practice in education’ as examples of widely quoted and accepted, but “would be easy for most teachers to sign up to without changing anything in their practice, and yet quite hard to turn into reliably effective teaching” (Laurillard and Ljubojevic, 2011b:89).

To be fair to Nicol, in his extensive report on *Transforming assessment and feedback in the first year*, (2009a) he does develop each of his principles with support from the literature and gives examples of how they might be applied in first year modules. A number of these ideas will be developed in the intervention described later in this study.

Laurillard's point above is, however relevant to the main focus of this study. She asks "is there a more detailed representation of the pedagogy ... that would assist with designing and evaluating the quality of a learning design?" (2011b:89). Her proposed solution, based on the development of pedagogical patterns and her Conversation Framework (Laurillard, 2002), will become a cornerstone in the design and evaluation of teaching activities in the proposed intervention based on some of the design principles mentioned above.

The background to the Conversation Framework and how pedagogical patterns are created using it are discussed in a later section.

2.2 Use of technology to support teaching and learning

This section will discuss briefly the nature of some previous technological innovations and the impact that those technologies have had on education. By looking at an historical overview, a long term perspective can be observed as well as any significant impacts over a long period of time. As technology is developing so quickly, it is useful to examine some of the common strands in the promotion, introduction and impact of past innovations (Selwyn, 2011c). The section will also consider what it is about digital technology that some people think will make a difference this time, and how this might come about.

One of the common strands is the evidently exaggerated expectations for new technological innovations, reported by a number of commentators:

> "Education is on the brink of being transformed through learning technologies; however, it has been on that brink for some decades now." (Laurillard, 2008b:1)

> "Throughout the history of education, the adoption of instructional programs and practices has been driven more by ideology, faddism, politics, and marketing than by evidence." (Slavin, 2008a:5)

A number of writers have identified cycles of innovation that always seem to end in disenchantment. This paper by Mayes is cited by numerous writers on the subject of technological innovation (Oliver, 2014; Selwyn, 2011c; Oliver, 2009);

"In the film 'Groundhog Day', the protagonist is forced to experience the events of a single day over and over again. He is free to act in any way he chooses, but whatever he does the day always finishes in the same way. ... People who have been involved over any time with educational technology will recognise this experience, which seems characterised by a cyclical failure to learn from the past. We are frequently excited by the promise of a revolution in education, through the implementation of technology. We have technology today, and tomorrow we confidently expect to see the widespread effects of its implementation. Yet curiously, tomorrow never comes." (Mayes, 1995)

This cycle has been formalised by an American information technology research and advisory company, Gartner, Inc (www.gartner.com). It publishes trends in the 'visibility' of technological innovations in the education sector. The publications go by the name 'Hype Cycle' where innovations are 'trended' going through stages of; innovation trigger, peak of inflated expectations, trough of disillusionment, slope of enlightenment until a mature technology reaches the plateau of productivity (see Figure 2.4)

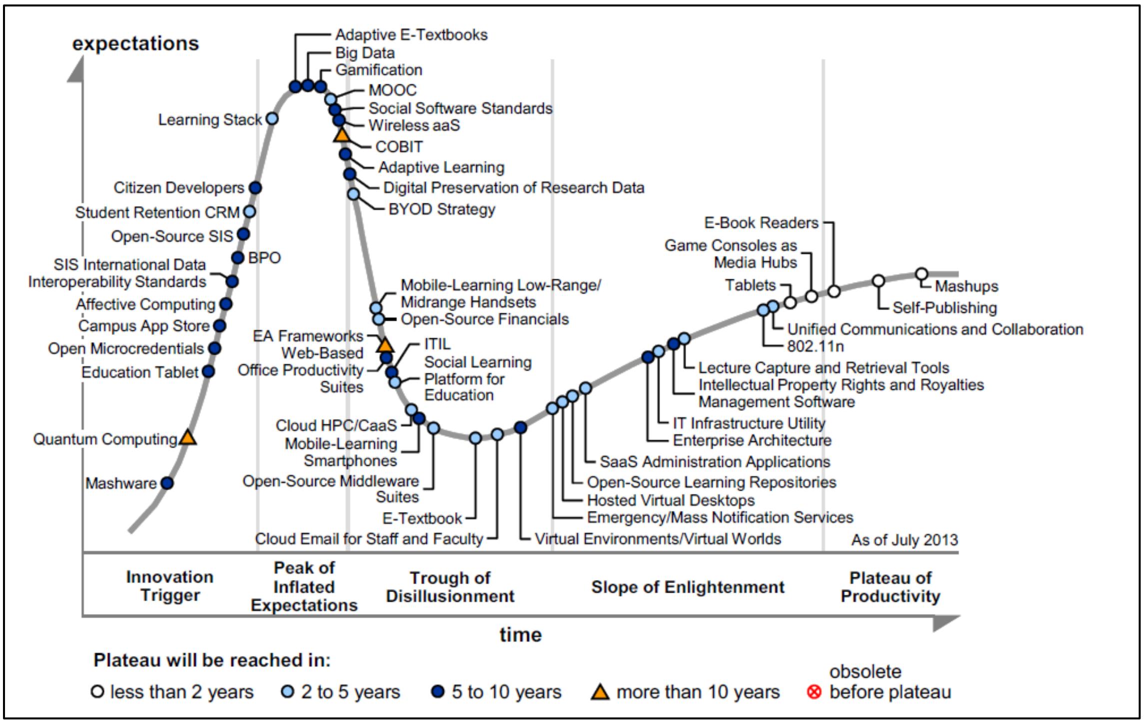


Figure 2.4 The Gartner Hype Cycle for Education (Gartner Inc, 2013)

While the approach is aimed mainly at the educational technology industry, it shows what types of innovation may be seen in the future.

Selwyn (2011c), discusses the links between developments in technology and education in the twentieth century – a century of rapid technological development, referring to educational film, radio, television and the emerging digital technology. Most of the evidence of the use (or non-use) of these technologies come from the United States where the government, individual states and commercial firms and philanthropists, persuaded by the innovators, introduced large scale implementations. One of the foremost critical commentators of the relationship between technology and education has been Cuban, who in his famous book, *Teachers and Machines: The Classroom Use of Technology since 1920*, documented the 'progress' of technology (Cuban, 1986). In each of the technologies Cuban mentions, a similar process emerged: initial enthusiasm for a transformational technology; investment in equipment and accommodation; commissioned content and training for teachers to use this modern and progressive new teaching resource. Without exception, after a few years, as studies were commissioned and evidence emerged, use was found to be lower than expected and impact quite minimal. The failure of mainstream media to transform education as it had entertainment and other domains remained puzzling. Cuban identified the most common reasons for this lack of use and impact as cost, poor quality training, equipment difficult to operate and lack of appropriate content (ibid).

Despite evidence from Cuban (1986) from the USA and Selwyn (2011c) television seemed to be the one technology that did provide evidence of use and impact at least in the UK. As the technology developed and standardised recording media became available, the use of television in schools rapidly increased both in the US and the UK. This was probably due to the new ease of recording (albeit analogue) mainstream dramas, documentaries, etc. in addition to high quality programmes specifically made for schools by the BBC and commercial channels. Indeed, this researcher in the 1980s worked in a fairly typical secondary school where a resource technician was employed to record, edit, and classify into a retrieval system, a huge library of school and mainstream broadcasts, which could be booked out by teachers to show in their classrooms as part of structured schemes of work and activities.

The growth of digital technologies started another round of so-called transformative or 'paradigm-changing' expectations, many developing previous innovations to a new and more convenient age; black- and white-boards to interactive boards; radio programmes broadcast at certain times to podcasts, analogue video to digital video etc. Conole (2014), has created an e-learning timeline, showing the major technological developments that have impacted on education in the past thirty or so years (Figure 2.5).

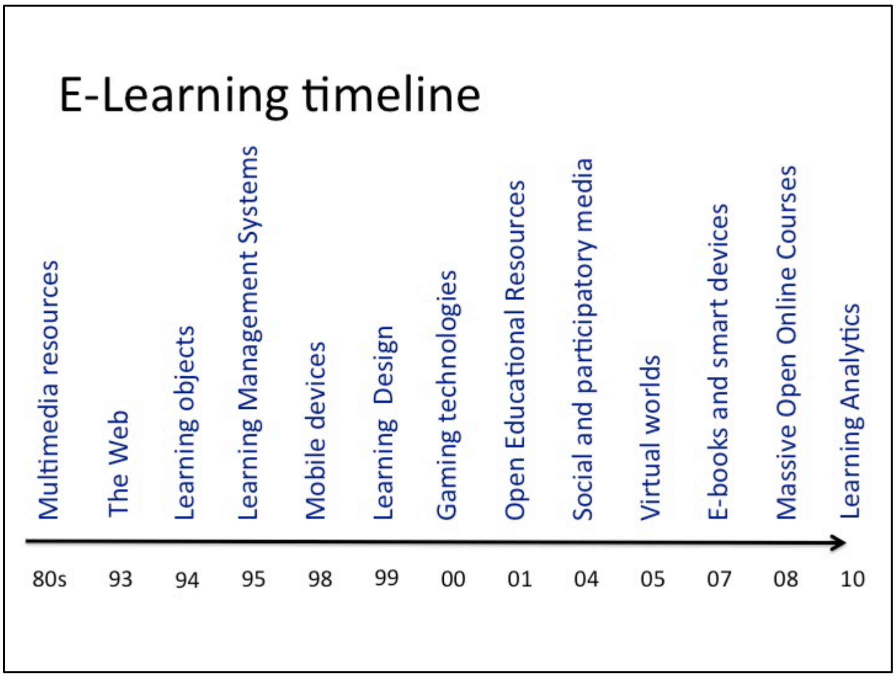


Figure 2.5 E-learning timeline (Conole, 2014:3)

According to Conole, the notion of multimedia authoring tools was one of the most significant developments for education. These tools were able to combine media elements; text, images, sound and video and (initially) combine them onto CDRoms, and then onto the web. The Internet and the World Wide Web enabled these multimedia resources to be put online once access and internet speeds became acceptable. This is where the word 'transform' started to appear in many educational journals and books, mostly in relation to higher education (Conole, 2014; Conole, 2013; Laurillard, 2008b; Littlejohn and Pegler, 2007).

Conole regards 'learning objects' as another significant step in the future design of e-learning, where stand-alone resources, etc. could be used and re-used in different courses or different institutions, where academics could create collaborative 'objects' for use in a variety of places (Littlejohn, 2003). This was to become an element of Virtual Learning Environments where these objects could be organised. Commercial production and copyright issues have, however slowed this possibility.

As far as this study is concerned, the most significant developments in Conole's analysis are the developments of the Learning Management Systems (LMS), later to become known as Virtual Learning Environments (VLE) and Learning Design, although the use of mobile devices and social and participatory media will also be considered.

Although, according to Conole's timeline, the development of LMS started in around 1995; it was not really until 2003 that easy to use Open Source products came to be available to teachers and non-specialists, e.g. Moodle developed in 2003 (Moodle.org). This was the VLE used in this study.

The reasons that digital technology is so attractive to many educationists and policy-makers are that it can be used to support a myriad of philosophies and ideologies. Both Selwyn (2011c) and Laurillard (2008b) describe how technology can be used to support these different theories. Despite the changes in technology, and the hyperbole surrounding new innovations, there is a growing belief by some that rather than technology creating new forms of pedagogy, the basic tenets of learning and teaching remain, and are necessary to ensure that pedagogy exploits and challenges technology:

> "Fortunately, we can turn to the traditions of learning theory to help with this. Amid the constant change of technology and its radical effects on the nature of learning and teaching, one thing does not change: what it takes to learn; especially what it takes to learn in the context of formal education." (Laurillard, 2009:7)

Traditional behaviourist theories were the earliest theories to develop the technology (Skinner, 1958), through 'operant conditioning' and 'programmed instruction', sometimes known as 'drill-and-practice' software. As will be discussed later, some of these ideas are becoming fashionable again. Skinner (ibid) was particularly critical of conventional classroom practice, where there was usually a substantial delay between instruction, assessment and feedback. In the 1990s computer-assisted learning, or integrated learning systems (ILS) became popular to support literacy and numeracy as computers became more sophisticated. In one of the few analyses of these methods, the University of Auckland noted; "the effectiveness of computer assisted learning has not been conclusively demonstrated... it has been shown to be less effective, on average, than other forms of intervention" (Parr and Fung, 2000:v). This or phrases similar to 'no significant difference' was to become a familiar conclusion to research into the impacts of novel technologies.

Cognitivist theories concentrate on the process of learning, rather than the measurement of observable outcomes of the behaviourists. Their ideas have been applied to the use of educational technologies through the development of 'intelligent systems' that attempt to 'mimic' human thinking. This has led to the development of 'intelligent learning environments' and simulations used in some work based environments (Selwyn, 2011c).

Laurillard (2009), includes 'instructionism' based on the use of structuring the process through highly organised presentations, multiple choice tests and feedback, which lead to appropriate further presentations.

During the 1980s and 1990s, the social aspects of learning were coming more to the fore;

> "Constructivist theories - not least the work of Piaget and his followers – describe learning as taking place best when it is problem-based and built on the learner's previous experience and knowledge. ...Constructivist theories therefore portray learning as much more active than in behaviourist or cognitivist accounts". (Selwyn, 2011c:73)

Jonassen (1999), did not regard objectivism (the assumption that knowledge can be transferred from teachers and acquired by learners), and constructivism (knowledge cannot be transmitted, but constructed through experience) to be incompatible, but difference perspectives on the learning process,

> ".. I prefer to think of them as complementary design tools (some of the best environments use combinations of methods) to be applied in different contexts." (ibid:10)

In spite of being written before the development of widespread digital communication technologies, Jonassen's model for designing constructionist learning environments reflect very contemporary design principles. These include; emphasising real-world settings, problem solving authentic tasks, the construction of knowledge through shared experience and collaboration and encouraging reflection.

Jonassen's suggestions for instructional activities to support learning environments mirror some of the ideas discussed previously (section 2.2) on encouraging independent learning, in particular, modelling performance, coaching, and scaffolding, a systematic approach to supporting students using the emerging digital tools.

Moving even further towards the view that learning is a social phenomenon, 'socio-cultural' theories emphasise the view that learning is mediated through the learner's culture. Much of this work is based on the ideas of Vygotsky, who considered learning and cognitive development to be closely linked to speech, language and social interaction (Vygotsky, 1962). Of particular note is his concept of the 'zone of proximal development' where difficult concepts could be learned with the aid of more knowledgeable others, whose support can be gradually withdrawn. This process is known as scaffolding. This concept has been developed into a more 'horizontal' or peer learning as students are encouraged to create their own explanations (Chi et al., 1994).

New digital technologies and networks can support these ideas in ways that their protagonists could not imagine. 'Collaborative learning' is now almost exclusively applied to the digital world, where discussion forums, wikis, blogs and social networking sites can give learners access to knowledge far beyond their immediate environment.

Each of the learning theories outlined above, focuses on different aspects of learning and as Laurillard states:

> ".. they generate different conventional teaching methods, and therefore different uses of digital technologies. However, none denies the importance of the others."
> (Laurillard, 2012:8)

The growth of digital technology and its use in education has generated a huge amount of interest and expectation. As in all things new, there is often contention and conflict over definitions. This new technology is referred to in different places in different ways. Including the word 'technology' infers the emphasis is on the technical infrastructure, the computers and applications, that can be used to find, share and manipulate information. This technology has now spread from desktop and laptop computers to tablets, games consoles and mobile devices previously known as 'telephones'.

When applied to its use in education, the term e-learning became widespread with the developments in the Internet in the 1990s. According to Garrison (2011:2), "E-learning is formally defined as electronically mediated asynchronous and synchronous communication for the purpose of constructing and confirming knowledge." In his book, *E-Learning in the 21st Century*, Garrison puts forward a 'collaborative constructivist' view of teaching and learning (ibid). In Garrison's view, e-learning can take two forms, online and blended learning. Online learning is a development of long-established distance learning, while blended learning is "the thoughtful fusion of face-to-face and online learning experiences" (Garrison and Vaughan, 2008:5), a mode of teaching and learning that will be discussed in detail in a later section.

Kirkwood and Price (2013), contend that 'technology-enhanced-learning' (TEL) has become the more modern term for educational use of technology, subsuming e-learning, although still finding it difficult to produce a definition. The trend in terminology from 'digital technology' as a descriptive term, to e-learning, with its emphasis on learning to 'technology-enhanced-learning' with its explicit assumption of 'better' or 'improved' learning has again become contentious. What has been improved?

> "Increasing technology use?
>
> Improving the environment in which educational activities are taking place?
>
> Improving teaching practices?
>
> Improving (quantitatively and/or qualitatively) student outcomes?" (Kirkwood and Price, 2013:2)

Changing the technology of learning and teaching cannot by itself improve any of the above (Laurillard, 2012; Selwyn, 2011c; Selwyn, 2011a; Garrison, 2011). One of the points of agreement is that one of the reasons for the 'no significant difference' outcomes of comparative studies between traditional and TEL environments is that, in the main, pedagogy has remained the same.

> "Why would we expect to find significant differences if we do essentially the same thing we have always done except change the medium of communication?" (Garrison, 2011:5)

While much of the literature referred to in this study is from research into the higher education sector, a great deal of this research is relevant, because of the general nature of educational technology and in the age group of the students in this study (17-18 years old). Selwyn's *Schools and Schooling in the Digital Age,* (2011b) is one of the few established references specifically to cover schools and digital technology in the UK. He describes the differences in the context where digital technologies intersect with compulsory schooling relating to regulation, control, power and the assessment structure in schools today, describing how the focus of study has shifted from the 'sociology of schools' literature in the 1970s and 80s, to studies where 'school effectiveness' and 'impacts' of innovations are prevalent today. Selwyn emphasises the issue that the changes in education and technology should be seen in the context of prevailing political and economic environments:

> “.. the rapid rise to prominence of the digital in contemporary education can be seen as part of a broader set of recent phenomena, not least the rise of a restructured free-market capitalism that lies at the heart of much - possible all - contemporary societal change. It follows that anyone seeking to make sense of contemporary educational change pays close attention to these issues.” (Selwyn, 2011b:6)

Many research papers confine themselves to looking at the impact of particular applications or interventions without considering the wider context (Selwyn, 2014; Selwyn, 2012).

A number of writers think that there is something sufficiently different about digital technologies that will enable education to break out of the ‘Groundhog Day’ cycle. A selection of ideas is presented below. Conole (2014), notes a variety of benefits; administration efficiency; dissemination of teaching and learning materials; the improvement of ICT skills; accessing a wide variety of information from around the world; sources of good practice and opportunities for collaboration.

Laurillard (2008b), asked “So what can the technology do for us? Rather than the more typical question ‘what can we use the technology for?’” (ibid:8). She identified issues of personalisation, the opportunity for students of all ages to receive some individualised attention; flexibility, where students could choose when and where to study; inclusion, for those with disability or disaffection and productivity, where technology can achieve economies of scale.

On a more practical level, many educational institutions of higher education have started to evaluate what new technologies can do for them. For example Edinburgh Napier University’s *Benchmark for the use of technology in modules,* (Smyth et al., 2011) envisages:

- Freeing up time for face to face contact
- Allowing students to study at time which are most conducive to their learning
- Provide opportunities for self-testing to reinforce factual knowledge
- Facilitate the collection of and feedback on assignments
- Encourage peer support and greater participation from all students
- Enable effective learning within and across different groups of learners, in learning from guest experts, and engaging with relevant professional groups.

The main difference in the potential of digital technologies identified by most of the current educational technology commentators is that previous technological innovations only really supported (albeit more efficiently), the delivery of learning materials. From text books, to television to the Internet (Web 1.0), the student is still a passive recipient of (even more) knowledge content. In itself this is not transformational. The development of what has become known as Web 2.0, where users can easily create and upload opinions and information, share this knowledge and collaborate with others to create new information, has the potential for the transformation. “The current passive information transfer approaches of higher education are contrasted with the interactive and constructivist potential of e-learning” (Garrison, 2011:4). In revisiting his ‘Groundhog Day’ article, Mayes (2007), thinks this may be the catalyst to break out of the cycle.

> “More recently we have generally come to accept that delivery of content is only .. a minor part of the important role learning technology can play in supporting learners. Such delivery systems [previous passive] support only one of the three stages I discussed then [1995], conceptualisation (engaging with new concepts), construction (internalising the concepts by using them in learning tasks) and dialogue (refining understanding through discussion, feedback and reflection. Only technology that supports all stages of the learning cycle can stand a chance of being transformational, by helping to embed a genuinely learner-centred and constructivist pedagogy”. (ibid:2)

Although there now seems to be a consensus around the need to change pedagogy to release the transformative potential of digital technologies, the trend is to see the constructivist movement as the way forward,

> “Current discussions of education and technology are based around assumptions that worthwhile learning should be active, learner-centred, social, communal, authentic, and so on ... it is important to acknowledge that such characteristics involve a commitment to a particular set of values. Moreover, it is important that these values are often at odds with the nature of the educational settings.. that learning takes place in”. (Selwyn, 2011c:60)

To support this direction, a number of reports and guidance documents have been published. In the UK as mentioned above, the various BECTA reports generally supported a move away from ‘traditional’ didactic teaching towards the more ‘learner-centred’ approaches that would enable the use of more technology (much to the ire of some of the main-stream media and the right of centre think-tank Civitas, (BBC, 2014)).

Another source of best practice principles is available from a wiki based at Staffordshire University that models a number of delivery patterns and examples of e-learning based on a variety of pedagogic choices (Walmsley, 2011).

From the USA, a number of institutions and commercial enterprises have published specific guidance as to how pedagogy could be structured to make the best use of digital technology. California State University, as part of its strategy to create high quality learning environments developed a rubric that could be used as a course self-evaluation tool, a guide to design a new course and a means for getting recognition for exemplary instruction. The fairly simple rubric, offers statements in a number of categories:

- Learner support & resources
- Online Organisation & Design
- Instructional design and delivery
- Assessment & evaluation of student learning
- Innovative teaching with technology
- Faculty use of feedback

under the headings 'Baseline', 'Effective' and 'Exemplary' (Chico, 2010).

Another example is that of Quality Matters, a quality assurance organisation that offers guidance through rubrics for higher education and K12 (secondary schooling), professional development workshops for school leaders and staff and extensive literature reviews of current educational research (Quality Matters, 2012). The system has generated a number of research articles (Shattuck et al., 2014; Shattuck, 2013; Bogle et al., 2009), as well as providing a context for other comparative research, for example (Swan et al., 2012). The K12 Secondary Rubric has nine standards, applicable to either online or blended courses, each with detailed annotation:

- The overall design of the course is made clear to the student at the beginning of the course
- Learning objectives are measureable and are clearly stated
- Assessment strategies are designed to evaluate student progress
- Instructional materials are authoritative, up-to-date and appropriate
- Forms of interaction incorporated in the course motivate students and promote learning
- Course navigation features and the technology employed in the course foster student engagement
- The course facilitates student access to institutional services
- The course demonstrates a commitment to accessibility for all students
- Optional compliance standard

While the rubric is based on instructional design principles, "it only addresses course design, from, it should be noted, an objectives-based perspective, ... The QM framework does not address course implementation or learning" (Swan et al., 2012:82). Swan's study using the Community of Inquiry (Garrison, 2011; Garrison et al., 2000), a collaborative constructivist approach (see later section), concluded that these two popular frameworks can be used together to improve course design and learning outcomes.

Nesta (National Endowment for Science Technology and Arts), was set up as a public body in 1998 to promote creativity and innovation (www.nesta.org.uk). In 2010 the incoming coalition government concluded that the organisation's activities were better suited to the voluntary sector, and in 2012 Nesta became an independent charity focussing on innovation, in a number of areas including education. Since then a number of reports and original research studies have been published with particular reference to technology and education. The first of these: *Decoding Learning: The proof, promise, and potential of digital education*, set out to review the evidence on technological innovation in education (Luckin et al., 2012). As with the literature referred to above, there was some evidence of technology improving learning, but that existing technologies are often underused, and that the potential would only be realised through innovative teaching practices. The report concluded that policy makers have:

> ".. made two errors. Collectively, they have put the **technology above teaching** and **excitement above evidence** [author's emphasis]. The means they have spent more time, effort and money looking to find the digital silver bullet that will transform learning than they have into evolving teaching practice to make the most of the technology". (ibid:63)

Michael Fullan – renowned 'guru' of educational management and change – followed up the above report by creating an index (or rubric) as a way of assessing digital innovation in learning (Fullan and Donnelly, 2013), based on his short book; *Stratosphere: Integrating Technology, Pedagogy, and Change Knowledge* (Fullan, 2013). Fullan likens the present state of digital technology and education to a 'swamp' where the 'push' of disaffected students and alienated teachers, together with the 'pull' of digital innovations has led to an "exciting, but undisciplined explosion" (Fullan and Donnelly, 2013:8). Pedagogy is bypassed in this 'swamp' because of its weak development, resulting in the lack of impact of digital innovations on student learning.

> "In thinking about how to reverse this situation, a simpler approach might be more helpful, one that is quite close to the strategising that will be required. There need to be policies and strategies that will simultaneously i) conceptualise and operationalise the new pedagogy; ii) assess the quality and usability of specific digital innovations; and iii) promote systemness. In other words, we considered what might be necessary

in order for technology to go to scale and to produce systemic change". (Fullan and Donnelly, 2013:12)

The result is the index; a summary appears in Figure 2.6.

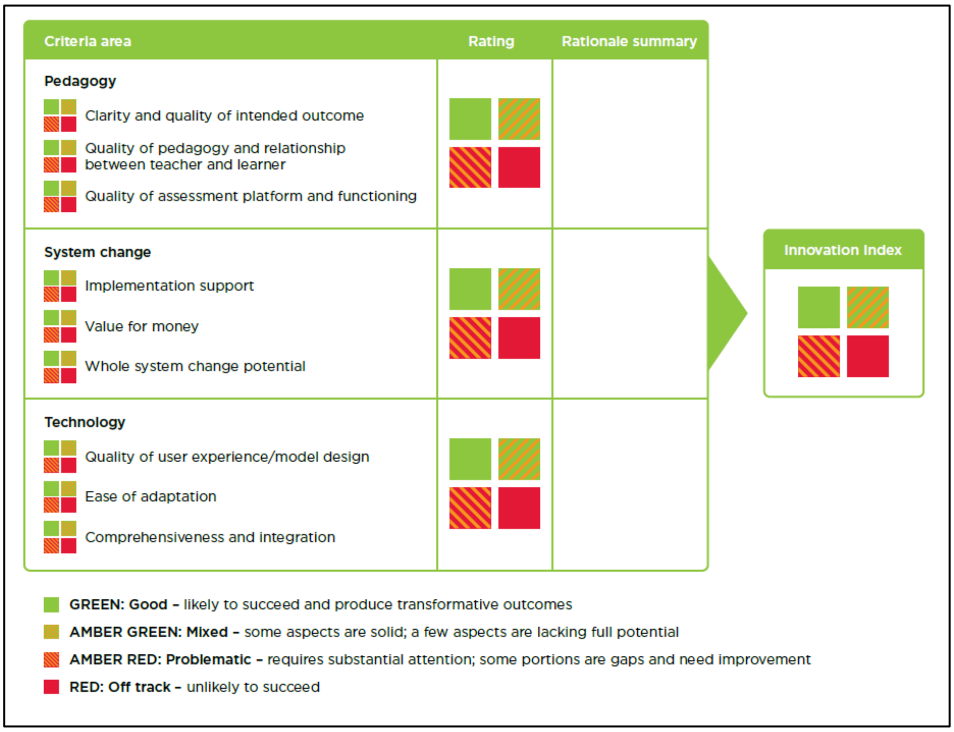


Figure 2.6 Score card: Innovation index (Fullan and Donnelly, 2013:13)

The guide to the index says that it is best applied to primary or secondary school – based innovations. Each component and sub-component is given a rating on a four-point scale (based on the colours – see Figure 2.6). Although the evaluation using the criteria is qualitative, each innovation could receive a score of three to 12 for each subcategory, nine to 36 for the index as a whole. The index provides detailed descriptors of what the various colours look like in practice (See Appendix B). Fullan develops his ideas of the transformation of learning possibilities further, with the development of the 'new pedagogy', 'change leadership' and 'system economics' in his latest work in collaboration with Nesta (Fullan, 2014).

To summarise this section; there is a general belief that technology is not at present widely supporting or improving educational outcomes for pupils. There is a multitude of ideas about the potential of such innovations, but research to date shows limited results (see 2.3.2). There is some agreement among international writers that it is the pedagogy that needs to change to allow technology to perform its transformative role. The section has summarised a number of guides and evaluation tools that could be used to assess the effectiveness of an innovation. These will be considered when the intervention that is the subject of this study, is evaluated.

2.3 Blended learning

There have been a number of models or frameworks to help teachers put together courses that would ‘blend’ classroom/online activities. As shown in the previous section, to design a course of study for students is a very deliberate action.

This section will attempt to:

- Define the terminology used
- Outline the various interpretations of ‘blends’
- Summarise the research base
- Appraise the theoretical bases informing practice
- Consider the possible future directions of BL in the school sector

The term ‘Blended Learning’ has been in use in the educational domain for a number of years. In the previous section it was defined as ‘the thoughtful fusion of face-to-face and online learning experiences’ (Garrison and Vaughan, 2008:5); others have defined it as ‘The integrated combination of traditional learning with web-based on-line approaches’ (Oliver and Trigwell, 2005:17), where ‘traditional learning’ is the face-to face classroom and the online is that part of the course delivered usually through a VLE (Sharma, 2010). The main point being made here is that blended or hybrid learning is not just teachers using the Internet in their lessons or asking students to ‘Google’ something for homework. The key elements include the deliberate design of courses that integrate face-to-face practice with online activities in a pedagogically valuable fashion.

The motivation for using technology has been discussed in a previous section, but there are three main reasons for schools or colleges to move from a ‘traditional’ class based pedagogy to a blended or hybrid version.

Firstly there are pedagogical reasons for integrating online activities, among them a belief that using technology will improve educational outcomes. Some research has shown modest, but significant benefits of blended learning in higher education (Bernard et al., 2014) and higher education and K-12 (Means et al., 2013).

Secondly, there are economic reasons, especially in higher education. Rising numbers of students and financial restrictions make replacing expensive face-to-face teaching with online teaching an attractive proposition. In secondary schools, replacing expensive qualified teachers with teaching assistants supervising online activities is a further development in the definition of blended learning which will be discussed later.

Thirdly, a mix of other motives, including flexibility of access to resources, efficient use of infrastructure, the development of communication skills, independent learning skills and preparing digitally aware young people for 'lifelong learning'.

Two linked literature reviews of blended learning have been published that are relevant to the context of this study, Drysdale et al. (2013), looked at research trends in dissertations and theses studying blended learning, and Halvserson et al. (2012) studied high impact scholarship and publication trends in blended learning. Both authors reported clear differences between higher education and K-12 in terms of publications and research.

Halverson reports that there is a lack of theoretically informed research into blended learning in school contexts and argues that study in this area is important because

> ... "school provides not only academic instruction, but also physical monitoring of students while parents work; many current K-12 blended learning environments do not reduce seat time (an almost fundamental component of some definitions of blended learning), but continue to the supervisory role while engaging students in online activities."(Halverson et al., 2012:397)

Drysdale et al. also mention these different contexts, describing the K-12 students as having different needs, abilities and limitations to students in higher education.

Another development, this time originating from practitioners, has been the concept of the 'flipped classroom', a practice popularised by two high school chemistry teachers from Colorado, USA (Bergmann and Sams, 2012; Educause, 2012). In response to a seemingly lecture and text book based pedagogy of many USA high schools, they began to systematically 'flip' the activities of students. Instead of 'lecturing' students during class time, they pre-recorded their lectures including presentations and audio using screen capture software, and set them as short video tasks to be done at home. In class the students worked individually or collaboratively on assignments and projects where the teachers were available for interaction and feedback. The idea has become popular across the world and has prompted books, websites and conferences supporting the approach. Flipped learning shares many of the attributes of blended or hybrid learning, promoting a flexible approach to the learning environment, changes in learning culture so that classroom time employs more active learning strategies. The process has spread mainly from practitioner networks among small public universities in the USA with some research sponsored by Pearson (Flipped Learning Network, 2014). The growing interest in flipped learning illustrates two strands found in this study, an interest from practicing teachers in their own professional development in responding to the challenges of pedagogy and the use of technology, and the failure of the more 'academic' literature on the subject to gain access into schools and colleges.

2.3.1 The rise of blended/online teaching

The performance of secondary school systems has been a matter of concern especially in parts of the developed world where league tables of results in the PISA (Programme for International Student Assessment) have shown that countries that have long defined themselves as leaders, have scored beneath the 'tigers' of south-east Asia and the smaller European countries, the latest results from 2012 show the UK ranking 26th, 20th and 23rd in maths, science and reading respectively, with the USA ranking 36th, 28th and 24th, below countries such as Shanghai (China), Taiwan, South Korea, Finland and Poland (OECD, 2014). In the United States a further issue of concern has been the low level of successful graduations from high school, with 'drop-outs' becoming a major political issue. While the reasons for these results are complex, a number of key issues have become the focus for policy makers and educationalists on both sides of the Atlantic. These issues are becoming more overtly political and mirror some of the other social and economic issues across the countries; the perceived poor quality of many teachers and the difficulty of recruiting 'excellent' teachers (Dwinal, 2015; Ratcliffe, 2014); the variable quality of teachers and schools, resulting in issues of equity and access to high quality teaching (Weston, 2013a; Wiliam, 2007), and concerns about the lack of personalisation or differentiation in the 'traditional' classroom model holding back 'bright' students and not giving sufficient support to those who struggle (Ofsted, 2013a).

In the United States and more slowly in the UK, policy makers are seeing solutions to the above issues in the development of blended or online learning. In the United States, the number of students enrolled in at least one online or blended course in K12 schools in 2009 was estimated at 1,030,000 (Picciano et al., 2012), with upward growth estimates to several million in the next 5 or 6 years.

This growth in blended/online learning has been rationalised and supported by many publications predicting the demise of the 'traditional school'. One of the most persuasive (to policy makers) has been the publications of the Clayton Christensen Institute (http://www.christenseninstitute.org/) and Public Impact (http://publicimpact.com/) a private agency supporting developments in K12 education in the United States. This growing move towards online learning has been theorised in Christensen's book, *Disrupting Class: How Innovation Will Change the Way the World Learns* (Christensen et al., 2008) and *Is K-12 Learning Disruptive? An introduction to the theory of hybrids* (Christensen et al., 2013).

These institutes or agencies share a number of assumptions and claims about the nature and future of education, the principle one being that online learning will eventually replace 'traditional' classroom based K12 education. They claim that online learning is a 'disruptive' innovation', " .. a disruptive innovation is one that replaces the original complicated, expensive product with something that is so much more affordable and simple that a new population of customers .. has enough money and skills to buy and use the product" (Christensen et al., 2013:12). The theory of 'disruptive innovation' does not necessarily run smoothly, suppliers of the technology have tended to adopt elements through a 'sustaining' strategy or the development of a 'hybrid'. This hybrid will contain elements of both the disruptive innovation and the traditional. Christensen (ibid) provides examples from the development of sail and steamships to hybrid motorcars and retail to illustrate the theory. When applied to education, the disruptive innovation is online learning, the sustaining strategy is 'blended learning' the 'best of both worlds' option while targeting the true disruptive technology to non-consumers, those who for a variety of reasons are not in the mainstream of the market. The theory states that in the end, the disruptions become good enough through being developed for non consumers that they become good enough to meet the needs of mainstream customers. Christensen states that there are insufficient non consumers in the US K-12 education system to create this climate of development and considers that a "hybrid solution of blended learning *schools* will likely be the dominant model of schooling in the United States in the future" (ibid: 27).

The claims of this model have been attractive to policy makers; the claimed potential benefits are impressive; greater personalisation; universal access to quality teachers and resources; equity of access and productivity or efficiency.

In their study of the development of online education in US schools, Picciano et al. (2012), surveyed districts and schools about their uptake of online courses. The results of the greatest response items are shown below: (ibid: 131)

1. Provide courses that otherwise were not available (79%)
2. Permit students who failed a course to take it again (credit recovery)(73%)
3. Provide additional Advanced Placement Courses (61%)
4. Provide for the needs of specific students (60%)

Other reasons included; reducing scheduling conflicts, extending the school day, building transition links with colleges and qualified teachers not being available. In particular, rural schools perceived that online and blended courses were more important than those where recruitment was easier. One of the dominant forms of online courses has been in 'credit recovery' where students are offered chances to retake courses in order to 'graduate' from high school. These are the areas of non consumption highlighted by Christensen that may provide the environment for the development of the disruptive options.

One of the aspects noted in the research was the growth in for-profit providers of these online courses, being paid for by schools and districts to meet high school dropout targets. Picciano also notes that the growth in courses has been mirrored by a concern about the quality of these courses and the suitability of students embarking on them. Often these students lack basic skills and the maturity and self-discipline to succeed.

The development of these ideas has not been without controversy. In some cases it has been dependent on a number of changes to school environments, principally led by the politically charged trend to close low-performing public schools and replace them with privately run charter schools.

The model for change includes the following claims and implications:

- Because there are too few 'excellent teachers', the 'reach' of those in schools must be increased by allowing them to teach large classes and leading teams of 'para-teachers'.
- 'Excellent teachers' will earn more and have improved career opportunities, paid for by employing fewer qualified teachers. There will be a need for a number of unqualified supervisors for 'technology-swap' sessions.
- The statutory curriculum and employment conditions for staff in charter schools are less rigorous.

The next section will summarise two scenarios of blended learning using Fullan and Donnelly's (2013) classification of technology innovations. These are school-based innovations whereby whole schools are transformed, and technology-enabled innovations where Internet-based courses are made available to students who may or may not be in schools.

2.3.2 School-based scenario

This scenario will look at the policy of one district in the United States and some of the responses to the developments. It illustrates the issues that are challenging the process at its cutting edge in the United States, but with many implications for developments in the UK.

Rocketship Education is one of the leading organisations promoting school transformation through blended learning. Rocketship has developed a number of charter schools in the US, in the Bay area, Milwaukee, Nashville and Washington D.C. and is looking expand its reach across the United States (Rocketship, 2014). The model employed by Rocketship includes combining online learning with face to face contacts. Students typically spend up to half their time online, either in a 'learning lab' or in some sort of rotation system. Students are supervised by 'individualised learning specialists' (ILS), freeing qualified teachers to reach more classes. There are a number of evolving 'blends' that combine small group, large class and online 'technology swap' time. Rocketship claim to be able to meet students' needs using engaging activities through online practice and feedback, making use of data analytics to adapt the experience of the students (Staker and Horn, 2012). The instructional model is supported by frequent testing to district and state standards. The teaching model enables schools to employ up to 25% fewer qualified teachers. ILS support computer lab work and help individual students when they need assistance. "Rocketship's computer-based assessments and system of accessible, well-organised, curriculum aligned instructional resources jump start teachers' planning and leave them more time to collaborate with other teachers and learning specialists to analyse and respond to individual students' needs" (Opportunityculture.org, 2013:3). The organisation also claims to pay its teachers 10-30% more than local public school staff (ibid).

This fast growing phenomenon in the USA of business practices influencing education reform is not without its critics. In particular Lafer, from the University of Oregon's Labor Education and Research Center, has written a scathing critique of the education reform proposals in Milwaukee, Wisconsin, based on the Rocketship model (Lafer, 2014).

Lafer's critique is formulated around five main arguments; the myth of the advantage of private charter schools; the restrictive curriculum offered by the Rocketship model; the business model of the reforms being based around generating profits rather than benefiting students; that school accountability would be fundamentally changed, and the preferential treatment offered to private charter schools.

The conversion of public schools to private charter schools in the USA. has been a model for the conversion from local authority schools to academies and the creation of 'free' schools in the UK. Despite these being heralded as the saviour of a discredited public schools system, in neither country has there been any evidence that the conversion, of itself makes any difference to school effectiveness (House of Commons, 2015; Lafer, 2014).

Lafer interprets Rocketship's model thus: ".. the replacement of teachers with computers for a significant part of the day; a reliance on young and inexperienced teachers for the rest of the day; narrowing the curriculum to math and reading with little attention to other subjects and even within these subjects, a relentless focus on preparing students for standardized tests" (ibid:7). Teachers in Rocketship schools do not have conventional teaching contracts, and are paid according to student test scores. As far as increasing the salary and career opportunities of teachers, Lafer cites Rocketship's own figures showing that 75% of teachers come from Teach for America schemes with a 30% turnover of staff and little salary progress for teachers in a scheme that was designed for graduates to become more attractive to corporate employment (the Teach First scheme in the UK is modelled on the USA TFA). Lafer claims that this is part of the business plan, "with more experienced teachers being regularly refreshed by the newer and cheaper recruits" (ibid:8). Dylan Wiliam, in a keynote speech in London while commenting on the importance of teachers in making a difference to students and how variation between teachers is a concern, made these remarks: "You don't really learn to teach at all well until you're six or seven years into the profession. And some recent data from Australia shows that the amount of value added by teachers actually carries on increasing for about twenty years. Basically almost all teachers are almost useless when you start" (Wiliam, 2007:3). There have been a variety of other reports on concerns about this model (Herold, 2014; Kirk, 2014; Pandika, 2014)

One of the harshest criticisms of this reform movement comes from an analysis of the business model of Rocketship and other charter sponsors (Kirk, 2014; Lafer, 2014). Schools such as Rocketship are financed through investment banks, hedge funds and venture capital firms, which although ostensibly 'non-profit', create their income streams from construction and the digital curriculum software that lies behind the innovation. The founder of Rocketship, John Danner left the organisation in 2013 to create an adaptive computer application to support common core practice and assessment (https://www.zeal.com/). In order to do this, the movement has been supported by powerful lobby groups in those areas targeted by Rocketship. Lafer describes one of these lobbying organisations the American Legislative Exchange Council (ALEC), a nationwide network that brings together some of the country's largest corporations, that lobbies to promote business-friendly legislation (ibid:32):

> "ALEC's education agenda includes proposals to permanently reduce state budgets; lower the standard of education required for teachers; restrict teachers' rights to collective bargaining; tie teacher pay to student test scores; replace public schools with privately run charters; replace human teachers with online or digital instruction; and insist that online courses, no matter what their actual cost of production, receive the same amount of state funding per student as regular classes."

An example of the changes to school accountability and the preferential treatment of charter schools is documented in the proposed changes to state education in Wisconsin (State of Wisconsin, 2014). Public schools would be judged on different standards than charter schools, and would not be allowed the opportunities to expand or develop new schools in same way that charter schools would be.

This links to policy changes in the UK are clear. The education reforms concerning the conversions to academies, the creation of 'free' schools, the exemptions of these schools from delivering the national curriculum or from having to employ qualified teachers, reflect the policy environment in the USA. There are also plans to develop 'blended learning' schools in the UK. An academy chain has announced that it will be opening such a school on the Rocketship model in 2016, with predictable responses from the trade unions (McTague, 2014; Stewart, 2014). While the UK government has said that it is opposed to allowing academies to run state-funded schools for profit, the involvement of large educational publishing companies in the delivery of content and online facilities will inevitably muddy the waters of what is regarded as a commercial enterprise. For example the British company Pearson, which dominates the testing environment in the USA and in the only for-profit examination board in the UK is also heavily involved in the production of text-books and online learning environments. What has concerned some is Pearson's involvement in policy making and school improvement (Mansell, 2012). The company has funded an inquiry into the impact of the academies programme and a study into the English examination system. Pearson has also launched a secondary school computer-based curriculum which will eventually be marketed to schools as a comprehensive solution. The company has been accused of becoming a quasi-government agency where the boundary between commercial interests and policy influence has become blurred.

2.3.3 Technology – enabled scenario

According to Fullan and Donnelly's (2013) classification of educational technology innovations, technology-enabled innovations differ from the school-based type discussed above in that they can be accessed by students from anywhere, not just from a school such as a Rocketship institution. These innovations can take a number of forms, from free MOOCs created by prestigious universities to Khan Academy tutorials. To illustrate the phenomenon, one example of a virtual school will be discussed in order to examine how this innovation has been integrated into one state in the United States.

Florida Virtual School is the largest virtual school in the United States offering online courses to all grades of students, part-time to students from Grades 1-12 and full time to students in Grade K-12. Courses are free to all students from public or private schools, or from homeschooled students between kindergarten grades and Grade K-12 as long as they are Florida residents (FVLS, 2014). According to the school's report, the number of students has risen from 11,500 in 2003 to 154,000 in 2008-9 and 462,000 in 2012-13, 97% of students are part-time, taking the rest of their courses in traditional public or charter schools, 75% of students come from public or charter schools, 20% are homeschooled and 5% from private schools (Florida Virtual School, 2014). From 2011, the Digital Learning Act requires students entering the ninth grade in 2011-12 and after to complete an online course to meet graduation requirements (ibid). The Florida Virtual Learning School is not the only virtual school; some districts have set up their own programmes in order to keep the funding (Florida Department of Education, 2014). All FLVS students must have their own computers or access to computers at their home schools, some district schools have created FLVS labs to give access to their students, in 2012-13 FLVS had 320 such labs, and claims that qualified teachers are available seven days a week from 8am-8pm, by 'phone, email or text messaging (Florida Virtual School, 2014).

Chingos and Schwerdt (2014) undertook a comparative study looking at how well students performed in the same courses at a traditional public school and at the Florida Virtual School. They report that of the two main goals of virtual education, access to courses was easily attainable. The range of courses at the virtual school is comprehensive with many students taking AP (Advanced Placement) courses that were either not offered by the student's school or where the course offered at the school was not perceived to be of high quality. The report concluded that, despite concerns about quality, these were not supported by the evidence, neither were FLVS students more likely to be absent from their regular school (ibid). Overall Chingos and Schwerdt concluded (2014:14):

> "Despite these limitations, this analysis yields important new findings on virtual education, a topic that has generated much hype but little serious evidence. The results are mixed regarding the promise of technology to increase the quality of education through personalization (as of 2009), but they do strongly suggest that fears of reductions in the quality of education are misplaced. We do not find any evidence of negative effects of virtual education on student learning, and a finding of equivalent quality, on average, between FLVS and non-FLVS courses may suggest a higher level of productivity in the FLVS courses".

These two scenarios of possible futures in the development of the use of technology to enhance learning and broaden the access to high quality education illustrate the contrasts described by Fullan and Donnelly (2013). Figure 2.7 illustrates the 'system gaps' whereby the two types of innovation systems are plotted against two axes: scale and embeddedness. It shows through this analysis that neither system at the present time can be said to be truly transformative.

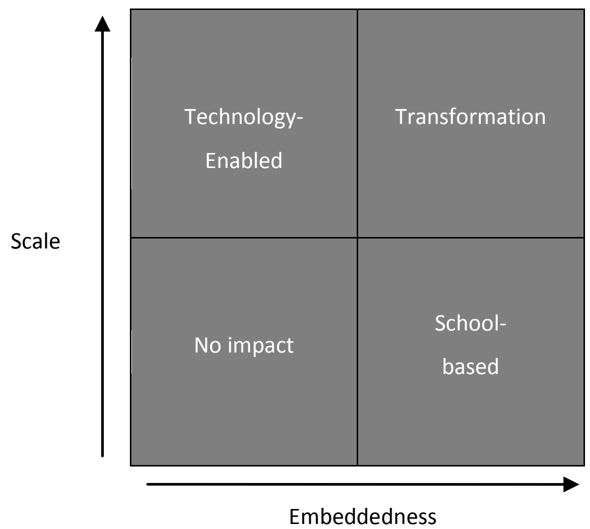


Figure 2.7 Innovation system gaps (Fullan and Donnelly, 2013:24)

The next section outlines a concept that could be seen to drive the two scenarios described above. Both are driven by the expectation that technology will improve education and that efficiency and cost control could be seen to have become more important than quality.

2.4 The McDonaldization of education

This section summaries some of the trends found within the education reform movements worldwide and attempts to contextualise the ideas of e-learning described previously and later. In George Ritzer's book, *An Introduction to McDonaldization* (2004), he merges the ideas of sociology, economics and management to shed an original light on some of the changes and developments of modern society. The main thesis of the book takes the principles of the famous fast-food restaurant and applies them to all walks of life including retail, healthcare and education. Wilkinson (2006), claims that the McDonald's analogy is valuable for three reasons; its emphasis on the micro-control techniques and the inevitable consequences for teacher's professionalism and practice; the inherent link to worker disenchantment; and how the blurring of economics, work and education lead to the commodification of learning. The same process is described by Ball, in terms of the shared assumptions in the world of educational reform 'package' world wide, ".. embedded in three interrelated policy technologies; the market, managerialism and performativity" (Ball, 2003:215).

Ritzer uses four dimensions to explain why McDonald's has become so successful and how these ideas have spread into other domains. The four dimensions are efficiency, calculability, predictability and control.

The most important dimension of McDonaldization is 'efficiency', as Ritzer puts it "the optimum method for getting from one point to another" (Ritzer, 2004:15). The fast food model achieves this by the speed and ease of transaction and through the routing of customers and workers following clearly defined steps under the supervision of managers, rules and incentives. Efficiency is not a neutral term, especially as it applied to the public sector. "At a national level, this emphasis promotes a utilitarian philosophy which implies that engagement in education is only beneficial insofar as it produces 'outputs' and, further, where these outputs are defined in relation to potential economic productivity, implies that education is a matter for wealth acquisition rather than a public good" (Wilkinson, 2006:89). It is not difficult to see how these processes can be applied to education through the replacement of costly teachers by online courses, computer marked assignments saving teachers' time and on-demand resources through the Internet replacing the need for costly repositories in physical libraries among others.

Calculability "is an emphasis on the quantitative aspects of products sold and services offered .. quantity has become equivalent to quality" (Ritzer, 2004:15). In the current education system in the United States, "the focus seems to be on how many students (products) can be herded through the system and what grades they earn rather than the quality of what they have learned and of the educational experience" (Ritzer, 2007:84). This need for quantification informs league tables in school performance (in the UK and US) and performance pay (in the US and coming in the UK). As has been discussed earlier in this chapter, in many educational situations this has involved the narrowing of curricular offerings and teaching rigidly to the test to achieve higher 'performances' in students rather than a broad education. Ball comments how "value replaces values" (2003:217).

Predictability, is defined as: "the assurance that products and services will be the same over time and all locales" (Ritzer, 2004:16). In terms of fast-food, customers know that the burger they eat in California will be the same as that served in Singapore, "it will not be awful, although it will not be exceptionally delicious either" (ibid: 16). Workers work to scripts to ensure predictability of service. As far as education is concerned, it is argued that predictability can ensure equality of access to courses, and equity for groups or individuals that might not get access for social, financial or geographical reasons. As a result of the McDonaldization processes, many courses have become similar, with similar structures, resources, activities and assessments. Teacher training sessions and 'guru' publications are full of 'scripts' for 'excellent' teaching that become embedded in the routines and expectations of school leaders and inspectors. Indeed, education policy in the UK since the 1990s has been characterised by numerous 'scripts' to be found in policy documents such as; the National Curriculum, Key Stage 3 Strategies, QCA Schemes of Work and professional standards for teacher training and headteacher qualifications. Wilkinson notes the paradox between governments promoting choice and diversity and its policies of standardisation and predictability. "Secretaries of State for Education are 'promoting diversity' ... and valuing 'distinct identity' only insofar as teaching staffs deliver the same curriculum using the same teaching strategies" (Wilkinson, 2006:92)

The last of Ritzer's dimensions is that of 'control'. This involves both the workers and the employees. "Lines, limited menus, few options, and uncomfortable seats all lead diners to do what management wishes them to do - eat quickly and leave" (ibid: 17). The extent of control over professional's practice is unique in the public sector. Not only is educational policy and structure determined centrally, but how the work at an individual operational level is also centrally controlled through inspections and accountability regimes. Ball's definition of the term 'performativity' summarises the nature of this control on teachers: "performativity is a technology, a culture and a mode of regulation that employs judgements, comparisons and displays as means of incentive, control, attrition and change – based on rewards and sanctions (both material and symbolic)" (Ball, 2003:216).

Control through non-human technology can be seen to be paralleled in the highly structured routes through online courses. The replacement of human employees through technology is a growing trend in retail, banking and now education where the cost, variable quality and availability of teachers can be mitigated by the use of technology (Weston, 2013a). The supervision of students (and staff) through the use of the tracking and data analytics of online courses can be seen both as strengths (Christensen et al., 2013; Weston, 2013a), or as a danger through excessive surveillance (Conlon, 2008; Land and Bayne, 2002).

Overall there are many advantages to McDonaldization as applied to education. For example, the implications for access to quality resources and courses to those in peripheral geographical places are undeniable. Ritzer himself acknowledges that the process of McDonaldization has brought benefits (Ritzer, 2004: 18):

- A wider range of goods and services is available to a much larger portion of the population than ever before
- Availability of goods and services depends far less than before on time or geographic locations
- People are able to get what they want or need almost instantaneously and get it far more conveniently
- Goods and services are of a far more uniform quality, at least some people even get better quality goods and services than before McDonaldization
- Far more economical alternatives to high priced, customized goods and services are widely available, therefore people can afford things they could not previously afford
- Fast, efficient goods and services are available to a population that is working longer hours and has fewer hours to spare

- In a rapidly changing, unfamiliar, and seemingly hostile world, the comparatively stable, familiar and safe environment of a McDonaldized system offers comfort
- Because of quantification, consumers can more easily compare competing products
- Certain products (for example, diet programs) are safer in a carefully regulated and controlled system.
- People are more likely to be treated similarly, no matter what their race, gender, or social class
- Organizational and technological innovations are more quickly and easily diffused through networks of identical operators
- The more popular products of one culture are more easily diffused to others

These issues refer to many of the criticisms of the current situation; lack of access and equity in schooling; and variable quality of teaching staff and resources.

Ritzer terms his critique of McDonaldization ‘the irrationality of rationality’. McDonaldization can be seen as containing the basic components of a ‘rational’ system. Ritzer argues that “rational systems inevitably spawn irrationalities. Another way of saying this is that rational systems serve to deny human reason; rational systems are often unreasonable” (Ritzer, 2004:18). He gives an example of the environmental impact of the fast-food industry, the ‘externalities’ of production. The environments become de-humanised, not perhaps that important in the food industry, but in an area where human relationships are important like education, impersonal courses, large classes and computer feedback can reduce the quality of the experience significantly. Ritzer argues that McDonaldization can be enabling as well as constraining if the process can be used to add efficiency that allows more time for creative and imaginative interaction.

2.5 Learning platforms and virtual learning environments

The term ‘learning platform’ was defined by BECTA (2006:6) as ‘bringing together hardware, software and supporting services to enable more effective ways of working within and outside the classroom’. Learning platforms have had a much longer history of use in the higher education sector than in schools (Younie and Leask, 2013; Passey and Higgins, 2011), and some major areas of disparity have been identified:

> “Evolutionary maturation: universities had been developing use for a decade, schools for only few years;
>
> Choice of technology: universities tended to use similar systems which supported transferability of skills across the sector; schools used many different systems leading to fragmentation of the skill base across the sector;

> Access to support and training: in the university sector on-site access to training supported the rapid building if a critical mass of staff users; schools did not have this support on site". (Younie and Leask, 2013:2)

As a result of the longer history of use, and the fact that it is much easier for researchers to investigate their own institutions than schools, the research literature is much wider in higher education. Higher education has had the support of JISC (Joint Information Systems Committee), funded by central government to support technological infrastructure in universities. Schools were supported by BECTA (British Educational Communications and Technology Agency), who sponsored a variety of research projects as well as publishing guidance and advice on ICT procurement and use. BECTA was abolished by the incoming coalition government in 2010 as part of the liberalisation of schools policy. The reports from BECTA showed 'significant progress' in schools having learning platforms, but varied results concerning their use (BECTA, 2009b; BECTA, 2008; BECTA, 2003). Most of the results were obtained by self-reporting questionnaires and were not necessarily an indication of quality of use. One of the last reports for BECTA, before its demise in 2011, reported rising use of learning platforms in schools, but little empirical research as opposed to anecdotal observation (Jewitt et al., 2010).

One of the results of the liberalisation of school policy and funding has been the proliferation of suppliers to schools, and the resulting fragmentation of systems.

One of BECTA's more ambitious publications, *Learning Platforms, Steps to Adoption, a step-by-step guide for schools* (BECTA, 2010), outlined the progression that a school could make in a number of elements, including administration, communication with parents, curriculum planning, teaching and learning and assessment and reporting. This report shared the view about the future benefits of education technology being associated with more constructivist pedagogy.

Although learning platforms comprise the whole infrastructure of systems supporting learning in schools, this project will concentrate on one aspect, usually referred to as the virtual learning environment (VLE) component of the learning platform.

The VLE is that part of a learning platform that is concerned with teaching and learning. It usually consists of a host web environment that is accessed through a browser. The VLE software provides a number of applications to support aspects of teaching and learning. While there are few providers in the higher education sector, a huge variety of suppliers, some of dubious quality is seen in the schools sector, some purchased from commercial providers, some designed, built and provided by local authorities. As a result, there are few common formats for sharing and training.

Essentially a VLE is a software application that, through a single login, can allow online access to a variety of activities and resources related to teaching and learning. The number and quality of the facilities have grown with the sophistication of the technology. These can be grouped under the following headings:

- **Resources for learning** - a repository of resources relevant to a course of study, these could include papers, ebooks, videos, examination papers etc. These are essentially passive in nature, but have the advantage of being all in one place.
- **Monitoring and assessment** - within the VLE are built-in facilities for multiple-choice tests, submission of student work, digital feedback from teachers, and monitoring and recording of student progress.
- **Communication and collaborative opportunities -** within the VLE will be facilities for students to; collaborate with other students e.g. wikis; discuss asynchronously within forums; peer assess other students' work; and for students to upload materials for others to see and comment on.

Just as teachers and students look to the assessment regime to tailor their teaching or learning behaviours, so one of the major influences in the planning/delivery of the curriculum on school leaders is the Ofsted inspection regime. The list of criteria within Ofsted is the benchmark on which schools are held accountable; there are no criteria that relate directly to the use of technology. Despite this, in recent years, Ofsted has taken more of an interest in the use of technology, publishing a number of special reports on the use of VLEs and case studies of good practice. Looking at Ofsted reports from the period 2011-2012, that Ofsted selected in their section on VLEs, the comments show that a number of stock phrases (see below) are appearing. These show that some sort of 'statement bank' exists for this area (Ofsted, 2013d), it seems that the use of VLEs is encouraged, certainly at post-16 level. However, school Ofsted reports seem only to mention the use of a VLE when it is outstanding or a feature of special interest. There is no requirement, or inspection question that affects school grading in this matter, leaving school leaders concentrating on the rubric or 'mark scheme' of the criteria that matter to the outcome.

Reports suggest that use in schools is not widespread, Ofsted reported that "the exploitation of VLEs at curriculum level resembled more of a cottage industry than a national technological revolution" (Ofsted, 2009:4). More recent reports suggest that little has changed since then (Ofsted, 2013b).

Case studies of good practice have typically taken the following form of reporting style:

> "To provide ideas or inspiration we offer a selection of case studies of providers that have, in our judgment, been using virtual learning environments well.
>
> This virtual learning environment (VLE) has:
>
> a wide range of interesting resources with good use of high-quality material, including a significant proportion from outside sources
>
> a clear strategy supporting a pragmatic approach to the VLE as blended learning to support teaching
>
> good engagement with enthusiastic teaching staff.
>
> Bournville's VLE is based on Moodle. About 65% of courses now have resources in their area. Routine support is provided by an e-learning technologist working for the professional development manager with technical support provided by the IT network manager. Support for tutors is provided by advanced practitioners and continuing professional development staff." (Ofsted, 2013c:12)

Use in schools of VLEs reflects the use of digital technology generally. Reports show that use is growing, but impacts are inconsistent and varied. Meta-analyses on the impact of school technology on attainment "tend to find consistent but small positive associations with educational outcomes. However, a causal link cannot be inferred from this type of research. It seems more probable that more effective schools and teachers are more likely to use digital technologies than other schools" (Higgins et al., 2012:3).

In their report on the use and potentials of learning platform use in some 'good practice' English schools, Jewitt et al. (2010), found that four major themes emerged from their data collection; learning resources; opportunities for independent and personalised learning; opportunities for collaborative learning and interaction; processes of monitoring and assessing for learning and teaching.

Teachers and students found that putting resources online enhanced the range and quality available, together with a 'one-stop-shop' available at any time whether at home or at school. The teacher's own resources, third-party commercial resources and links to a variety of other sources were valued by teachers and students. While the report's main conclusion about resources was that they added adaptable, manageable and relevant sources to students, "some teachers also reported some negative aspects of this visibility in particular that it enabled a stronger managerial gaze on the work of teachers that may reduce innovation and risk taking" (ibid:341).

In order for the VLE to support independent and personalised learning, the organisation of the sequences of activities and assessments becomes important. The study reported a number of ways in which the VLE had been used in this way; activities used to supplement and support classroom learning; homework tasks might be set for the whole week or month so students could organise their own schedule; giving students opportunities for reflection and revision materials for upcoming examinations. There were, however some tensions relating to equity and access, with some teachers worried about setting work online when not all students had good access either to a computer or the internet at home. Some schools made arrangements for students to be able to use school ICT resources for extended time before and after normal school hours.

Case study schools reported using the VLE to allow students to collaborate on projects and share ideas through discussion forums, blogs and wikis. Some schools responded that they had collaborated with other schools using wikis.

In addition to the ubiquitous multiple-choice quizzes, a wide variety of assessment and feedback activity was reported by schools in the study, these included digital forms of teacher feedback; video to support student reflection, and the visibility of grades over time.

Jewitt et al.'s (2010) conclusions on the benefits of learning platforms or VLEs are shared by other studies (Younie and Leask, 2013; Higgins et al., 2012; Passey, 2011; Ofsted, 2009) as are the means by which pedagogic benefits can be enhanced and made more likely:

- A clear shared vision of the purpose of the VLE in terms of work at home and school
- Strong support from school leaders, with VLE strategies in place, together with appropriate funding and resources
- Training for teachers and students on changing pedagogies of VLE use, rather than just how to use the technology

This is consistent with many of the studies referred to above in that success cannot be attributed to technology without commenting on the school culture, organisation and leadership context in which its use occurs.

2.6 Students as 'digital natives'?

Many of the innovations and new practices depend on the more autonomous use of technology by students, implying that the students will have the technical and SRL skills to operate in the new worlds of digital education. This section examines some of the research into whether students have the digital literacy to cope with the demands of new learning environments.

According to Marc Prensky, "the single biggest problem facing education today is that our Digital Immigrant instructors, who speak an outdated language (that of the pre-digital age) are struggling to teach a population that speaks an entirely new language" (2001:3). This new language belongs to the Digital Natives which is how Prensky describes the new generation of students who have grown up with new digital technology. "Our students today are all "native speakers" of the digital language of computers, video games and the Internet" (ibid:1).

This was written in 2001 when the potential impacts of digital technology were becoming clearer, in particular the notion of 'Web 2.0'. This term has been described as identifying a "significant trajectory of development involving the tools and practices of digital technology" (Crook, 2012:63). Another term that is sometimes used is 'the participatory web', denoting the opportunities for social participation now widespread in society. These developments in digital technology have been referred to as a 'singularity'(Bennett and Maton, 2010), a revolutionary event that changes things so fundamentally that "there is absolutely no going back" (Prensky, 2001:1).

Since Marc Prensky wrote this rather polemical account in 2001, a number of studies have been published that have attempted to throw some light onto what technology these 'digital natives' have actually been using and what activities they have been using them for in both social and educational contexts. Crook (2012) and Beckman (2014), researched the use of technology by high school students and Conole (2008) and Thompson (2013), looked at British university students and American 'freshmen' respectively. The results from these studies show that the term 'digital native' is perhaps too broadly drawn and hides a great variety of experiences, skills and practices of young people.

Beckman reports that students' use of technology outside school was dominated by communication and interest-driven activities, such as watching videos online, listening to music and general browsing of the Internet. "Generally students' use of these technologies was habitual, performing very similar activities each day: and basic passive uses, using the most rudimentary features of the applications" (2014:351). In school, the students' activities were also of a fairly low level, using word processors to write assignments, the Internet for research and watching YouTube videos in class. She notes that:

> "while Moodle and Edmodo provide opportunities for interactivity, students did not report using these features. Students' descriptions of these activities begs us to question whether this is fundamentally different from a printed version of the same task on a piece of paper. Furthermore, data from students' technology diaries demonstrate that these social tools were used infrequently". (Beckman et al., 2014:355)

Crook's (2012) analysis focussed on a number of themes looking at the tensions arising out of importing Web 2.0 practices into the school setting, including Web 2.0 inquiry, Web 2.0 collaboration and Web 2.0 publication, looking at progressively more sophisticated activities. The level of technical skill was reported to be low in all areas, mirroring the findings of Beckman above. Crook also found that tensions between social and school use regarding communications applications were apparent in terms of unstructured Internet searching, and blocking of sites in school; evidence of 'cut and paste' report writing; poor experiences of collaborative activities through students' unease about sharing their work and opinions in a school environment.

Kennedy (2010), carried out a survey among first year Australian HE students about the frequency with which they used technology-based tools, ranging from mobile phone use to Web 2.0 publishing. His analysis clustered users into four main groups; Power users (14%), who used a wide range of technologies frequently; Ordinary users (27%), who were regular users of Web and mobile technologies, tending not to engage in Web publishing or file sharing; Irregular users (14%) similar to the ordinary users, but less frequent, and basic users (45%), who were characterized by extremely infrequent use of new and emerging technologies. He found that age, sex and residency all were significant factors in the distribution of user characteristics and that the so-called digital generation was far from homogenous.

Thompson's study of freshmen, similarly reported: "contrary to popular beliefs that the digital native generation is universally proficient on all digital technology tools, this study showed that the range of technologies students use might be fairly limited" (2013:20). The study reported that as the tools moved from passive browsing to more active collaborative use like blogging or media creation, the frequency of use declined rapidly.

Conole's (2008) research on British university students is much more positive. She describes students creating a "networked extended community of learners using a range of communicative tools to exchange ideas, to query issues, to provide support, to check progress" (2008:521). This is very likely because of the selective and mature nature of the students in the study, some of which were assessed on the portfolio integrated into the course VLE and where blogging is an expected part of course completion. Interestingly, she notes that even these students are ambivalent about the value of discussion forums, preferring to read than contribute posts.

Apart from the level of maturity, a number of researchers have used Bourdieu's key concepts to help to explain the misalignment between school and home use of digital technologies. This analysis separates the 'home *field*' from the 'school *field'*. Beckman (2014), describes the home *field* as a place where the family determines the technology available and the culture of use, where students are the primary users of technology and hold a higher position in the home *field* and where there are few rules about use. This home *habitus* (dispositions structured by experiences) is in contrast to what they experience in the school *field,* where their *capital* (the status and resources they possess and thus their position in the hierarchies of any context) is valued significantly differently (Bennett and Maton, 2010). The technological experiences in the home *field* reported by much of the research is of a low level and limited in scope, challenging Prensky's notion of digital natives possessing sophisticated technological skills and knowledge. Beckman states that "without the skills and knowledge or training required to effectively (to utilise and possibly gain *capital*) use the Internet, or the support networks ...one would not have the *capital* to benefit from connectivity" (Beckman et al., 2014:361). In the study, students responded in various ways to using technology for learning, they seemed to like some activities that aligned with their social *field*s like watching videos, but did not respond well to the highly controlled and structured learning environments in school. She concludes her study by suggesting that schools look for opportunities to build on the students' experiences and socialise students into the use of technology that is different from home, valuing the *capital* that students demonstrate.

This study collected some data from a brief survey of student access to and use of technology at home, in order to ascertain some of their digital skills and thus appropriately tailor any training and design of the learning environment.

2.7 Barriers to the adoption of educational technology

The failure of schools and teachers to adopt educational technology has been ascribed to a number of predictable factors. These can be grouped into two main linked areas; those factors that relate to schools and teachers and their supposed conservative nature and their 'natural' resistance to any change that threatens their professional role and status; and those factors that relate to educational policy. In terms of educational technology, there is also the overriding hyperbole mentioned previously. The claims of 'paradigm shifts' or the transformation of education, rather than reflecting a description of reality could be merely "creative fictions, heuristic devices which highlight specific developments, and should be approached with ..scepticism" (Maton and Moore, 2000:7). Rather than changes in the real world, these changes could be best understood as "changes in the conditions of some members of the intellectual field (the new knowers)" (ibid:7). These 'new knowers' could be said to include many of the educational technology evangelists, bloggers and some less critical commentators on the field, while others just don't 'get it' (ibid).

A common approach to analysing this failure is in looking at the lack of use of technology is schools as "yet another example of an innovation which has failed to penetrate the forces of sociocultural reproduction built into the institutional structures of schools" (Somekh, 2004:168). This analysis tends to emphasise the mismatch between the present 'industrial' structure of schools and the openness of the digital revolution that has impacted most other areas of life including retail, entertainment and so on. Selwyn summaries the situation by rephrasing a quotation from Cuban "digital technology meets classroom – classroom wins" (2011b:34).

Some commentators take a pragmatic view of the reluctance of schools and teachers to integrate technology in their work. *Beyond the early adopters; Moving reluctant majority*, emphasises training courses (Hixon et al., 2012; Drent and Meelissen, 2008). *Risk-aversion: understanding teachers' resistance to technology integration,* concludes that risk-aversion and perceptions of the value of technology in teaching are holding back the use of educational technology (Howard, 2013). *Implementing learning platforms in schools and universities: lessons from England and Wales,* explains schools being further behind universities because of differences in support and training as well as interoperability issues (Younie and Leask, 2013). Others take a more fundamental approach.

Belland (2009), cites the work of Bruner who coined the term ‘folk pedagogy’ to describe how teachers, students, parents and politicians ‘know’ how teaching ‘should’ appear.

> “In theorizing about the practice of education in the classroom, .. you had better take into account the folk theories that those engaged in teaching and learning already have. For any innovations that you a ‘proper’ pedagogical theorist, may wish to introduce will have to compete with, replace, or otherwise modify the folk theories that already guide both teachers and pupils” (Bruner, 1996:46).

Bruner argues that teachers tend to act on their folk beliefs rather than their professed beliefs (ibid); Belland (2009) refers to a number of studies that support this view in terms of the behaviour of pre-service teachers in the USA. In one study Belland refers to an English professor: “Though she professed constructivism, Smith used a teacher-directed approach to lead her students to use constructivist strategies to teach English as a new language. She attributed this contradiction to her experiences as a student in teacher-directed classrooms, which instilled in her an unconscious teacher-directed pedagogy” (ibid:356).

Belland uses Bourdieu’s concept of *habitus* to explain why it is so difficult to change the ideas in folk pedagogies. *Habitus*, or set of one’s dispositions to appreciate or act in certain ways, is influenced by the totality of an individual’s life conditions and experiences. New experiences that attempt to alter or change the views already present in *habitus* would often be resisted. *Habitus* does not deny agency or change; it just makes it difficult, especially when individuals have been in school settings for such a long period of time. This is the reason behind Belland’s claim that teachers’ attitudes to change are more resistant than other professions, like law or finance.

By acknowledging the deep-rooted nature of the resistance, Belland suggest some ways in which teachers’ *habitus* could be changed through pre-service and in-service teacher training:

- Influencing a *habitus* should be capable of generating practices that conform to the intended outcomes

- Training programmes should be long enough to show links between alternative theories and practice
- Teachers should be exposed to models of teaching that demonstrate the benefits of alternative pedagogies

This could also explain why "resistance on the part of teachers, head teachers and educational officials consists partly of assumptions that run so deep that they are barely recognised formally (e.g. the division of knowledge into separate subjects, and the division of the school day into short time periods)" (Somekh, 2004:170).

Although much of what follows refers to technological innovation, it can be argued that schools possessing these characteristics tend to be the most inventive in all aspects of development.

An interpretation of Bourdieu's *social capital* has also been used to explain why schools have not adopted the use of technology. Li and Choi (2013), found that "the *social capital* of a school had a direct influence on teachers' receptivity towards technology use and their perceived effectiveness of professional development" (ibid:1). In their analysis, *social capital* is defined as an intangible resources deriving from the relationships among individual members of an institution" (ibid:2). Through a questionnaire based on teachers' attitudes towards perceived *social capital*, impact of professional development, change in pedagogical use of technology and student learning, Li and Choi concluded that: "In gist, the *social capital* of a school plays a pivotal role in effecting changes in pedagogical use of technology in teaching and learning" (ibid:13). In their terms, a school that possesses *social capital* is characterised by the following:

- Mutual trust between principal and teachers
- Effective communication channels between senior management and teachers
- Shared beliefs
- Goal alignment
- Sense of belonging
- Willingness to take risks
- Willingness to collaborate and share experiences

One of the common threads from this part of the review is the underlying importance of professional development opportunities for teachers within a supportive environment that recognises the personal risks teachers take when attempting actions outside their 'comfort zones'. These ideas of modelling, culture and sharing experiences feature in a number of sources (Li and Choi, 2013; Bonk, 2010; Belland, 2009; Tearle, 2003).

Many of the above commentaries refer to the importance of initial teacher training (ITT), as well as ongoing professional development. In the context of teacher training in the UK, the policy on teacher training is for more teachers to be trained 'on the job' in schools (Harrison, 2012). Less than 70% of teacher trainees are now trained in university, 23% and rising (2014) are now working in 'training schools'(DfE, 2014; Universities UK, 2014). Universities UK reports that the reforms endanger the levels of expertise in teacher training and leave many departments vulnerable, claiming that "the speed and magnitude of the change in allocations has led to questions being asked about the long term viability of delivering ITT courses in certain subjects, or even in the overall delivery of ITT" (Universities UK, 2014:2).

In addition to the reforms to teacher training, the Department for Education in England and Wales announced in 2012 that academy schools could employ unqualified teachers, thus bringing them in line with private and 'free' schools (Mulholland, 2012), and by the end of 2014 it was estimated that 400,000 school children were being taught by unqualified teachers (Wintour, 2014).

In this situation, there is a question of where innovation and research based developments will come from. In an environment of high stakes assessment and league tables, many schools are still reluctant to embark on what seems are risky innovative directions involving unproven technology.

The funding of educational technology has been common in the developed economies, through national grants for hardware and infrastructure. Some of the spending plans have been criticised for their lack of attention to how the new technology might have been used (Dale et al., 2004) and how some commentators feel that hardware had been dumped into schools without any consideration of school practices and cultures (Selwyn, 2011b). Others blame unrealistic expectations that undermined teachers' ability to integrate the technology (Convery, 2009). Other, more outspoken commentators would like policies to change direction and to support educational software publishers to produce interoperable solutions designed specifically for the educational market, rather than schools relying on generic software. This is exemplified by the post of one such blogger, entitled: *It's the technology, stupid!* (Weston, 2013b).

Selwyn concludes his discussion on the failure of schools to take on board educational technology by noting that "the advantage of attributing blame .. is that it isolates a neat set of institutional and practitioner deficits that, in theory, should be susceptible to change through further policy directives and funding streams" (2011b:35).

In practical terms, Selwyn asserts that the use of technology is a contested area full of conflict and struggle, he suggested that one way forward is the use of "*critical* accounts of the complex and often compromised realities of learner's *actual* uses of digital technology" (author's emphases) (2011b:36). This study of an intervention to bring the use of digital technology to an erstwhile 'traditional' classroom and curriculum is one such attempt and the research approach is targeted to meet these criteria.

A number of these issues will be addressed in later sections with reference to the success or otherwise of the intervention in this study.

2.8 Learning design and its representation

Laurillard (2012), makes the claim that teaching is a 'design science' closer to engineering and architecture than to natural sciences, and cites Herbert Simon's book, *The Sciences of the Artificial*, "..the natural sciences are concerned with how things are ... Design on the other hand is concerned with how things ought to be." (Simon, 1969:132). Dewey (2009), in an essay written in 1922, compares education to engineering and bridge building, "There is at present no art of educational engineering" (ibid:3). He argued that any educational progress or art will not develop without creative experimentation "it is ... fatal to postpone effort until we have the art and to try and deduce the art in advance from scientific knowledge .. we actually possess" (ibid:3). He regarded education at that time (1922) to be at a rationalization stage where educational theory and teacher training were progressing, but "where is the evidence of any corresponding change in practice? The most optimistic soul, if candid, will admit that we are mostly doing the old things with new names attached" (ibid:4). Dewey wanted to see thoughtful experimentation in classrooms to enable theories to develop, as in bridge building, "there was no art or science of modern bridge building until after the bridges of the new sort had been constructed" (ibid:2). In this context learning design could be said to contribute to this thoughtful experimentation.

Laurillard (2011), uses the term ‘learning design’ as a synonym for ‘pedagogy’, where she cites Pollard’s definition: “the practice of teaching, framed and informed by a shared and structured body of knowledge” (Pollard, 2010:5). The term ‘learning design’ is used to be more inclusive of all sectors of education from primary schools to higher education. She notes the contrasts between higher education and the secondary sector in that lecturers rarely document teaching plans, while secondary teachers are expected to produce structured, detailed plans for accountability. The two sectors do however, share the same lack of opportunity for learning about teaching and the time for training and reflection (Laurillard et al., 2011).

Learning design has also been addressed by Conole as one of the major recent developments in the progression of technological enhanced learning environments:

> “It is a methodology for enabling teachers/designers to make more informed decisions in how they go about designing learning activities and interventions, which is pedagogically informed and makes effective use of appropriate resources and technologies. This includes the design of resources and individual learning activities right up to curriculum-level design. A key principle is to help make the design process more explicit and shareable. Learning design as an area of research and development includes both gathering empirical evidence to understand the design process and the development of a range of learning design resources, tools and activities.” (Conole, 2013:8)

Both authors are concerned to enable teachers to achieve improved learning outcomes for their students and to find the most appropriate ways to use new technologies to assist this aim and to share resulting designs. Laurillard starts with the Conversational Framework (Laurillard, 2002), “a way of capturing the iterative, communicative, adaptive, reflective and goal oriented actions with feedback that are necessary to support the complete learning process” (Laurillard, 2008a:140).

Both Conole and Laurillard agree that that learning design includes not only the ‘product’ as in a physical artefact or scheme of work ready to be delivered, but also the process of designing the learning activities and sequences. These products can be seen at different levels of granularity, from a course syllabus to short learning tasks. The Open University Learning Design Initiative (OULDI) looked at how a learning design approach could help teachers in planning work for their students, while at the same time making better use of emerging technologies. The OULDI reported a number of benefits of a learning design approach (Conole and Wills, 2013:26):

> "It can be seen as a means of eliciting designs from academics in a format that can be tested and reviewed with developers, that is, a common vocabulary and understanding of learning activities
>
> It provides a means by which designs can be reused, as opposed to just sharing content
>
> It can guide individuals through the process of creating learning interventions
>
> It creates an audit trail of academic design decisions
>
> It can highlight policy implications for staff development, resources allocation, quality etc.
>
> It aids learners in complex activities by guiding them through the activity sequences."

When considering teachers' perceptions of the representation of learning designs, teachers "..stated that they wanted examples, preferably from their own subject disciplines and they wanted others to talk about design practices and ideas for learning and teaching." (Conole and Wills, 2013:27)

Laurillard makes a similar point when discussing aspects of the Learning Design Support Environment project (LDSE, 2011), one of the main aims of the LDSE project is to encourage teachers to 'build on the work of others', by using educational research findings and colleagues' teaching practices. Unfortunately it seems that few teachers in any sector look to educational research for their pedagogy (ibid), but are more willing to look for and share practices with colleagues. At the start of the LDSE project, lecturers from higher education were consulted on the structure of the tool and there were concerns about a template, gap filling tool that was not flexible. Research has shown that teachers may be resistant to the idea of generic learning designs, because they deny the specific subject context that teachers identify with. However, Laurillard (2008a:145), responds by referring to the many examples of generic learning designs:

- *Textbook*: text on paper, organised into chapters with titles, paragraphs, notes, illustrative diagrams, footnotes, exercises, answers, contents list, page numbers, indexes, bibliography, further reading;
- *Lectures*: one to many, one room, raked seating, tables for note-taking, presentation equipment, demonstration facilities;
- *Essays*: topic defined, reading list, word length, text on paper, explicit structure, explicit writing style.

Other common templates or pedagogic forms could include; structured schemes of work; lesson plans; generic activities to encourage learners to generate questions after a lecture; activities to encourage collaborative decision making etc. All of these examples can be transferred across subject boundaries. “The form captures the pedagogy, and it is the teacher’s task to interpret the form and customise it to their specific context. In this sense, generic pedagogic forms are commonplace throughout education.” (Laurillard, 2008a:145)

Kagan structures (Kagan, 2011), are another example of generic patterns used in schools to support techniques for collaborative learning. There is a big demand for training and resources in primary and secondary schools including 6th forms, indicating that there is a demand for well-written and presented ‘structures’ or patterns where teachers can see a benefit for themselves and their students. There have been a number of attempts to transfer this idea to digital contexts (Armellini and Aiyegbayo, 2010; Conole, 2010a; Li et al., 2010; Falconer and Littlejohn, 2007), but this project will utilise two; the OULDI and LDSE projects.

According to Conole, there are three main benefits of the visual representation of learning designs: “firstly, it can help guide the teacher’s thinking, secondly, it helps make the design explicit and sharable with others and thirdly it provides a way of representing and articulating the design process.” (2013:27)

One of the tools used in the OULDI is CompendiumLD, a software tool designed to help teachers create and visually represent their learning designs (Compendium Institute, 2012; Open University, 2011; Brasher et al., 2008). The software is periodically updated and can be freely downloaded from the project website (http://compendium.open.ac.uk/institute/).

The software uses a mind map graphical user interface (GUI), by which a designer can drag and drop icons that represent actors (students or teachers), actions (learning tasks etc.) and resources. These icons can be linked and annotated to create flow charts or sequences of activities.

The *Learning Design Support Environment* (LDSE, 2011), is a project that aims to use digital technologies to support teachers in designing effective technology-enhanced learning. In terms of pedagogy, the project aims to use that body of knowledge and learning theory that is available through the design principles of academic researchers.

The LDSE project is a design tool that enables teachers to develop and test their design ideas. This design tool: “elicits users’ conceptions of the learning design process; balances their requirements and concepts against the existing knowledge base of teaching and learning..; and provides a formal representation of the learning design that can be analysed in terms of the underlying principles” (Laurillard et al., 2011:3). Further background, detailed descriptions of the LDSE project and debate about the application of the software tool are available from a number of sources (Laurillard, 2012; Laurillard and Ljubojevic, 2011b; Laurillard et al., 2011; LDSE, 2011; Masterman and Manton, 2011; Laurillard, 2008a).

Both the CompendiumLD and LDSE applications were used to aid the design of the intervention in this study.

2.9 The Conversational Framework

In addition to the organising frameworks and design principles derived from the discussion and definition of independent learning in a previous section (2.1), an intervention of this nature needs to integrate further pedagogical frameworks in order to provide a firm theoretical foundation to the study.

The Conversational Framework was developed by Laurillard from ideas on conversation theory by Pask (1976) and others, including Kolb (Kolb and Kolb, 2005; Kolb, 1984) and was originally published as a framework for the effective use of educational technology (Laurillard, 1993). The Conversational Framework represents the communication processes that occur between students and teachers during the learning process. In Laurillard’s words (2008a:140) it was:

- developed from research on student learning;
- a combination of the theoretical perspectives of conversation theory, constructivism and reflective practice;
- an account of what it takes to learn in a conceptual domain, in a formal educational context;
- designed to provide a challenging framework for getting the best out of digital technologies.

Figure 2.8 illustrates the Conversation Framework, the key to the abbreviations used in the figure and those that follow are found in Table 2.5. The framework shown in Figure 2.8 demonstrates the teacher interacting with a learner; a learner interacting with another learner; learners adapting their practice; and learners reflecting on their practice to enhance understanding. Despite the origins, the model does not favour either face to face or technological communication, nor does it favour particular learning theories. Indeed Laurillard emphasises that the Framework includes attributes from a number of learning approaches (2011b:97): "Instructivism, on the presentation, tasks, learner activities, and advice and guidance from the teacher; Constructionism, on the practice environment and the nature of the task and feedback it provides for the student, and the means of producing a representation of their construct; Social constructivism, on the discussion between learners, and the sharing of their ideas; and collaborative learning, on the discussion between learners and the sharing of their attempts and doing the task".

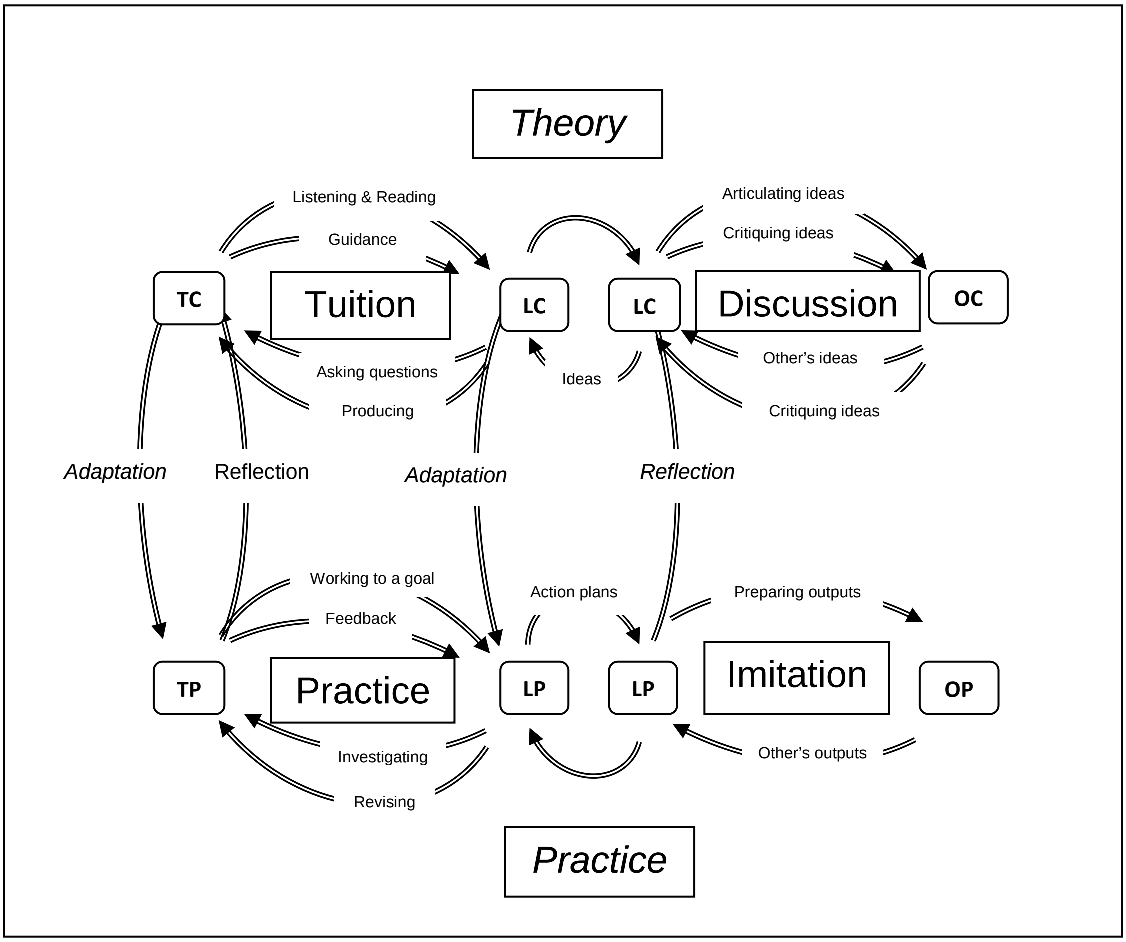


Figure 2.8 The Conversational Framework for learning and teaching (Laurillard and Ljubojevic, 2011b:96)

Abbreviation	Meaning	Abbreviation	
TC	Teacher's conception	TCC	Teacher communication cycle
TP	Teacher's practice environment for learners	TPC	Teacher practice cycle
LC	Learner's conception	TMC	Teacher modelling cycle
LP	Learner's practice	PCC	Peer communication cycle
OC	Other learner's conception	PMC	Peer modelling cycle
OP	Other learners practice	PP	Peer practice
TPME	Teacher's practice modelling environment	PC	Peer concepts

Table 2.5 Key to terms used in Conversational Framework figures

Laurillard distinguished between the upper half of the Framework (Figure 2.8), which she terms the theory level, where concepts are taught through tuition or discussion, where students can receive, argue, query and re-articulate them with the teacher and other learners. The lower half of the Framework represents the practice level. Here students adapt concepts to real problems and reflect on their practice to help their understanding. The differentiation between the two levels emphasises different aspects of feedback. The feedback in the upper, conceptual level is likely to be extrinsic, someone else's (a teacher or peer or computer) evaluation of performance, whereas at the practical level, feedback is likely to add intrinsic feedback from their own performance or output (2011b).

The representation, which has been derived from general principles of teaching and learning, can be used for evaluating any learning design format (ibid:98):

- Encourage contacts between students and faculty (upper left)
- Develop reciprocity and co-operation among students (upper & lower right)
- Use active learning techniques (lower left)
- Give prompt feedback (left)

In a later incarnation of the Conversational Framework, Laurillard has developed the model to emphasise four learning cycles within the representation (Figure 2.9), the numbers are described in Table 2.6.

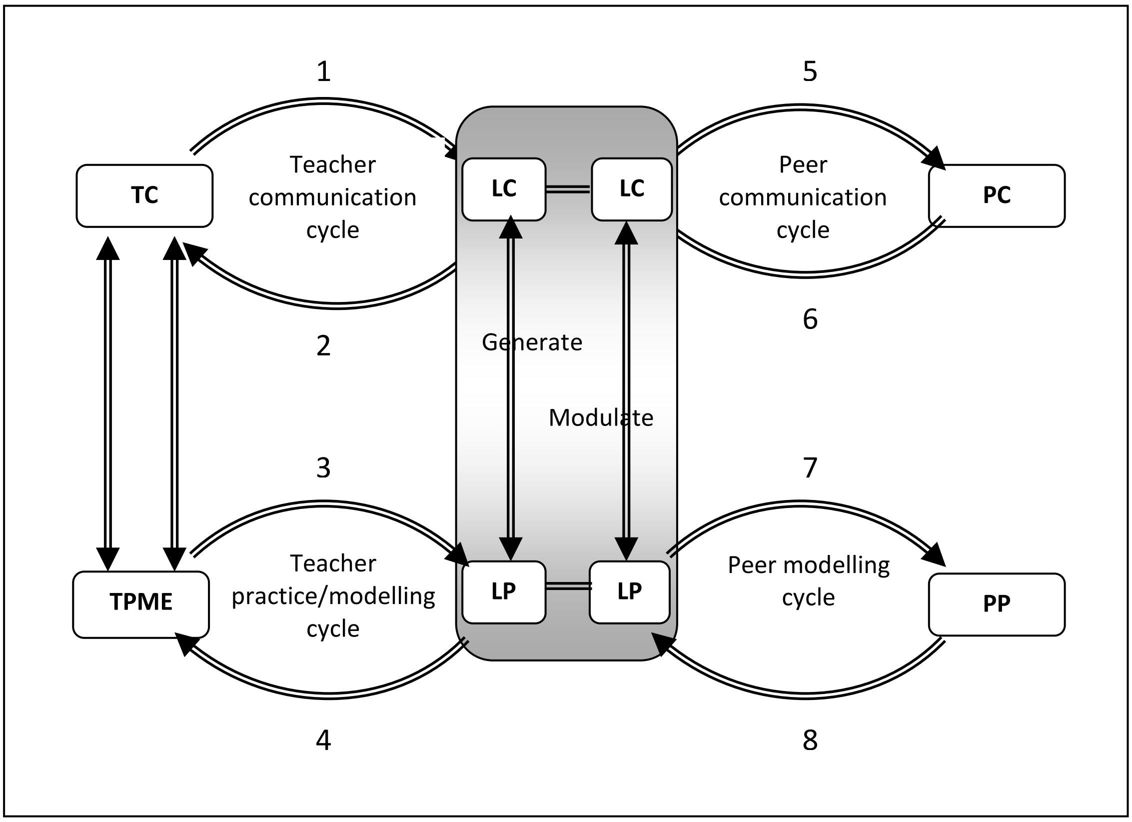


Figure 2.9 The learner learning through the four learning cycles (Laurillard, 2012:92)

The cycles are described in more detail in Table 2.6.

The Conversational Framework thus provides a guide to the various ways in which teachers can motivate and structure the learning process to include as many elements supported by theory as possible.

The teacher communication cycle (TCC)	
1	Enables each learner to modulate their concept by giving them access to the teacher's concept
2, 1	Motivates each learner to generate questions or articulations of their concepts and practice because the teacher is giving them extrinsic feedback
The teacher practice cycle (TPC)	
4, 1	Motivates each learner to modulate their practice by generating actions that elicit extrinsic feedback from the teacher
The teacher modelling cycle (TMC)	
4, 3	Motivates each learner to modulate their practice by generating actions that elicit intrinsic feedback from the modelling environment
The peer communication cycle (PCC)	
6	Enables each learner to modulate their concept by providing access to their peers' concepts
5, 6	Motivates each learner to generate articulations because they are getting extrinsic feedback from their peers
The peer modelling cycle (PMC)	
4, 7	Motivates each learner to generate actions in the practice environment because they are sharing the output of their practice
8	Enables each learner to modulate their practice by using the model of their peer's output.

Table 2.6 Descriptions of the learning cycles (Laurillard, 2012:94)

A number of studies have used Laurillard's Conversational Framework to guide the design of programmes of study and/or evaluate the programmes to examine the breadth of experience provided for the students.

Field and Kent (2006), combined the Conversational Framework, a commitment to active learning and a blended learning delivery model to re-design a first year law course. They wanted a framework that would provide a clear structure and a theoretical foundation for their learning designs. They found that the model supported their commitment to Ramsden's (1992) six principles of learning and formed a secure basis for re-designing their course.

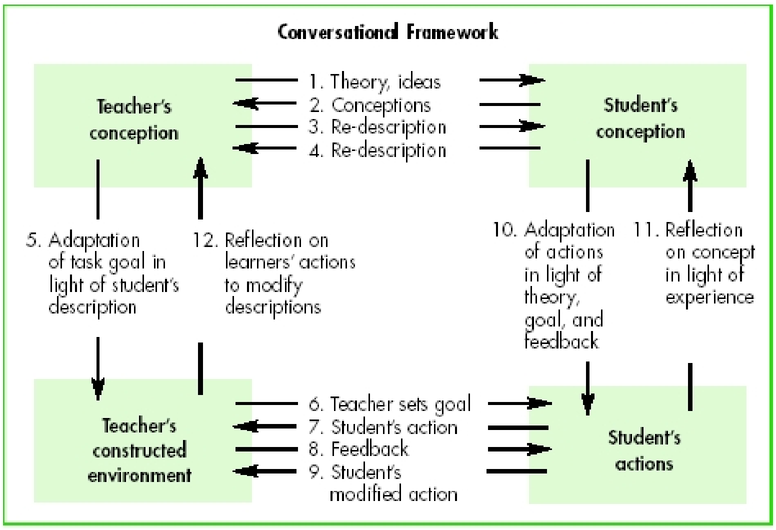


Figure 2.10 Laurillard's Conversation Framework 12 steps (Laurillard, 2002)

A similar study was carried out by Heinze, Procter and Scott (2007), who used the twelve stages of Laurillard's (2002) original model (Figure 2.10) to guide the design of an Information Technology course for part-time adult learners, through a medium of blended learning. They found the staff were not very willing to engage with the framework, which they found 'complicated' and difficult to apply. The study also found that students were unwilling to complete formative activities, discussions and reflective activities. One of the conclusions was that using the Conversational Framework was a useful start and a sound theoretical foundation for planning a blended learning course, but the model "relied heavily on student and staff willingness and ability to take part in the dialogue" (ibid:117). At the end of the study, the authors create a revised model to suit their learners, involving structured work surrounding the summative assessments and the introduction of multiple learners.

The motivation behind Neo et al.'s (2013) study of a course re-design, was to challenge passive learners; introduce active learning; attempt to engage the students; develop independent learning and to introduce educational technology into the learning process. Again the authors followed the twelve stage model (Figure 2.10) of the Conversational Framework, but experienced a more positive outcome. They found the course re-design had indeed engaged the students who had responded well to the emphasis on dialogue and the authors regarded the enhanced relationships between teachers and students as being very successful. The relationships between students and the teacher were very much improved by structuring the guidance, feedback and teacher presence. Student-student relationships developed through collaboration and communication. The students contributed to blogs and peer support and assessment. The relationship between teacher and technology was behind the progress made, through the design of a platform to structure and guide the course. The student-technology relationship enabled the students to create a collaborative learning community, negotiating with teachers and other students. The authors concluded that the model "was an effective framework to design a learning environment that would encourage improved student participation and engagement, and was able to yield several important interrelationships between the teacher, students and technology" (Neo et al., 2013:49).

2.9.1 Using the Conversational Framework for evaluating learning design

In their chapter; *Evaluating Learning Designs through the Formal Representation of Pedagogical Patterns* (2011b; 2009), Laurillard and Ljubojevic link learning design to Design Principles of good practice to the development of pedagogical patterns and the representation of those patterns. Two methods of representing pedagogical patterns have been discussed previously. The LDSE is underpinned by the Conversational Framework (CF). The LDSE and CF can further be used to evaluate the learning design against the intended outcomes and/or learning approaches. "Given the Conversational Framework as a representation of what it takes to learn, in principle we should be able to test the pedagogic value of a learning design by showing which aspects of the framework it conforms to and therefore which learning theories it matches" (Laurillard and Ljubojevic, 2011b:98).

By analysing the learning activities or sequences within a series of lessons against the CF, it should be possible to expose deficiencies in respect of the design by using the quadrants of the CF model shown earlier (*Figure 2.8 The Conversational Framework for learning and teaching (Laurillard and Ljubojevic, 2011b:96)*). In their chapter, Laurillard and Ljubojevic map Learning Activity Management System (LAMS) activities against sections of the CF model. In this study, Moodle, an open source LMS was used, and an adapted figure showing Moodle activities mapped against the appropriate parts of the CF model is shown in Figure 2.11.

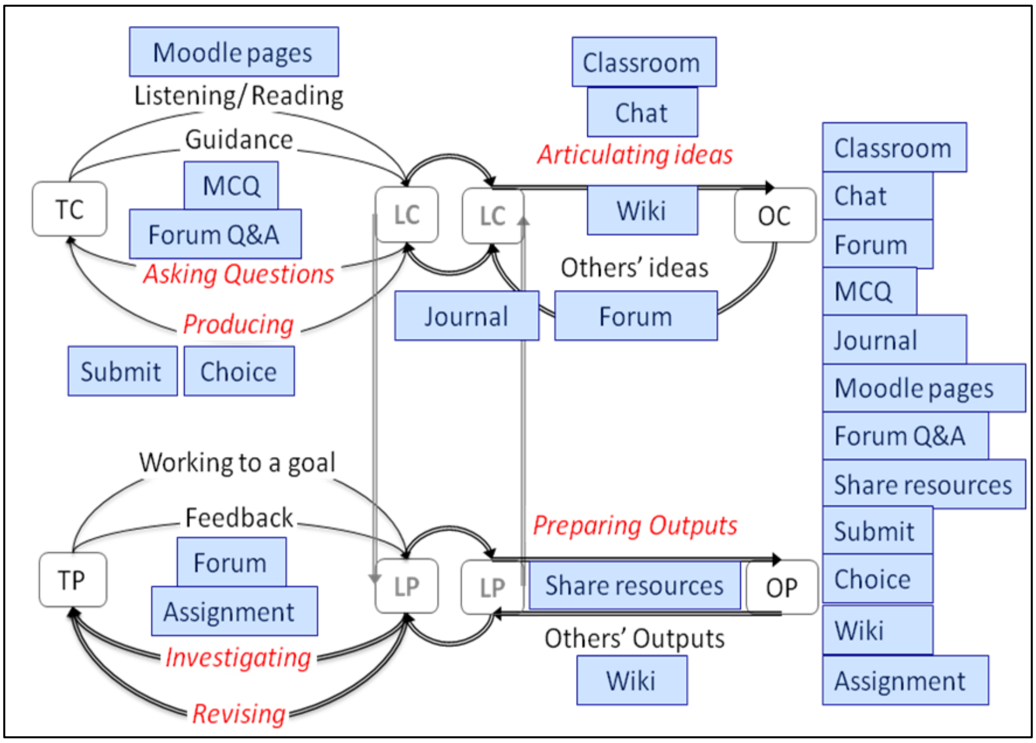


Figure 2.11 Mapping Moodle activities to Conversational Framework adapted from Laurillard and Ljubojevic (2009:19)

This linking of the Moodle activities to the CF allows teachers and designers to plan lessons and series of activities using the library of teaching and learning activities (TLAs) available in the LDSE, under the learning types described in Table 2.7 and to examine whether the sequence of sessions contains elements of all the cycles shown in Figure 2.9.

Learning types	**Conventional technology**	**Digital technology**
Acquisition	Reading books, papers; Listening to teacher presentations face-to-face, lectures; Watching demonstrations, master classes.	Reading multimedia resources, websites, digital documents and resources; Listening to podcasts, webcasts; Watching animations, videos.

Inquiry	Using text-based study guides; Analyzing the ideas and information in a range of materials and resources; Using books, people, field trips, to collect data for analysis; Comparing texts, searching and evaluating information and ideas.	Using online advice and guidance; Analyzing the ideas and information in a range of digital resources; Using digital tools to collect and analyze data; Comparing digital texts, using digital tools for searching and evaluating information and ideas.
Practice	Doing practice exercises; using tools; doing practice-based projects, labs, field trips, face-to-face role-play activities.	Using digital tools, models, simulations, digital games, microworlds, virtual labs and field trips, online role-play activities.
Production	Producing their own representations of what they have learned, using statements, essays, reports, accounts, designs, performances, artifacts, animations, models, videos.	Producing and storing digital documents, representations of designs, performances, artifacts, animations, models, resources, slideshows, photos, videos, blogs, e-portfolios.
Discussion	Tutorials, tutor groups, student seminars (students leading discussion), discussion groups, class discussions.	Online tutorials, tutor groups and seminars, email discussions, discussion forums, web-conferencing tools (synchronous and asynchronous).
Collaboration	Small group project, discussing other students' outputs, creating a joint output.	Small group project, using online forums, wikis, chat rooms, etc. for discussing other students' outputs, building a joint digital output.

Table 2.7 Types of learning and support from conventional and digital technologies (Laurillard, 2012:96)

During the intervention of this study, the project team created learning designs that use those learning cycles appropriate to the context and the intended outcomes. These sequences in the intervention were evaluated from the perspective of the Conversational Framework.

2.10 The Community of Inquiry

In his book, *E-Learning in the 21st Century*, Garrison makes the point that e-learning has its roots in the collaborative traditions of computer conferencing rather than in the individualistic traditions of distance education or correspondence courses (2011). Originally developed around the analysis of text-based asynchronous group communications in higher education (Garrison et al., 2000), the Community of Inquiry (CoI) framework developed "a conceptual framework that would provide order, heuristic understanding and a methodology for studying the effectiveness of computer conferencing" (Garrison et al., 2010:6). Since its initial development and refinement, the CoI has been applied to all modes of e-learning including blended learning, the context of this study, notably developed by Garrison and Vaughan (2008).

The CoI is a theoretical framework that "represents a process of creating a deep and meaningful (collaborative constructionist) learning experience through the development of three interdependent elements – social presence, cognitive presence and teaching presence" (Garrison, 2011:22). The relationship between these factors is represented in Figure 2.12.

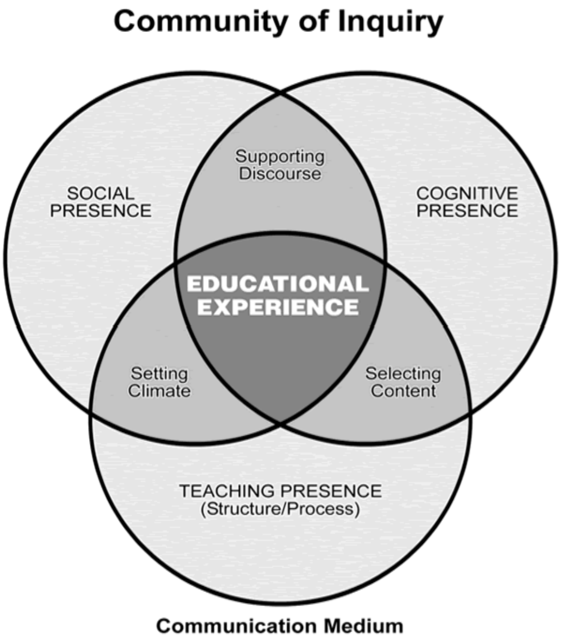


Figure 2.12 Community of Inquiry Framework (Garrison et al., 2010)

The CoI framework is centred around the notion of an educational community "a formally constituted group of individuals whose connection is that of academic purpose and interest who work collaboratively towards intended learning goals and outcomes" (Garrison and Vaughan, 2008:17). This is emphasised in Social Presence, the ability of members of the group to be able to communicate purposefully in a trusted environment, whose climate is set by the teacher. While this element of the CoI was initially at the heart of the framework, the primacy of Social Presence has been questioned and, it is claimed, over-emphasised, especially in hybrid or blended learning environments (Annand, 2011). While collaborative online group work is an important element of e-learning at all levels, Social Presence, where the teacher facilitates and supports online discussions in virtual learning environments and face to face discussions in class, it seems to be the one element that has received the most critique and 'requires further investigation' (Xin, 2012; Annand, 2011; Garrison et al., 2010; Shea and Bidjerano, 2009).

The Cognitive Presence element of the CoI is designed to encourage higher level thinking and learning through a practical inquiry model comprising four phases. The process starts with a triggering event, where a problem or issue is presented, followed by exploration where students search for and discuss relevant information and ideas. Having researched the topic, students begin to integrate the information and ideas, tentatively suggesting solutions to the initial problem. In the final phase, the resolution, students test the supposed solution through, for example presentations and discussions, or through individual or group projects. Garrison and others accept that the challenge for teachers is to move students through these phases, with many research studies indicating that students were not proceeding to the resolution phase (Shea et al., 2012; Akyol and Garrison, 2011; Garrison et al., 2010). The most common explanation is that "previous research methods have resulted in a systematic underrepresentation of the instructional effort involved.." (Shea et al., 2012:90). Another reason why this process may be undeveloped is the nature of the discipline. It has been argued that the CoI might be best suited to 'soft' disciplines where theories are more contested than 'hard' subjects like biology, where theory is more established and the emphasis is more on knowledge acquisition (Annand, 2011). Whether facilitating discourse between students, or creating the learning activities to carry students through the phases of Cognitive Presence, the evidence suggests that more emphasis be placed on the third element in the framework; Teaching Presence.

According to the CoI, Teaching Presence is defined as "the design, facilitation and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes" (Anderson et al., 2001:5), and includes three distinct roles for the educator; design and organisation, facilitation and direct instruction. Redmond, (2011) has summarised these roles as 'visible actions' that teacher makes throughout the course (Table 2.8).

Categories	Indicators
Instructional design and organisation	• Setting the curriculum • Designing methods • Establishing time parameters • Utilising medium effectively • Establishing netiquette; and • Making macro-level comments about course content

Facilitating discourse	• Identifying area of agreement/disagreement • Seeking to reach consensus/understanding • Encouraging, acknowledging or reinforcing student contributions • Setting the climate for learning • Drawing in participants, and prompting discussion • Assessing the efficacy of the process
Direct instruction	• Presenting content/questions • Focusing the discussion on specific issues • Summarising the discussion • Confirming understanding though assessment and explanatory feedback • Diagnosing misconceptions • Injecting knowledge from diverse sources; and • Responding to technical concerns

Table 2.8 Teaching presence categories and indicators (Redmond, 2011:1052)

There are clear parallels between Learning Design, discussed earlier and Teacher Presence. As mentioned above, it is only with the reflections of hindsight that the importance of learning design has become evident in discussions of the CoI, as discussed in the special issue of the Internet and Higher Education journal; *The community of inquiry framework, ten years later*, (Swan and Ice, 2010).

The CoI framework has been the basis of a number of research studies into e-learning, looking to explain and prescribe the teaching and learning process (see Swan and Ice (2010), Garrison (2010) and Arbaugh et al. (2008) for discussion of the qualitative and quantitative studies). The need for a way to test the validity of the framework was met by the production of a 34-item CoI survey instrument, which has been tested and validated in a number of institutions. The survey used Likert scale responses to sets of statements divided into the three elements, Teaching Presence, Social Presence and Cognitive Presence (Arbaugh et al., 2008).

The CoI has been one of the most popular frameworks for the analysis of e-learning and there have been a number of critiques, mainly focussing on the differing definitions of terminology (Xin, 2012; Jezegou, 2010) or the over emphasis of Social Presence (Annand, 2011). Further critiques, (Shea et al., 2012; Shea and Bidjerano, 2010), question whether the CoI can fully explain learner behaviour and examines links with the framework to important work on self-regulation, acknowledging that e-learning, whether fully online or blended in nature requires significant levels of self-regulation or independent learning skills among the participating students, the focus of this study. As a result a fourth element, Learning Presence is proposed that better explains the link between Teacher Presence and Cognitive Presence. Learning presence is characterised by a combination of self-efficacy and individual effort. Addressing fully online and blended learning courses: “Learning presence is evident where learners are asked to actively collaborate ... asking students to collaborate more deeply through instructional design that includes complex forms of collaboration appears to foster learning presence ..” (Shea et al., 2012). Shea’s earlier research, (2010), suggested that ideas about learner self-regulation should inform the role of learners within the CoI. Central to this interpretation is the notion of ‘self-efficacy’. In this research ‘self-efficacy’ is defined as “a subjective judgement of one’s level of competence in executing certain behaviours or achieving certain outcomes in the future” (ibid: 1723). It is also reported that self efficacy is a good predictor of learning outcomes. The link with self-regulation is made through the requirement of positive self-efficacy beliefs in order for learners to see their achievements as under their own control, rather than a matter of a given set of abilities. In the context of preparing learners for higher order thinking and learning, part of the teacher presence must be to introduce students to skills of self-analysis and reflection.

Figure 2.13 shows the relationships between elements in the revised model. Learning Presence was coded from a scheme that included indicators that were derived from the self-regulation literature, and in the studies reported showed significant correlation with course grades (Shea et al., 2012). The CoI provides a clear summary and theoretical framework for examining the processes involved in the design and evaluation of an e-learning course.

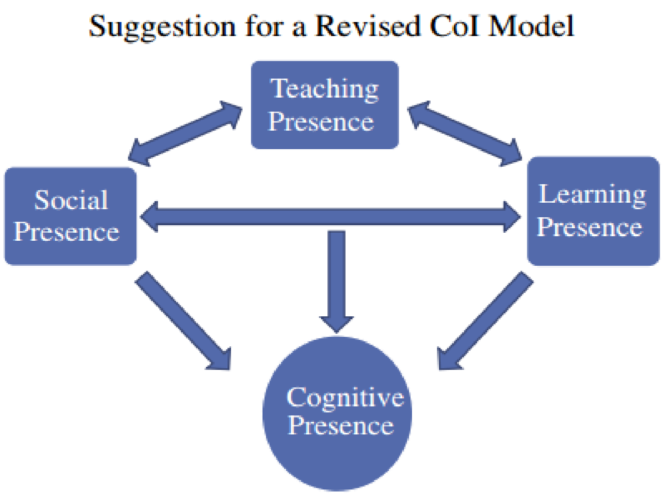


Figure 2.13 Revised Community of Inquiry model (Shea et al., 2012)

This framework integrated the presences of CoI into all aspects of the development of the intervention in this case study, and complemented Laurillard’s Conversation Framework cycles. Learning design and the teacher concepts cycles emphasised the role of teacher presence, the peer communication cycles complemented social presence and the modelling cycles included elements of the learning and cognitive cycles.

Chapter 3. Methodology

In the previous section, it became clear that the impact of technology on teaching and learning has been less than anticipated in comparison to its influence on other social and commercial fields. Some of the common issues that have prevented the establishment of educational technology innovations have been identified; these included poor alignment between innovations and classroom realities; over estimation of the interest, motivation and technological literacy of teachers and students; and the emphasis on delivery rather than pedagogy.

As far back as 1995, Schön was suggesting that a new epistemology was required to inform educational research:

> "If integration, application, and teaching are to be taken as "forms of scholarship" in other than a Pickwickian sense, the new scholars must produce knowledge that is testably valid, according to criteria of appropriate rigor, and their claims to knowledge must lend themselves to intellectual debate within academic (among other communities) .. if the new scholarship is to mean anything, it must be a kind of action research with norms of its own". (1995:26)

In suggesting this course of action he acknowledges that this creates a form of dilemma between traditional notions of rigour and relevance. To illustrate this he created an analogy of landscape topography, cited by McKenney (2013) and used by Fullan and Donnelly's *Alive in the Swamp* (2013) publication referred to in Chapter 2.

> "In the varied topography of professional practice, there is high, hard ground overlooking a swamp. On the high ground, manageable problems lend themselves to solution through the use of research-based theory and technique. In the swampy lowlands, problems are messy and confusing and incapable of technical solution. The irony of this situation is that the problems of the high ground tend to be relatively unimportant to individuals or society at large, however great their technical interest may be, while in the swamp lie the problems of greatest human concern. The practitioner is left with a choice. Shall he remain on the high ground ... or shall he descend to the swamp of important problems where he cannot be rigorous in any way he knows how to describe?" (Schön, 1995:26)

Research in the 'swampy lowlands' presents a myriad of difficulties and those willing to embark on this type of research have challenged Schön's dilemma that rigour and relevance are mutually exclusive (McKenney and Reeves, 2012; Reeves, 2011). This will be addressed later in this chapter.

McKenney refers to the perspective of teaching and learning and designing activities that move from the current situation to the desired situation as the 'zone of proximal implementation'. McKenney takes Vygotsky's concept of proximal development and applies it to what can be implemented by teachers and schools. "The zone of proximal implementation refers to the distance between what teachers and schools can implement independently and what they can implement through guidance or collaboration" (McKenney, 2013:4).

McKenney and Reeves identify four characteristics of innovations that tend to successful implementation; value added innovations offer improvements to the current system; they are clear, in that participants can visualise this improvement and their own involvement; they are compatible with existing values and cultures; and tolerant to adaptation in a variety of contexts. Table 3.1 shows the methodological implications for such research.

	Before design (needs/context analysis)	During design (prototyping and formative evaluation)	After design (summative evaluation)
Value-added (better than status quo)	Learning practices, problems, outcomes *in the baseline situation*	Learning practices, problems, outcomes *during use*	Learning practices, problems, outcomes *with all implementation scaffolds removed*
	Observation, learner work/assessments, document analysis, brief questionnaires (e.g. learning environment rating scales) to study enacted curriculum; focus groups and interviews to get teacher perceptions		
Clear (participants can envision their involvement)	Mindsets, habits and conventions within the classroom/school *in the baseline situation*	Mindsets, habits and conventions within the classroom/school *during use*	Mindsets, habits and conventions within the classroom/school *that are sustained or changed after the innovation*
	Interviews, observations, and logbooks to track how clearly professionals understand their role and how actively they engage in it		
Compatible (compatible with values, beliefs, surrounding educational context/system)	Values, cultures, beliefs, priorities, and contextual /system factors *in the baseline situation*	Values, cultures, beliefs, priorities, and contextual /system factors *that help or hinder implementation*	Values, cultures, beliefs, priorities, and contextual /system factors *that are sustained or changed after the innovation*
	Observation, interviews, document analysis to understand and track how alignment between the innovation and other determinants of implementation		
Tolerant (withstands the natural variation of actual use)	Actual behaviours of teachers and learners and reasons for them *in the baseline situation*	Actual behaviours of teachers and learners and reasons for them *during use*	Actual behaviours of teachers and learners and reasons for them *with all implementation scaffolds removed*
	Observation, interviews and document analysis to understand what teachers and learners actually do and why		

Table 3.1 Methodological considerations for researching TEL innovations at the zone of proximal implementation (McKenney, 2013:6)

The implication is that research into the development of such innovations needs to consist of collaborative actions between practitioners and researchers. In order to undertake such collaborative research, appropriate forms needs to be chosen. McKenney cites Wagner's (1997) taxonomy of different forms of researcher practitioner co-operation: "data extraction agreements (researchers are outside schools and engaged in reflection; practitioners are inside schools and engaged in action); clinical partnerships (researchers and practitioners remain in their usual places, but engage in reflection together ..); and co-learning agreements (researchers and practitioners collaborate on processes and of action and reflection)" (McKenney, 2013:7). In this study the researcher and practitioners worked together in the third type of agreement, working in the school to design, implement and evaluate the innovation.

The following sections will outline the research questions in this study and develop the ideas underpinning the research methodology outlined above.

3.1 Research questions

The methodology for this study is based around the following research questions, the phrasing of the first research question has been guided by the work of Plomp (2009:19) in his descriptions of design/development research:

> "what are the characteristics of an <intervention X> for the purpose/outcome Y (Y_1, Y_2,), in context Z"

Research question 1. What are the characteristics of:

d) blended learning sequences that can develop independent learning behaviours in an A level science course?
e) a TELE that will promote student engagement in the new course?
f) an educational context that encourages the effective use of educational technology?

Research question 2:

Do students learning from a blended learning re-design improve SRL as measured by the motivational strategies learning questionnaire (MSLQ)?

Research question 3:

How effective is the chosen collaborative educational design-research approach in investigating an authentic educational challenge in a living educational context?

This section will outline the approaches used in this research project. It will discuss briefly some past and current debates about 'rigour' and 'relevance' in educational research and educational technology research in particular. There will be a justification of the research approach taken in this study and acknowledgements of the challenges that taking this approach entails. This type of research approach demands a great deal from the researcher and practitioners involved and this aspect is discussed at some length. The final part of the section deals with notions of validity and the criteria by which this should be judged in this study.

3.2 ‘What works’ and the evidence-based debate

Whenever governments announce that education is in crisis, educational research comes in for criticism (Cameron, 2011). In order to try and counter so-called ideological criticisms of the education system, Estelle Morris in February 2012 called for evidence-based research to inform both practice and policy in the form of an Office of Educational Improvement (Morris, 2012). One of the main arguments stated was to remove education policy from the political arena. This argument for evidence-based education is reminiscent of the debate following David Hargreaves’ speech in 1996, where he criticised the reputation and purpose of much education research and practice, as being fragmented, noncumulative, and methodologically flawed, with researchers often engaged in disputes about philosophy and methodology (Hargreaves, 1996). These ‘wars’ between qualitative and quantitative have become ‘normal science’ in educational technology research and educational research generally (Jones and Kennedy, 2011).

Hargreaves asserted that after qualification, teachers rarely read research and “do not regard it as a guide to the solutions of practical problems” (1996:4). He went on to argue that both education research and practice should be at the heart of evidence-based education – proposing an organisation similar to that mentioned above by Estelle Morris, a National Education Research Forum (ibid: 10). Much of the argument rests on the push towards experimental research that will provide secure evidence about “what works” (Biesta, 2007). In the USA, these ideas have shaped research funding. The ‘No Child Left Behind’ policy has favoured the ‘gold-standard’ randomized controlled trials (RCT). Indeed in some areas it is the prescribed methodology for educational research. The argument uses the examples of medicine, transportation, agriculture and technology as examples of systematic improvement through experimental research (ibid) (Slavin, 2008a; Slavin, 2003).

Opposition to the notion of this interpretation of evidence-based education focuses on the question of homology between education and these other fields, the reliance on experimental and positivist methodologies and the implications of a hierarchically structured school improvement environment. The UK National Strategies are an example of such ‘imposed’ practices. Many of the critics of evidence-based research argue that so important is the notion of context in educational studies that the best that can be said of such research is that; this is what worked, here, at that time and in these particular circumstances (Biesta, 2007).

Slavin, a keen supporter of evidence-based research, refers to the success of syntheses of 'best-practice' for example, the 'What Works Clearing House' and the 'Best Evidence Encylopedia' (Slavin, 2008a). These programmes bring together high-quality examples of research that meet the specifications for inclusion. These specifications require that items follow an experimental design, using the principles of randomised controlled trials, or at least large well-controlled matched designs. In response to some criticism of his original article, Slavin defends the idea of objective research databases, and argues that even though context is important in how innovations are implemented, and effect sizes do not tell all about new programmes, these syntheses offer the best solutions to practicing teachers looking for successful innovations (Slavin, 2008b).

Some have rejected these synthesis programmes as fatally flawed because of the difference in the assessments and impacts accorded to the various studies (Reeves, 2011; Schoenfeld, 2009).

This aim of this study is to produce learning design principles concerning sequences or pedagogical patterns that will encourage the development of independent learning skills. If these are seen to be successful, i.e. they 'work', a rigorous research approach is required to ensure credibility. This will be discussed in the following sections.

3.3 Educational technology research

Research into education technology has been blighted for years by the 'no significant difference phenomenon'. Russell (2001), collated a bibliography of media comparison studies in education, comparing student outcomes between face to face and distance delivery courses. These studies went back as far as 1928, looking at technological developments from radio, television, film to the internet, the overwhelming number of studies showed 'no significant difference' between the two modes of delivery.

In Hattie's (2009) meta-analysis of innovative education treatments, the 'top performers'; feedback to students and teachers (0.7 – 1.0), teacher clarity (0.77) and whole class interactive teaching (0.88), by far outweigh technological innovations like computer assisted learning (0.3), simulations and games (0.3), web-based learning (0.18) in terms of effect sizes beyond the 'hinge point of 0.4'.

These studies say a great deal about the management of technology in education and the nature of research into technology in education. The results from these reports show that there is nothing inherent in technology that will improve teaching or learning.

One explanation is that these studies fail because they “confound educational delivery modes with pedagogical methods” (Reeves, 2011: 8). Reeves predicts that future research into comparative media studies involving iPads and tablet computers will also return more ‘no significant differences’. Much of the research in this area concentrates on the technology rather than pedagogy:

> “We need to stop being seduced by technology and trivial applications masquerading as an educational experience. Much of what we have experienced during the first decade of the 21st century is an infatuation with personal information and communication made possible by ubiquitous and expensive technologies ... (whose) influence in the educational sector remains on the periphery and its potential is largely unrealized. The problem is that in the past educators focussed too much on the technology and not enough on examining the deficiencies, limitations, and dissatisfaction with the existing pedagogical practices common in higher [this could apply to all phases] education. The question is not what technology can do but what are the educational needs.” (Garrison, 2011: 123)

This project will attempt to identify the educational needs of the students and re-design the pedagogy using appropriate technological tools. The research approach discussed in the next section will attempt to align the aims and purposes of the study with an appropriate research paradigm.

3.4 Research approach

The research approach chosen to investigate educational technology is based upon the philosophical assumptions regarding interpretations of epistemology and ontology of the researcher. In general, quantitative research is carried under the assumption of objectivity, a reality which can be observed and measured, while qualitative research is conducted under the assumption that reality is socially constructed and that multiple realities exist that are essentially local and context based. As far as epistemology is concerned, quantitative research is confirmatory and deductive, while qualitative research is largely explorative and inductive (Luo, 2011).

In discussion of the different approaches to research into the use of educational technology, Luo (2011) provides a succinct summary of how these different interpretations might impact upon the research. Luo identifies the four main perspectives and these are summarised in Table 3.2.

In pragmatism, Luo states that it offers researchers a “third choice besides basic research and ethnography, which draws upon the strengths of both quantitative and qualitative methods to address certain research questions” (ibid:5). However, there are still some qualitative researchers who are suspicious of any research tainted by quantitative methods; "mixed methods research offers particular strengths and that although it serves as a Trojan Horse for positivism, it may productively carry other paradigmatic passengers" (Giddings, 2007:1).

Philosophical Perspectives	Ontology	Epistemology	Implication for Research
Objectivism and Realism	Reality exists in terms of properties and relations between its entities	Learning is recreating a correct representation such properties and relations in human mind	The effectiveness of an educational intervention can be determined by objectively assessing learners' mastery of "knowledge" demonstrated by a series of pre-specified behaviors.
Idealism and Rationalism	Our mind shapes the world as we perceive it. Reality is a mental representation.	Knowledge is acquired through intellectual and deductive reasoning rather than the sensory experience.	Educational research should shift its focus from examining the change of learners' behavior to the change of the mental structure and organization in learners' mind
Relativism	Absolute truth and reality does not exist. Meanings of experiential or physical events are constructed within the relationship between them.	Truth and falsity are relative to the observer and its cultural context. Knowledge is socially, culturally and experientially constructed, local and specific to the observer and the context.	Research should be conducted in naturalistic settings without controlling extraneous variables. It should allow learners to describe their experience and construct their own reality.
Pragmatism	Truth and reality is contemporary, ever-changing and a matter of degree, determined by its real effects and practical consequences.	Knowledge is essentially a plan of action, and proposes practical ends to be attained. Pragmatism emphasizes the genetic and instrumental character of knowledge.	It offers researchers a philosophical and methodological middle ground, allowing both quantitative and qualitative data collection and analysis methods to be used to address certain research questions.

Table 3.2 Ontology, epistemology and research implications of four philosophical perspectives (Luo, 2011:5)

One of the emerging trends in research into education technology is the use of design-based research (DBR) within case studies (Wang and Hannafin, 2005; Design-Based Research Collective, 2003). Based on a pragmatist approach, and relying on an appropriate mix of methods, DBR could be said to "include the use of induction (or discovery of patterns), deduction (testing of theories and hypotheses), and abduction (uncovering and relying on the best of a set of explanations for understanding one's results)" (Luo, 2011:10). These approaches will be discussed further below.

3.4.1 Educational Design Research (EDR)

Design research was first conceptualised in the 1990s. It has been called 'design-experiment', 'development research' or 'design-based research' (DBR); in this study the term 'educational design research' (EDR) will be used. Cohen and Manion (2011), include this research approach in their section on 'experiments', although noting that it does "not conform to the requirements of an experiment .. it has been termed (misleadingly) a design experiment" (ibid: 330). One of the first proponents of the method was a design scientist who was aiming to "engineer innovative educational environments and simultaneously conduct experimental studies of those innovations" (Brown, 1992:141), and who emphasised the dual goals of "contributing to a theory of learning, a theoretical aim that has always been a keystone of our work, and contributing to practice" (ibid:143).

The development of educational design research was largely motivated by a desire to make research more relevant to educational policy and practice. As mentioned previously, the weak link between educational research and practice was becoming a major concern (van den Akker et al., 2006; Reeves et al., 2005; Hargreaves, 1996). It was also a time when some researchers were questioning the ontological assumptions of most published research into instructional technology. This research assumed that education is part of an objective reality that could be studied like the 'natural sciences' like biology and chemistry, and supported mainly positivist experimental research methods like random controlled trials (RCT).

In his critique of Hargreaves, Elliott (2001), discusses the notion of an 'engineering model' of research, aiming to exert a direct influence on educational practice, as opposed to an 'enlightenment model' which aims to shape ideas and is largely theoretically based. Elliott claims that Hargreaves' aim to " uncouple his endorsement of an engineering model of social and educational research from the charge that it presumes a crude and naive positivism" is only partly successful, questioning the process of continuously investigating exceptions to social science generalisations (Elliott, 2001:557). Unlike an engineering project which ends with a product, design research is iterative, refining the 'design' to enable practitioners to see ways in which the 'design principles' can be adapted to new contexts.

Another impetus for the development of this research approach was the advent of new technologies. The growth in the internet and interactive technologies posed a challenge to educational institutions.

Research into education technology has mirrored the changing fashions in learning theories. The arrival of new technologies (film, programmed instruction, television, computers), has been accompanied by claims of the potential 'transformation' of education, only to result in disappointment (Somekh, 2004; Cuban et al., 2001).

Educational design research (EDR) has gradually become the preferred approach to studying educational technology; the main factors that appealed to this field were the fact that it addressed complex problems in real contexts in collaboration with practitioners. This research approach generated a great deal of interest and special issues devoted to EDR were produced during 2003 and 2004: (*Journal of the Learning Sciences*, vol. 13 no.1; *Educational Researcher*, vol. 32, no. 1; and *Educational Psychologist*, vol. 39, no.4).

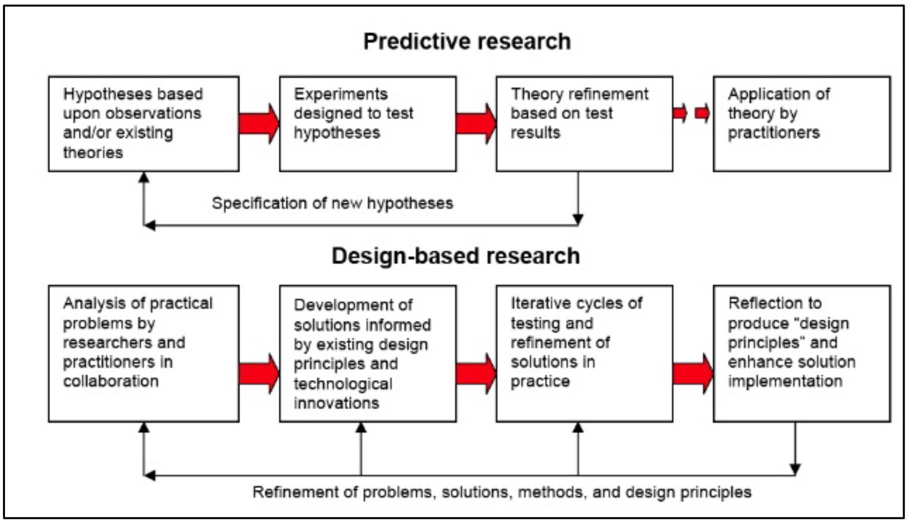


Figure 3.1 Predictive and design research approaches in educational technology research (Reeves, 2006:59)

The structure, definition and methodology of EDR (Figure 3.1) can be divided into nine major areas based on Anderson and Shattuck's analysis of ten years of progress (2012) and Conole's interpretation of the methodology (2010a). The following account will consider these areas and note how the present study conforms to this approach:

Being Situated in a Real Educational Context

This provides a sense of validity to the research. This study was located in a secondary school (see later research context), that is ‘typical’ of secondary schools in the area.

Analysis of a Practical Problem

In this research approach, the identification of a real problem was the first step. The identification of the problem creates the purpose for the research. The identification of the issue under study, the lack of independent learning skills in sixth-form students was the result of a number of formal and informal meetings with schools prior to the start of the study. The collaborative discussions that followed created the proposed interventions which became the focus of this study.

Driven by Theory and Prior Research

This work builds on a substantial body of work regarding Communities of Inquiry (Garrison, 2011; Salmon, 2011) which offer a theoretical framework for the establishing and sustaining online communities in a discourse of inquiry; the conduct of blended learning where face to face contact is supported by online activities (Vaughan, 2010; Garrison and Vaughan, 2008); Laurillard’s Conversation Framework (Laurillard, 2012) which offers a model of interactions that support teaching and learning in any environment, but is especially relevant to online or blended learning was central to the project.

Focussing on the Design and Testing of a Significant Intervention

The context of this work is significant in that the vast majority of previous work has focussed on higher education; this study refocussed some of the outcomes of that research onto a new context. The design of the interventions in this study were based on prior work on learning design and the emerging work on pedagogical patterns (Laurillard, 2012; OULDI, 2011; Conole, 2010b). The interventions were planned collaboratively with practitioners, documented and evaluated systematically to aid validity and inform others who may wish to use these interventions.

Using Mixed Methods

EDR is “largely agnostic when it comes to the choice of methodologies used and typically involves mixed methods using a variety of research tools and techniques” (Anderson and Shattuck, 2012: 17). This project used a multiple and mixed-methods approach (see research methods later) appropriate to the research questions.

Involving Multiple Iterations

The design approach uses iterations of interventions to refine and evaluate possible solutions to the outlined problem. This inevitably means that in theory, the research cycle never ends, however, in this study there were three iterations, based on circumstances as mundane as the resources and time available, the sustainability of the study in schools etc. The iterations were progressive, aligned to the nature of the problem (self-regulation in sixth form students).

The use of interpretive methods and iterations of action, could also apply to action research (AR), another popular research approach in educational contexts. What differentiates EDR from action research, apart from the emphasis on researcher-focussed reflection in AR, is the outcome of the process. Whereas both approaches involve formative evaluation, EDR aims to advance a theoretical agenda and produce ‘design principles’ that could influence practice in other contexts (Barab and Squire, 2004).

Involving a Collaborative Partnership between Researchers and Practitioners

Another factor differentiating EDR from AR is collaboration. In AR the researcher (usually) is the practitioner as well. In EDR the collaboration between researchers and practitioners is seen to be fundamental in terms of relating research to practice. In this study, a number of meetings took place between the researcher and teachers who expressed an interest in the project, both in identifying the initial problem and in designing and evaluating the interventions. This collaboration increases the likelihood of influencing practice.

Evolution of Design Principles

The end point of EDR is to ‘develop design principles’. While not intending to be ‘grand theories’ that will function in all contexts, these principles along with the conditions within which they operate could become embedded in the research institution and inform the dissemination of successful innovations.

Practical Impact on Practice

One of the major motivations for the development of EDR was the relationship between research and practice. If a success criterion was to be applied to this approach, it would be that of implementation and adoption of educational innovations as a result of published research. Supporters of EDR have high expectations in this regard. Writing in 2005, Reeves, in his discussions on educational design research, commented that:

> "If design research proliferates, it could contribute more than the ubiquitous, but ultimately futile, media comparison studies, and overcome the sterility of most qualitative studies. If it becomes the preferred model in instructional technology research, design research may well advance the quality and usefulness of a field that is presently at risk from becoming inconsequential and irrelevant." (Reeves et al., 2005: 110)

This research approach has been adopted in recent years by a number of eminent researchers in the field, including Laurillard and Conole (based in the UK and Australia).

Laurillard attempts to "take educational research out of the laboratory into practice" by looking at education as a design science (2012: 4), building design principles rather than theories using EDR. Researchers, studying an educational innovation needed to develop a methodology that was "not classically experimental, but iterative, progressively refining the initial theory-based design as it is actually implemented" (ibid: 6). Laurillard extends these outcomes or design principles to include pedagogical patterns, based on her Conversational Framework.

Clearly EDR shares epistemological, ontological and methodological assumptions with action research, case studies and others, but it extends the reach of these, by expecting more structure and collaboration and less focus on the researcher than action research, and including experimental iterative episodes to the case study. EDR is also differentiated from action research by the production of design principles that can used to inform work in other contexts.

Anderson and Shattuck's (2012) meta-analysis of ten years of DBR, showed that the research approach is being used increasingly in educational contexts (especially in the US), and in K-12 (secondary schools) and in technological interventions in particular.

The authors noted that while the studies reported that they were part of multi-iteration interventions, nearly all them were still in progress. In a critique of the meta-analysis, McKenney and Reeves (2013) reported that the studies selected only showed evidence of *potential* rather than real impact and that an important factor missing from Anderson and Shattuck's analysis was that of the essential starting point of a DBR study, departing from a problem. These and differences over terminology and literature sources illustrate the continuing debate within the emerging immature field.

Ormel et al. (2012), in a small scale meta-study of design research projects, looked at the nature of research-practice interactions within selected projects concentrating on the design of instructional solutions. The study analysis focussed on four main areas; general characteristics of the projects in terms of context and designed solutions; the roles of the participants; the sources of knowledge used to inform designs; and the demonstration of the knowledge created by the studies. The analysis found great variation in grain size, time scale, and the kinds of research questions being asked. Participants often took on multiple roles, especially in small scale projects where researchers and teachers worked collaboratively, both contributing to design and pedagogical issues, while teachers were less often involved in the actual research activities.

Three sources of knowledge used to inform the designs were classified in the analysis; literature, project data and practical knowledge. Although literature-based knowledge from educational theory or from other studies was often referenced or 'modified', relatively few studies showed how literature informed the design. Data from empirical findings such as user feedback, student and teacher interviews and surveys inform designs, though often not explicitly. Practical knowledge from the teaching participants' and the researchers' experiential knowledge about the field of teaching, learning and schooling was not often referenced. "Most design research projects found in this review use literature and/or project data to inform the design of instructional solutions .. Less than half of the reports discuss practical knowledge informing the design" (Ormel et al., 2012:977).

In this project, all three of the above types of knowledge were used in the re-design of the biology course. Literature sources espousing general theories of educational design were considered, including the Conversational Framework and the Community of Inquiry discussed in the previous chapter as did smaller research articles on specific strategies for the design of individual activities and assessment. Empirical data from student and teacher interviews and feedback was incorporated into the designs as was the experiential knowledge from the teaching practitioners and the researcher (also an experienced teacher).

In terms of the research aims and knowledge, Table 3.3 shows how this study summarised the knowledge areas produced using the structure of Ormel et al.'s analysis:

Research aim	Observable knowledge based on empirical data	Procedural/declarative knowledge informing design	Implications for theory building are discussed
To design a course that encourages students' independent learning	Learning gains, teachers' and students' perceptions of blended learning. Gains in scores relating to self-regulated learning	Lessons learned, design refinements, design modifications.	Design principles, design considerations, application/confirmation of earlier work

Table 3.3 Research aim and intended new knowledge in this study after Ormel et al. (2012)

3.5 Frameworks for conducting Educational Design Research

In order to conduct such research, several proponents of this research approach have attempted to create design-research models, frameworks and principles to formalise the process and aid novice researchers where the focus on research and design are integrated (McKenney and Reeves, 2012; Bannan, 2009; Herrington et al., 2007; van den Akker et al., 2006; Wang and Hannafin, 2005). At the most fine grained end of the spectrum of models is Bannan's (2009; 2003) Integrative Learning Design Framework "that attempts to provide a comprehensive, yet flexible guiding framework that positions design research as a socially constructed, contextualised process for producing educationally effective interventions with a high likelihood of being used in practice" (Bannan-Ritland, 2003:21). This model, shown in Figure 3.2, features fourteen steps, in four phases (informed exploration, enactment, evaluation at local and broad levels) together with appropriate guiding questions and research methods. In the first phase, the framework emphasises the identification of real problems to investigate with an audience targeted and appropriate literature and previous research reviewed. These 'initial theoretical conjectures' provide the broad direction for the next phase, enactment, where a prototype is designed and tested. Bannan's framework includes two stages of evaluation, the local impact and the broader impact, although it is acknowledged that few studies to date have met the last criterion (McKenney and Reeves, 2013; Ormel et al., 2012; Bannan, 2009). Wang and Hannafin (2005) produced a set of principles that summarise the common features shared among the above sources that support ‘purposeful and systematic’ research. These linked design with research from the outset with an opportunity to set practical goals for theory development; involved conducting research on real world settings with close collaboration with participants; research methods should be implemented systematically with continuous and analysis of data; designs should be refined continually and the contextual influences on the design principles documented to further validate the design.

Informed Exploration	Enactment	Evaluation: Local Impact	Evaluation: Broader Impact
Questions: What are identified gaps/problems? What information can be gleaned from existing research? What is the learner need? What are the social, cultural and organisational influences/constraints What are the characteristics of the audience?	Questions: What are the learning targets for innovation? What design principles or strategies may be applicable? How to identify and operationalise cognitive and performance processes in design? To what extent does the design embody the theoretical model	Questions: Is the enacted design usable, valid and relevant? Is the design instance accessible and efficient in delivering instruction or supporting learning? What is the local impact or effectiveness of the design instance? How effective is the design solution in achieving learning targets at its highest fidelity in full context?	Questions: What factors influence diffusion, adoption and adaption on innovation? What are the pragmatic demands of the learning environment that influences adoption of the design? What policies and culture shape participants use of the innovation?
Methods: Benchmarking Performance/needs analysis Interviews Survey of experts Focus groups Observations Case studies	Methods: Task analysis Contextual analysis Designer logs Expert review Audience review	Methods: Usability testing Expert review Observation Interviews Formative evaluation Pre-post comparative studies Quasi-experimental studies	Methods: Analysis of computer files Multi-site interviews Surveys and observations Correlational studies Quasi-experimental studies

Figure 3.2 Phases of the Integrated Learning Design Framework (Bannan, 2009:54)

These principles are consistent with the phases and detail of Bannan's framework. McKenney and Reeves (2012), have produced a rather simpler visual generic model for design research (Figure 3.3), which has been built on previous frameworks and models. In reducing the features to a more manageable scale, they have emphasised only the 'essential elements' (ibid:76):

- Three core phases in a flexible, iterative structure: investigation/analysis; design/prototyping; evaluation/retrospection.
- Dual focus on theory and practice: integrated research and design processes; theoretical and practical outcomes.
- Indications of being use-inspired: planning for implementation and spread; interaction with practice; contextually responsive.

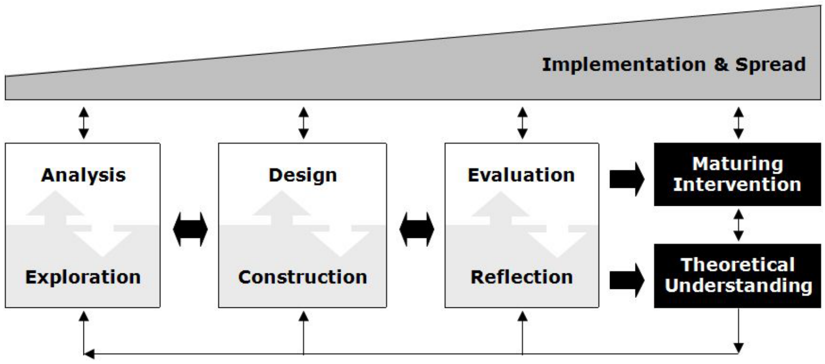


Figure 3.3 Generic model for conducting design research in education (McKenney and Reeves, 2012:77)

The dual focus on research and design, also influence the intended outcomes of this kind of research. One of the practical outcomes of this type of research is the documented product of the intervention, in this case a web-based learning environment and the scheme of work that underpins it. Another practical outcome is the professional development of the participants, the research and the teacher practitioners who have been involved in the collaboration of the research and pedagogical elements of the study. Design research also produces theoretical understanding, contributing to knowledge in the field. This research can contribute to the development of the theories underpinning the project and can produce "theoretical insights of a prescriptive nature. These are often referred to as design principles" (McKenney and Reeves, 2012:19).

This study will follow the principles of these frameworks using ideas from the variety of examples referred to above.

3.6 Challenges

In common with all types of research there are challenges to using the educational design approach. Many of the challenges refer to the fact that the approach is an emerging methodology and not experimental. These include measurement problems, external validity, and lack of control groups and so on. As an emerging field of enquiry, the approach also suffers from some disagreements about standards and conventions e.g. how many iterations there should be or what to do with the often excessive amounts of data collected (Design-Based Research Collective, 2003).

The main challenges seem to come from three areas, generalisation from the outcomes, researcher bias and issues of reliability and validity.

3.6.1 Generalisations

One of the main criticisms of all research in education is the problem of the 'generalisability' of the results to other contexts. Bassey (1999), suggests that there are two kinds of outcomes from 'predictive' research, statistical generalisation from surveys, and what he terms 'fuzzy' generalisations from case studies or experiments. Bassey agrees with Hargreaves about the lack of cumulative knowledge from most educational research, but differs when Hargreaves appears to want research that "demonstrates conclusively that if teachers change their practices from x to y there will be a significant and enduring improvement in teaching and learning" (Hargreaves, 1996:9). Bassey is among a number of researchers who attempt to create a response from essentially 'qualitative' researchers to the argument that single case studies have no value. He argues for 'fuzzy generalizations', "a statement that makes no absolute claim to knowledge, but hedges its claim with uncertainties" (Bassey, 1999:12). While statistical generalizations hedge their bets by claiming the percentage chance of what was found in the sample would also be found in a population, fuzzy generalizations claim "that *it is possible, or likely, or unlikely that* what was found in the singularity will be found in similar situations elsewhere: it is a qualitative measure." (ibid: 12). Yin (2009), uses the term 'analytic generalisation', to describe the process of expanding and generalising theories or propositions, rather than to populations. Flyvbjerg (2006: 227), makes use of what he terms 'soft theories' that is testing propositions or hypotheses, and that while "formal generalisation is overvalued as a source of scientific development ... 'the force of example' is underestimated" (ibid: 228).

One of the early proponents of design-based research, referred to generalisations as the ability to transfer theoretical insights or practical interventions to other settings;

> "We must operate always under the constraint that an effective intervention should be able to migrate from our experimental classroom to average classrooms operated by and for average students and teachers, supported by realistic technological and personal support" (Brown, 1992: 143).

In studies of this nature, the documentation of the process and the context become essential features of the project.

It is also important to acknowledge that in projects such as these, where the researcher has influenced the interventions and contexts, any claims may not be generalisable to other environments where the researcher cannot influence the contexts (Barab and Squire, 2004).

The outcomes of educational design research are similarly couched in tentative terms, these involve the production of context based design principles and artefacts or 'pedagogical patterns' (Laurillard, 2012). Laurillard advocates this methodology because it is immediately relevant to teachers who are involved in the design of curricular interventions and can see and assess impact. This collaborative activity can bring back the notion of the teacher as researcher, rather than being the object of external researchers.

The main outputs from a study of this kind are the practical contributions mentioned above and theoretical contributions, abstracted from empirical findings contributing to a body of research that is useful to others outside the immediate setting.

"The primary practical contribution of EDR is the intervention developed to solve a real problem in practice" (McKenney and Reeves, 2012: 41). McKenney and Reeves classify these practical outputs into different types; educational products, processes, and programmes or policies. This study aims to produce both products and processes through the creation of artefacts including teaching resources and teachers' guides, but also instructional strategies and sequences or pedagogical patterns. In addition to these practical outputs, other less tangible contributions are expected in setting powerful or inspiring examples of possible solutions, and in developing new skills and insights in the collaborating practitioners.

Cronbach describing education treatments noted; "when we give proper weight to local conditions, any generalisation is a working hypothesis, not a conclusion" (Cronbach 1975: 125, cited in Reeves, 2011).

3.6.2 The case study

As described above, this project is clearly consistent with the case study as a research method that focusses on one particular instance of work done in a naturalistic setting. Yin defines a case study as:

> "A case study is an empirical study
>
> that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident.
>
> copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result
>
> relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result
>
> benefits from the prior development of theoretical propositions to guide data collection and analysis." (Yin, 2009: 18)

In the project proposed in the title, the 'case study' seems to be an appropriate method, however, Yin excludes from his categorisation research where the investigator wishes to manipulate behaviours, and these contexts he suggests are better studied through experimental or quasi-experimental designs (ibid). The fact that consideration of the design-research approach is missing from Yin's conceptualisation of case studies and that eminent documenters of research methods in education like Cohen and Manion (2011) omit detailed reference to this approach, illustrates the emerging nature of this path.

The central concept of case studies or comparative case studies will be adopted in conjunction with a design based approach, in which the researcher in collaboration with practitioners will manipulate learning environments and create interventions on an iterative cycle or formative evaluations.

3.6.3 Design narratives

Linking to the previous section on generalisability, one of the central ideas in the scientific paradigm is replicability. Hoadley (2002), asserts that there are two main reasons why this is often impossible in many education technology studies; firstly because of the cultural nature of these interventions and secondly because researchers cannot control many of the variables acting in and around ‘messy’ classroom environments. Hoadley (2002:453), argues that in the context of design-based research

> ‘we must endeavour to meet the challenge of replicability by adequately describing our research. Not only is the researcher obligated to fully describe the tools he or she may have built, but also relate as fully as possible the context in which the tools are being studied, activities and practices offered to users, and most importantly the evolution of the context over time in response to the tools’.

He notes that usually, “studies present a technology fully formed as if it had risen from the oceans like Venus herself” (ibid:453). Hoadley suggests the use of a design narrative as a structure to convey the ‘plot’. The narrative would of necessity be selective, but would describe the history and evolution of a design over time. In his article he goes on to document the highlights of an eight year design study on the development of a discussion tool for collaborative use in a middle school. On being selective he states: “I do not describe every design change (or even all of the major ones) but rather choose some to illustrate how our stance of design implementation and design-based research led to new insights about generating collaboration for science learning” (ibid:454).

More recently Mor (2011), has developed the idea of a design narrative arguing that they “provide a ‘thick description’ of the design experiment, allowing critics to assess the validity of the researcher’s claims and trace them back to the evidence” (ibid:2). He recognises that many design-based studies do in fact use ‘narrative’ as a reporting style, but rarely explicitly formulate it as a methodology. He notes one of the exceptions as Barab et al. (2008), who describe sharing, “not only the designed artefact but also providing rich descriptions of the context, the guiding and emerging theory, the design features of the intervention and the impact of these features on participation and learning” (ibid:323).

Mor (2011), attempts to formalise what a design narrative might look like. Partly this is in response to claims that narrative might be incompatible with scientific discourse and publication traditions, and partly because using terminology and methods from an ethnographic tradition may be unfamiliar to researchers. It is helpful here to clarify what a ‘thick’ description might be. Although there is still much debate about different typologies of the term in the ethnographic domain, Ponterotto (2006), draws together the essential components of ‘thick description’ which involves accurately describing and interpreting social actions within the appropriate context, together with the thoughts, emotions and web of social interaction. This includes motivations and intentions. "The context for, and the specifics of, the social action are so well described that the reader experiences a sense of verisimilitude. 'Thick description' of social actions promotes 'thick interpretation' of these actions, which lead to 'thick meaning' of the findings" (ibid: 543).

Mor suggests that formalising the nature of design narratives might satisfy scientific standards while retaining the essential qualities, carefully designing forms and procedures for design narratives (2011:3). He proposes that there should be three central elements; firstly a transparent audit trail from reliable data to conclusions; secondly, a functional focus linked to a value dimension with attention to context and representation; and thirdly, a clear contextual description, a protagonist, a plot – a temporally and semantically linked sequence of events – and an implied moral. Mor then goes on to suggest a distinction between two design narratives that emerge; the researcher narrative (RN) and the participant narrative (PN).

The RN is written from the researcher's perspective, in the first person. This describes the pedagogical problem and the story of intervention that aims to provide a resolution. The narrative includes descriptions of the design and development of activities, social practices and the technology. "These elements are seen as an integral unit, under the socio-technical stance that these are inseparable and any partial description would be meaningless for our purpose" (ibid:4).

The PNs are third person accounts from the perspective of the teachers and learners in the intervention. This includes their opinions on the development, activities and designs and any results from evaluations and evidence of impact on learning outcomes.

Thus according to Mor (2011:5), design narratives should:

- Provide an account of an aspect of a design experiment, from the perspective of the designer/researcher of that of a participant and, as much as possible, capturing their voice.
- Clearly delineate the context of the design experiment and its educational goals.
- Present a documented record of the researchers'/participants' actions and their effect.
- Incorporate data collected and processed in appropriate scientific methods.
- Decouple reporting events from their evaluation and reflection.
- Be followed by a statement of the derived conclusions, linking them clearly and explicitly back to the narrative.

The outcomes from such a design based project are varied. In most sources these are described as design claims or design principles, statements about educational changes in particular contexts (Conole, 2013; Laurillard, 2012; McKenney and Reeves, 2012; Mor, 2011; Reeves, 2011). In addition to these design principles, other outcomes are also expected; professional development of the researcher and practitioners; development of the learning outcomes of the students; the actual 'product' of the intervention; the professional development of other members of staff of the institution through discussions with the research team.

The section above will form part of the criteria by which this study should be evaluated.

3.6.4 The role of the researcher

One of the challenges in educational research is the role of the researcher. Using classical models of research, there is little debate about the necessity for the objectivity of the researcher. The very nature of 'action-type research' poses difficulties for the role of the researcher. In this project the researcher collaborated with practitioners to design and evaluate interventions. This is acknowledged as being one of the strengths and challenges of the education design research approach:

> "It is through understanding the recursive patters of researchers' framing questions, developing goals, implementing interventions and analyzing resultant activity that knowledge is produced. Rather than remain detached from the research context, researchers are implored to intervene where possible .... critics will observe that such interventions 'taint' the research context". (Barab and Squire, 2004: 10)

This puts a great responsibility on the researcher to use a variety of methods to support the credibility of the study and any claims that are sought.

In addition to issues of credibility to a research community, Akkerman et al. (2011), in their analysis of the conduct of a study about ICT supported learning environments found three considerable challenges that the researcher had to overcome. The first concerned access to the team. One of the tenets of this form of research is the collaborative nature of the project. 'Ilya', a novice researcher, whose involvement was documented in the analysis, found the conduct of the research very challenging, especially when working in 'messy' and complex environments. They found that one of the most difficult early challenges was 'establishing authority' within the field of study and the team within which she would be working. Ilya had to invest a great deal of time 'being there', before her status moved from being the PhD student to becoming a team member whose contributions were respected and used. She reported that she had to gain a formal recognition from three levels of authority in the university where she was working; institutional policy makers, managers and teachers (ibid: 4). A second challenge was the difficulty of aligning the research project with the actions of teachers and managers with whom she was working, her research design assumed a clear linear progression of iterations, evaluations and redesigns. In practice, this was not possible, resulting in some compromises to her project. The third challenge came during the latter part of her project, Ilya became concerned about the nature of some of her data. While collecting data, Ilya differentiated between 'formal' and 'informal' contacts with her team members. She classified interaction that was planned, e.g. meetings discussing and reflecting on interventions as 'design in action' and it these cases she took on the role of silent observer, recording interactions and treating it as 'data'. She also engaged in informal interactions, 'off the record'. In Akkerman et al.'s study, Ilya maintained that she was more interested in the design product than the design process and justified her distinctions, however, at the end of her study, she regretted her stand, basing partly on her determination to be a 'proper' researcher (2011).

In the planning of this study, the researcher took great care in establishing contacts with the three levels of authority, and attempted to build relationships that would support collaborative work, having spent time in the school before undertaking actual research, listening to concerns, offering support and training and producing resources. The second challenge did not arise as the researcher had no prescribed timeline or pre-planned interventions and could work in collaboration with the teachers' plans. As far as participant observation is concerned, the participants were aware that the researcher was writing the study up as a research project. The ethical considerations conformed to BERA and the university ethics protocols regarding access, permissions, confidentiality and anonymity. In 'naturalistic' studies of this nature, the more contextually detailed descriptions may result in ethical tensions over issues of anonymity and confidentiality (Cohen et al., 2011). In terms of classifying types of participation, this approach is sometimes termed 'complete participation', where the researcher would be transparently working as part of a team in designing interventions, in addition to other data collection activities. In this case there was not a clear distinction between 'informal' and 'formal' data, as this study is as interested in the process of the design as the product itself. The selection and use of data was subject to criteria such as relevance, transparency and permissions from the participants, as well as the intended audience of the report.

Working collaboratively with teachers provided opportunities for professional development of both parties. Existing beliefs and actions may need to be confronted by all participants in these situations, and differing interpretations and discussions of teaching methods and designs were handled in a sensitive manner (Bradley and Reinking, 2011).

3.6.5 Reliability and validity

For researchers following a 'scientific-based' research paradigm, assessing reliability and validity of research is fairly straightforward. Writing at the height of the 'evidence-based' research revival in the United States, Slavin celebrated the passing of the 'No Child Left Behind Act', as a victory for rigorous, systematic and objective research methods. In his view, reliability and validity was a matter of having control groups, randomised experimental trials with large sample sizes with statistically significant results (Slavin, 2003).

For those who doubted the value of this type of research, different definitions of reliability and validity have emerged (Cohen et al., 2011); according to Barab and Squire (2004: 8), "..trustworthiness and credibility.. are akin to reliability and validity, but do not necessarily require the use of objective and quantitative methods.. and usefulness is somewhat akin to generalizability and external validity".

This 'usefulness' or 'consequentiality' is an essential part of conducting EDR, the value is in the relevance of the project and the rigour of the process.

As well as generalisations, critics of case study type research also point to other issues of reliability and validity. Bassey maintains that the concepts of reliability and validity cannot be applied in the same way to case study research as to surveys or experiments. One of the limitations of this type of research is the perception that qualitative studies are open to bias, lack of validity and replicability. Yin, (2009) calls for a 'chain of evidence' to be included with any case study report, so that a third party could track and verify the stages, sources and interpretations of the process, this echoes Bassey's (1999) 'audit trail' to increase the trustworthiness of the study and Edelson's call for systematic documentation of all aspects of the design and context (2006).

Reeves (2011) describes six types of validity that researchers should establish. In this example he is referring to his work on the development of serious games for use in training, these validities have been applied to this project on developing learning activities and sequences (Table 3.4).

Validity	Developing Serious Games	Developing Pedagogical Patterns/Sequences (this study)
Face	On the face of it, does the game or simulation seem to be a credible representation of the domain(s) of interest?	Does the overall design of the learning environment encourage students to engage with the curriculum and activities?
Content	Does the game or simulation encompass the appropriate content and breadth of content?	Does the sequence align with the examination specification and depth of study?
Learning	To what extent does the game or simulation afford sufficient opportunity and support for learning?	To what extent does the sequence provide a range of activities that support the learning and assessment objectives?
Curriculum	To what extent is the game or simulation appropriately aligned with other curriculum components?	Do the sequences align with other curriculum components, e.g. high stakes examinations, school requirements etc?
Predictive	To what extent does performance in game or simulation transfer to performance in the real world?	Can the structure/design of the sequences transfer to other courses in the institution or to other institutions?

Table 3.4 Different validities, after Reeves (2011: 14)

An additional validity could be added, that of sustainable validity, which could be achieved if the intervention design has been integrated into the delivery of the curriculum after the research intervention has passed.

Researchers conducting studies outside the 'scientific-based research' paradigm are very conscious of these issues of credibility. As a result they are likely to be very aware of the necessity to justify their approach and provide evidence of their reflection.

This study sought to strengthen the credibility of the process by employing a number of research methods, resulting in a variety of data collection instruments. This contributed to a 'triangulation' of data that increased the confidence in the resulting report (see next section on research methods where the data collection process will be discussed in more detail). Research methods included pre- and post-testing using a validated self-regulated learning instrument; an end of study evaluation using Q methodology; observations, periodic interviews and focus groups during the progress of the iterations in order to contribute to the formative evaluation of the interventions.

3.7 Data collection – context, introduction and outline

The context of this study was a small, non-selective, local authority rural school in northern England. The intervention was the re-design of an A level biology course. The new design intended to take advantage of a technologically enhanced learning environment and the course was delivered through a blended learning approach. The researcher collaborated with the teachers of the course. Further details of the context and intervention are to be found in Chapter 4.

The data collection programme of the study was planned to align with the research questions (Table 3.5) and the design research frameworks outlined by Bannan and McKenney and Reeves (Table 3.6).

Research Question1 What are the characteristics of:	Data Collection	Analysis
a) blended learning sequences that can develop independent learning behaviours in sixth form students?	Iteration of course re-designs. Staff and student interviews VLE logs, assignments etc. Researcher as co-designer, regular meetings of design team. Student surveys	Qualitative analysis of data
b) a TELE that will promote student engagement?	Course design evaluations Staff and student interviews Student surveys, Student course evaluation using Q-methodology	Q-methodology analysis to 'discover' student perceptions and response to the course re-design and influence design principles
c) an educational context that encourages the effective use of educational technology?	Observations, interviews and literature review	Analysis of case against criteria in literature
Research Question 2		
Do students learning from a blended learning re-design improve SRL as measured by the motivational strategies learning questionnaire (MSLQ)?	MSLQ instrument class survey pre-and post- intervention. Non-intervention group post-survey	MSLQ analysis, Excel and SPSS, Effect size calculator
Research Question 3		
How effective is the chosen collaborative educational design-research approach in investigating an authentic educational challenge in a living educational context?	Staff and student interviews Observations	Qualitative analysis of overall process

Table 3.5 Alignment of research questions, data collection and analysis

As can be seen from Tables 3.5 and 3.6, this study incorporates an eclectic multiple mixed-methods approach in keeping with the design-research framework described previously. Using multiple methods ensures that data and information is verified and triangulated from a number of sources, while 'more is not necessarily better' in terms of data collection sources, it makes missing vital elements of the overall picture less likely (Darbyshire, 2005). Much of the information to support the study came from qualitative methods; interviews, observations, conversations and the meetings of the project team.

Design Research Stages		
Exploration	Design	Evaluation
Questions: What problems have been identified? What information is available from existing research? What is the cultural/social context?	Questions: What are the learning aims? What design principles are appropriate? To what extent does the design embody the theoretical model? How does the audience react to the design?	Questions: Is the design product usable, valid and relevant? How effective is the design in achieving its targets?
Methods: SWOT analysis Literature review Teacher/student interviews Survey of student technology use Pre-intervention MSLQ survey	Methods: VLE logs Project team meetings Staff and student interviews	Methods: Staff and student interviews Evaluation meetings Post-intervention of MSLQ survey Non-intervention group survey Q-methodology analysis

Table 3.6 Alignment of data collection questions and methods after Bannan (2009)

3.7.1 Interviews with students

The interview as a data collection instrument allows both the researcher and participant to discuss their interpretations of the context from their own perspective. In this study, an additional purpose of the interviews with staff and students was to share information about the project and to create a bond of common purpose (Cohen et al., 2011). For this reason, the structure of the interviews was of the less structured variety. It was important that the students in particular felt engaged in the process of the project and not just the objects of a research experiment. For this reason the interviews can be seen as a two way process, with the researcher gathering opinions, perspectives and 'data' regarding the learning experiences etc., but also offering a platform for the researcher to share the aims and design ideas of the project (including explanations of permissions, use of data and demonstration of the recording device used). For this reason, the interviews with students could be described as 'semi-structured', comprising mostly open questions (ibid), planned from a general schedule guiding the themes for the researcher. This allowed students to respond in flexible ways and for the researcher to follow this without fear of leaving the schedule. The format of the interviews was that of 'group' interviews rather than focus groups. Focus groups concentrate on the interaction between the participants, yielding a collective rather than an individual view, with the main emphasis being on the participants' agenda rather than the researcher's. In this study, the ethical considerations stipulated that it was advisable to interview students in a group. The group interview does allow discussions to develop, but the researcher keeps control of the agenda (Cohen et al., 2011). There are obviously difficulties in some circumstances that may involve dominant individuals, reluctant participants etc., and whether 'the party' line may be followed in response to questions from the outsider (researcher). There is also the danger of 'group think' (ibid), where individuals may be reluctant to speak out against the prevailing ideas. These issues were considered while conducting interviews. Another reason for interviewing students as a group was to appear less intimidating and threatening, as the status and power relations involved, certainly at the start of the project, would be clear. A technique used to break down the initial artificiality of the interview situation is the use of a focus display, in this study the use of projected images of aspects of the learning environment, where students could react to the display rather than describing abstract conceptions. This has been termed 'photo-elicitation', common in interviewing students where the participants often respond differently to visual representations offering more and different information. This method is recognised as helpful in mediating between the researcher and interviewees and providing a focus that covers potential awkward silences (Woolner et al., 2010; Harper, 2002).

On a practical note, interviewing students in groups (around six at a time), meant that disruption to school lessons and timetables was minimised.

3.7.2 Interviews with staff

Interviews with staff do not need to consider many of the aspects above. There were a number of interviews with the staff involved in the design project. These staff were part of the team, so the agenda and context of the interviews were familiar. Again, as the interviews were for evaluation purposes, they took the form more of a meeting than a formal research interview, for example the initial informal SWOT analysis described in Chapter 4. These interviews were organised at specific moments in the study to consider particular relevant issues. A pre-planned loose schedule was employed in order to focus the direction of the interviews.

3.7.3 Monitoring of electronic logs, records and activities

One of the main values of digital learning environments is the potential for the production of data. Virtual Learning Environments are capable of producing vast amounts of data. The VLE records every item that is added to the environment, when and by whom. Similarly every time a student or teacher logs into the system, what s/he looks at is recorded together with the time and place (through the ISP address of the computer accessing the environment). If the student attempts a quiz or an assessment, the data or score is recorded into the 'mark book' of the VLE, as is every post in a discussion forum or wiki. This aspect of using VLEs, now termed 'data analytics' is fast becoming one of the major features in e-learning developments. Many proponents of e-learning evangelise the possibilities of 'personalised' learning programmes and 'individual' attention from learning environments that can potentially adapt the offering to individuals from information in the data, e.g. assessment scores etc., (Dwinal, 2015; Weston, 2013a; Christensen et al., 2008). Others see a darker scenario. A number of writers use the analogy of Jeremy Bentham's C18th notion of a panoptican, a circular prison design that allowed control through total surveillance (Land and Bayne, 2002; Gandy, 1996). Poster (1996) develops the notion of a 'superpanoptican' where the individual's records in interconnected databases become the 'retrievable identity' of that individual. This concept can be seen as somewhat prescient in view of the use, value and sale of data, identity and financial theft via the internet that has become so much of routine life nearly twenty years later. As far as educational use of data is concerned, all individual institutions can ensure is that professional and ethical considerations are embodied in acceptable use policies. In this study, none of the data from the BLAST learning environment was available to anyone outside the research team. Data was used for identifying students' use of the learning environment, their posts in forum discussions and wikis, and their scores in online assessments. However, if the project became school wide and further, the acceptable use policy would need to be much tighter.

The quantitative data collection elements are described below.

3.7.4 Initial survey of student technology use

In order to assess the access to ICT infrastructure of the participating students and their current use of technology, an initial survey of student use of technology was employed (see Appendix H). The survey was designed to be a simple task that the students undertook in class. There were three sections to the survey; a tick box section that notes what technology the students had access to, with an opportunity for comment on each; a 'level of competence' section where students assessed their competence through four descriptors; followed by a section concerning the frequency students undertook various technology based activities. The survey was conducted in class by a participant teacher who was on hand to answer any questions about terminology or unclear questions. The purpose of the survey was to assess students' access to, and use of technology, and was a useful contextualisation of the 'digital natives' debate discussed earlier (see section 2.6), the analysis involved some simple charting of responses. The results were used to inform the designs and expectations of the students' use of the learning environment.

3.7.5 The self-regulated learning instrument (MSLQ)

The rapid rise of distance learning, online learning and blended learning in secondary (K12) and post-secondary education, notably in the United States has naturally given rise to the questioning of the efficacy of technologically enhanced learning environments (TELEs). One of the common characteristics of these new forms of teaching and learning is the assumption that users will need to have study skills that support some level of autonomy. The online availability of resources and activities and the flexibility of study schedules require those aspects of independent or self-regulated learning (SRL) discussed previously (see section 2.1).

The measurement of SRL has been dominated by self-report measures. The most well known being the motivational strategies for learning questionnaire (MSLQ) developed by Pintrich and others (Pintrich et al., 1991). This instrument, designed well before the development of TELEs, arose out of a 'Learning to Learn' project in the 1990s (Hofer et al., 1998) where undergraduates were encouraged to develop basic concepts of cognition, motivation and study skills. The survey uses a social-cognitive view of motivation and learning where students' motivation is "directly linked to their ability to self-regulate their learning activities" (Artino, 2005:3).

Other surveys looking at SRL have been devised, Macaskill and Taylor (2010) devised a measure for studying autonomous learning in university students and Barnard-Brak et al. (2011) created a measure specifically to look at SRL in online learning – the Online Self-regulated Learning Questionnaire (OSLQ). In view of the nature of the students participating in this study and the nature of the learning environment, it was felt that the MSLQ was the most appropriate instrument for gathering information about aspects of SRL. The redesign of the course into a blended learning environment, with the teacher still giving the majority of structure, meant that the OSLQ was not felt to be appropriate in this study as it was designed primarily for higher education online learning environments.

The MSLQ survey supports a number of SRL learning models, taking the assumption that self-regulation is a learned skill set. The survey is most often used to evaluate the success of interventions to encourage aspects of self-regulation (Goh et al., 2011; Orhan, 2007; Chang, 2005; Duncan and McKeachie, 2005). The targets of the survey have ranged from Junior High School students to Graduate students, to obtain feedback on course design, for students to use in self-diagnosis etc. The survey focuses on the course level, by asking students to respond to attitudes within one course. The emphasis on the roles of both motivation and cognition follows from previous research on self-regulated learning (Barnard-Brak et al., 2011; Zimmerman, 1999).

The final version comprises a questionnaire with a 7 point Likert-type student scale from “not at all true of me” to “very true of me” (see Appendix G). The MSLQ is divided into two main constructs; motivation and learning strategies. Each of the main sections is divided into sub-sections or subscales. In total there are fifteen different subscales. One of the attractions of the MSLQ is the fact that these subscales can be used as required, the whole survey can be implemented or just those subsections that apply to a particular study (Artino, 2005; Pintrich et al., 1991).

In this study the subscales used were:

- Task Value (TV) – 6 items
- Control of Learning Beliefs (CLB) – 4 items
- Self-Efficacy for Learning and Performance (SELP) – 8 items
- Metacognitive Self-Regulation (MCSR) – 12 items
- Time and Study Environment (TSE) – 8 items
- Effort Regulation (ER) – 4 items
- Peer Learning (PL) – 3 items
- Help Seeking (HS) – 4 items

The subscales used aligned well to the strategies used to develop independent learning skills (see section 2.1). The first three subscales relate to motivation; asking students about the interest, importance and utility of tasks; expectancy, where students are asked whether they can accomplish tasks by their own efforts, and self-efficacy requiring judgements about confidence in achieving outcomes. The second category of subscales used refers to metacognition and resource management. The alignment of these subscales and SLR strategies are summarised in Table 3.7.

The MSLQ was first administered at the beginning of the course, before the students had much exposure to the TELE or course redesign. Students completed the survey again towards the end of the course, having experienced the strategies in the course redesign and become familiar with the TELE. The survey was also administered to students in another class who had not experienced the use of the VLE or the blended learning activities. This class was parallel to the experimental group in terms of age, academic level and education stage. No students in the intervention group were surveyed in the ‘comparison’ group. The comparison group was only surveyed at the same time as the end-of-course ‘post-intervention’ group.

The results and analysis are discussed in section 5.2.

Subscales	Strategies used in this study to support SRL within learning sequences
Task Value (TV) – 6 items	Emphasis on shared teacher/student goals, engaging activities to encourage motivation
Control of Learning Beliefs (CLB) – 4 items	Explaining benefits of activities, discussions, feedback on activities, reinforcing notions of student control (Dweck, 1999)
Self-Efficacy for Learning and Performance (SELP) – 8 items	Using and understanding marking schemes, self- and peer-assessment, formative feedback, emphasis on students understanding their own and expected performance
Metacognitive Self-Regulation (MCSR) – 12 items	Goal setting and planning activities, mind-map planning, scaffolding, pre-lesson readings, quizzes, use of graphical representations, self-testing
Time and Study Environment (TSE) – 8 items	Organisational help, use of graphical representations to show links between online and class work, text messaging for reminders
Effort Regulation (ER) – 4 items	Encouraging student engagement, task variety, student participation, alternative types of assignments and assessments
Peer Learning (PL) – 3 items	Pair and group work in class, discussion forums online, self- and peer-assessment, collaborative class and online work
Help Seeking (HS) – 4 items	Pair and group work in class, discussion forums online, self- and peer-assessment, collaborative class and online work

Table 3.7 Alignment of MSLQ subscales and teaching strategies employed to encourage SRL

3.7.6 Student course evaluation using Q methodology

Student evaluation is an essential part of any course re-design. While student surveys and interviews give valuable group and individual insights into course evaluations, the grouping of student perspectives is also valuable in resulting design principles aimed at improving the course. Q methodology was first developed in the 1930s by a psychologist and physicist William Stephenson who wanted to show that subjective views of individuals and groups could be studied in a quantitative and rigorous way. One of the researchers most notable for new interest in this procedure is Steven Brown who wrote a ‘definitive’ science of Q methodology (Brown, 1980). According to Brown; “Fundamentally, Q methodology provides a foundation for the systematic study of subjectivity, and it is this central feature which recommends it to persons interested qualitative aspects of human behaviour” (Brown, 1993:2). In this primer, Brown gives a ‘methodological tutorial’ on how to carry out the procedure. The procedure is attractive to researchers following a case study approach as it does not require the representative large samples normally used in statistical tests. The procedure captures participant perceptions and then organises them into common narratives. Q methodology has been used in a great variety of contexts; academic course evaluations; (Ramlo and Newman, 2010; Deignan, 2009; Ramlo et al., 2008); patients’ experiences of treatment: (Spurgeon et al., 2012); and environmental perspectives: (Webler et al., 2009).

Q methodology follows a sequence of steps, guidance is available in a number of guides and primers (Webler et al., 2009; Van Exel and De Graaf, 2005; Brown, 1996; Brown, 1993).

Step 1 Defining the concourse

The ‘concourse’ refers to the “flow of communicability surrounding any topic” (Brown, 1993:2). It comprises the range of views on the topic in question, in this case the re-design of a traditional course into one delivered through blended learning and issues surrounding the e-learning experience of the students. The source of these self-referent statements can come from a variety of sources; in this case from interviews, observations, comments made on surveys as well as statements linked to some of the evidence in relevant literature on the subject. In an attempt to cover all the main areas, a number of broad themes was created to create a systematic approach. The themes used to construct the concourse were; those statements that referred to aspects of the individual; those that were relevant to the social aspects of learning; pedagogical issues; statements that were relevant to the design of the learning platform; and finally to technological issues. The themes and statements are included in Appendix F.

Step 2 Developing the Q set

The Q set is the final list of statements from the concourse. There is no specific number of statements required, but most primers suggest a number between 40 and 50. The Q set should be representative of the views in the field under investigation. Researcher bias is reduced by selecting statements verbatim from the concourse, using natural statements from individuals and literature. While researcher bias cannot be eliminated (the selection is made by the researcher), it can be reduced by conscious practice. In this study 47 statements were included in the Q set. The Q set of statements were printed on cards with an identifying number (Appendix F)

Step 3 Q Sort

The set of cards was presented with a set of instructions (Appendix E) to the students, firstly to read all the cards and then place them into one of three piles: Agree, Neutral, and Disagree. The students then placed the cards onto the supplied grid according to the scale: +5 to -5 and record the numbers. Students were told that their distribution did not have to align with the grid (Figure 3.4).

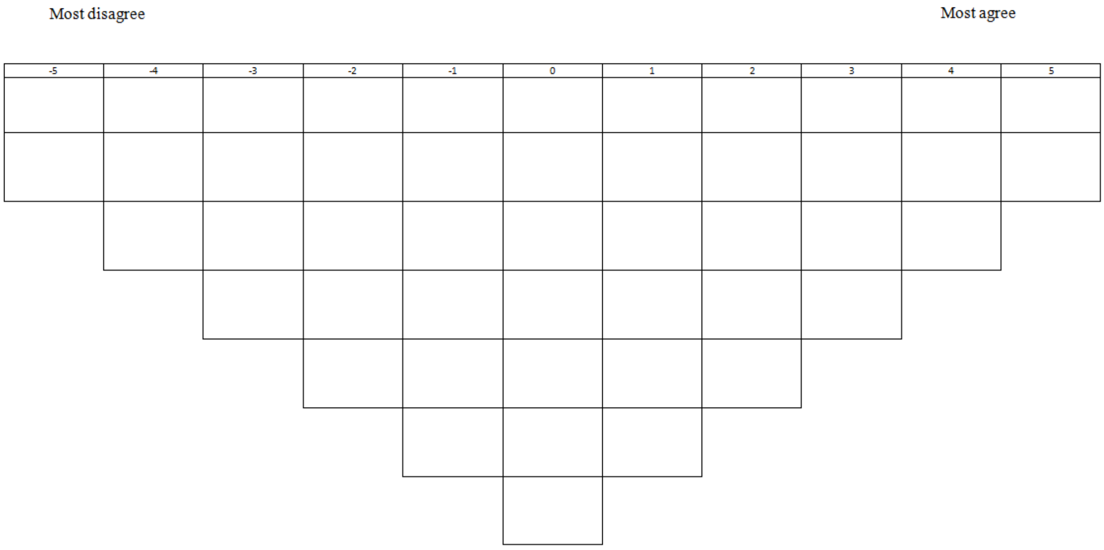


Figure 3.4 Grid for suggested distribution

Students were also asked to comment on those statements they placed on the extreme ends of the grid.

Step 4 Analysis and Interpretation

The analysis in the methodology requires the use of correlations, factor analysis and the output of factor scores to reveal patterns in the data. The initial correlations identify a number of factors with Q sorts from the participants loading with the highest factor loadings used to compute the scores for each statement. The calculations and data processing in this study was carried out using the public domain PQmethod software (Schmolck, 2014), which produces outputs that are fairly straightforward to interpret. The software rotates these factors to maximise the loadings of participant responses (Q sorts) on the identified factors and to ‘flag’ them. Those loaded with highest scores on each factor can produce a ‘model’ Q sort that can ‘represent’ the perspectives of that factor. The final output of PQmethod is a table for each identified factor, listing the statements, the averaged Q score for each statement and the z-score. The z-score is a “measure of standard deviation, how far a statement lies from the centre of the distribution, thus illustrating the salience or relative importance of each statement in that factor” (Spurgeon et al., 2012:5). Statements are listed according to statistical significance as ‘distinguishing’ statements, where participants have placed that statement in significantly different positions than those in the other factors; or ‘consensus’ statements, where all the participants have placed statements in significantly similar positions.

The results of this procedure are included in section 5.1.

3.8 Conclusion

Research into the possibilities of educational technology enhancing teaching and learning has a dismal record (Selwyn, 2011a; Amiel and Reeves, 2008; Reeves, 2006; Cuban et al., 2001). The rhetoric of evangelists has not been matched with the reality of impacts in schools. Amiel and Reeves (2008) emphasise the importance of values in educational technology research, educational technology is not value free, it is intricately connected with political agendas and power hierarchies in educational institutions. They assert that the ‘ends’ of educational research ought to be debated and open, the role of research being not only to describe and explain, but also to change. Much research into the impact of technology has shown no significant differences in outcomes, (ibid). Garrison, (2011) asks why would we expect to find any difference if all we are doing is the same thing with a different medium of communication? Much work in educational technology has emphasised the technology itself rather than how new teaching and learning opportunities can be served by new tools.

It is anticipated that the project will add to the areas of knowledge about the topic through a valid and accountable research process using the methodologies described above. One of the aims of this study is to examine the suitability of this emerging research approach to this phase of education. Brown refers to the importance of context in forming design principles as “essential features that must be in place to cause change under conditions that one can reasonably hope to exist in normal school settings” (1992:173), and the skills required to generate that knowledge creates a very challenging research method:

> “ .... I need additional expertise, more methods if you like, that were not part of my training. I need to know a great deal more about school restructuring, teacher training and support, and teachers as researchers. I need to use ethnographic methodologies to study which aspects of the program are readily adopted and which are resisted. I need to know the conditions favorable for adoption. I need to study the sociology of dissemination. I need to know about public policy issues, and so forth. Again changes in theory and practice demand concomitant advances in methodology for the conduct, documentation, and dissemination of research.” (Brown, 1992:173)

Chapter 4. The Intervention

This section covers the intervention and how the research design outlined in Chapter 3 was implemented. The overall plan can be seen in Figure 4.1.

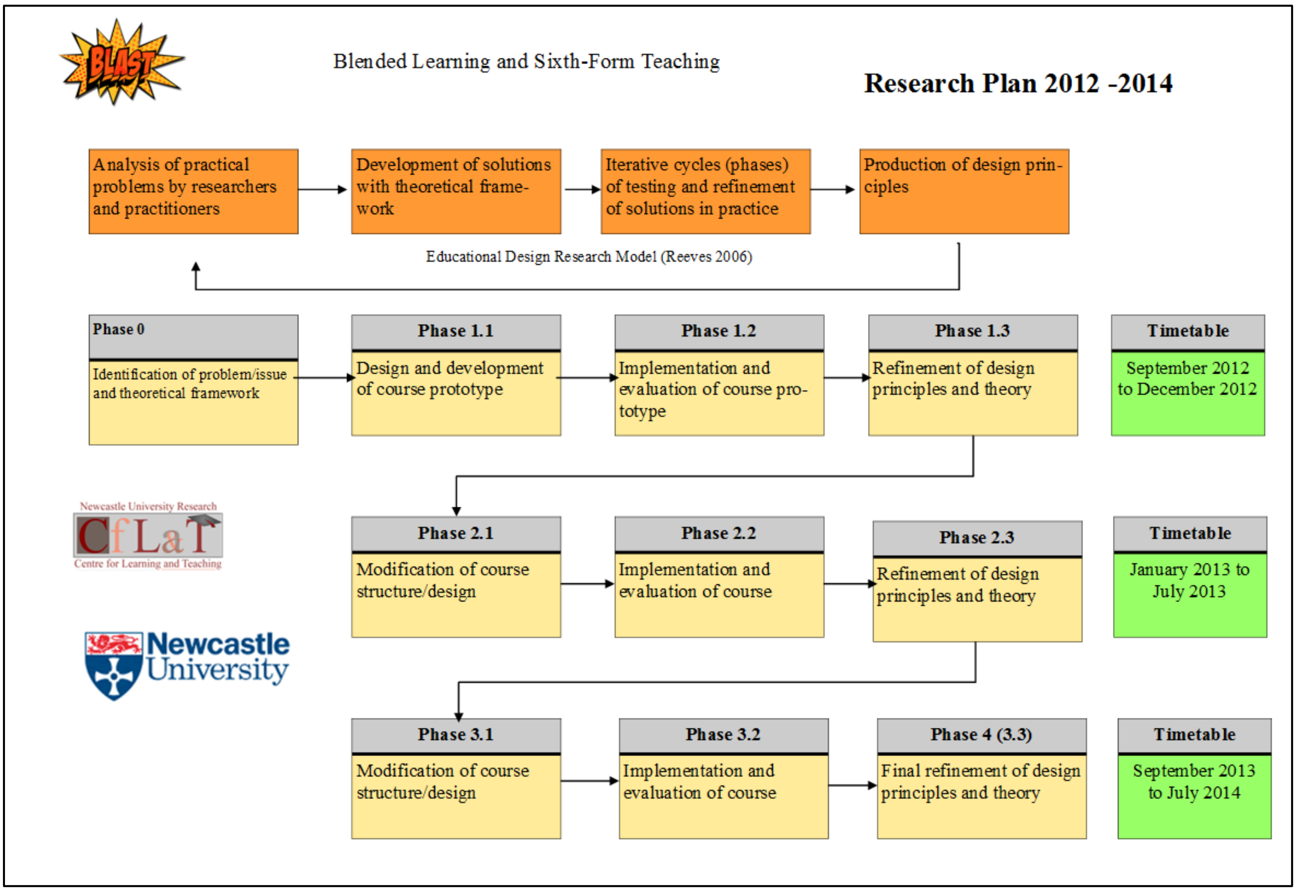


Figure 4.1 Research plan for BLAST

The section will start by outlining the preliminary phase, where the research context is described, including some background on the research team, the teachers and the researcher. The course that is being redesigned is described including the assessment criteria. As part of the preliminary phase, some initial student interviews were carried out together with a survey looking at student use of technology. There follow some issues that determine the characteristics of the development of the first BLAST learning environment prototype whose progress is described in detail in the following sections.

4.1 Preliminary phase

This intervention is, to a large extent, following the design procedures detailed in *Conducting Educational Design Research* , by McKenney and Reeves (2012). McKenney and Reeves cite William's (2004) work on pre-service science teachers as a good example of the discussion of the design, prototyping and formative evaluation of a learning environment. While the main stages will be addressed in this study, much of the design, evaluation and revision work was carried out while the learning environment was 'live' to students as they prepared for the high-stakes examination. The small scale of this project in terms of case, time and resources, means that many of the processes have been condensed.

The issues to be investigated started with a conversation between the researcher and practitioner (secondary school teacher), a former colleague at a different school 15 years previously. In order to carry out a sustainable research project it is important that practitioners can engage with the research and care about solving identified issues (McKenney and Reeves, 2012). The type of research approach chosen would entail the practitioner investing time and effort into a research project that may achieve very little. The researcher was also aware that it was important that the research examines 'legitimate' problems rather than identifying solutions in search of problems – a situation not uncommon in new design projects involving technology (ibid).

The issues that were discussed involved concerns over some of the characteristics of the practitioner's sixth form classes:

- Passive and dependent learning attitudes
- Limited time spent on task
- Concerns about student outcomes
- Lack of independent learning skills

The class she was speaking about had just completed their GCSE examinations and were embarking on an A level biology course. The students were 16 or 17 years old and had experienced a highly structured curriculum and pedagogy up to this time, with a complete timetable and little opportunity for independent work. The term 'spoon-fed' is often used to describe this situation. Teachers and school leaders, under pressure for examination results that feed into league tables of schools' performance have tended to structure students' learning to a high degree. These students, starting their new A level course,

> *"sat back and waited to be taught, as if they were still in year 11, they have a number of free study periods a week and don't know how to use them". (Jenny, project team member)*

During the conversation, it was apparent that the teacher was very concerned about these students and whether they would ever reach university; she couldn't imagine them being able to cope in that situation.

According to writers on the research approach chosen, the issues of concern should be verified in the literature and main themes and authorities identified (McKenney and Reeves, 2012; Wang and Hannafin, 2005; Barab and Squire, 2004).

The literature review is a vital part in this process, it shows what has been studied in the past, and identifies frameworks for structuring the study. Clearly the issues and characteristics of the students described above are not uncommon and have been studied across all the continents. The themes that emerged from literature searches (Chapter 2), were: transition from school to higher education, from a structured, mostly 'passive' educational experience; ongoing concerns with independent learning (or self-regulated learning); the importance of feedback in the context of independent learning; the opportunities that technology could play in developing independent learning; a consensus that learning and teaching must be well-thought out before technology was considered; technology should be used within a deliberate learning design, where frameworks could be used to structure and evaluate the learning; that educational design research being the most appropriate approach for this study.

All of the above themes were discussed with the teachers who were interested in the project. The project was given the acronym BLAST (Blended Learning And Sixth-form Teaching). A semi-informal SWOT analysis was undertaken to discuss the feasibility of carrying a realistic study, before detailed proposals were drawn up.

- **Strengths:** Two highly motivated teachers who were willing to commit time and energy to the project. The researcher had technical and pedagogical experience of using virtual learning environments.
- **Weaknesses:** The project was targeting a high stakes examination course, where risk taking might be difficult. The senior management, though supportive of the project, was not directly involved and extra training, time and resources were not immediately available. Although the researcher's first degree was in environmental science, he was not sufficiently qualified to teach the course or collaborate on issues of content etc.
- **Opportunities:** The school had just implemented a new virtual learning environment (Moodle), which was well supported by technicians.
- **Threats:** The work of the school had to take priority over the research study. The school had been performing 'marginally' according to examination tables and school inspections and therefore was constantly under threat of further inspection, which caused stress to staff, and could disrupt research plans, school development priorities etc.

Research questions were developed from the problems identified, the context and the literature in order to structure a sustainable research study that was feasible in terms of time, data collection methods, staffing and resources.

The research questions that emerged from the process described above, involved the redesign of a course using technology enhanced teaching and learning:

1. What are the characteristics of:
   a) blended learning sequences that can develop independent learning behaviours in an A level science course?
   b) a TELE that will promote student engagement?
   c) an educational context that encourages the effective use of educational technology

2. Do students learning from a blended learning course re-design improve independent learning skills as measured by the motivational strategies learning questionnaire (MSLQ)?

3. How effective is the chosen collaborative educational design-research approach in investigating an authentic educational challenge in a living educational context?

Discussions debated these issues and a research pack was produced, which outlined the process of the research and how it might impact the school. The pack contained an introduction to the themes of independent learning and technology; the research questions and research methodology with data collection plans and timings; information addressing ethical issues and copies of the consent forms as well as brief information sheets that would be made available to students and parents (in accordance with the university enhanced ethical approval guidance).

4.2 Research setting

The setting for this intervention is a small 'bog-standard' (not an academy, church school or specialist college), non-selective local authority secondary school in a rural area of northern England. The details below come from the 2010 Ofsted report:

- This is a smaller than average secondary school
- An above average proportion of students is known to be eligible for the pupil premium.
- The proportion of students identified with special educational needs .. is above average
- The proportion of students .. who are White British is above the national average
- The college meets the government's current floor standards .. in English and mathematics (Ofsted, 2010)

Overall the school received a grade 3 in the last Ofsted inspection in February 2010, in 2010 a grade 3 was regarded as ‘Satisfactory’, in the previous inspection in 2009 the school was given notice to improve.

In the 2010 report, the school was deemed to have the following strengths: good leadership and management; good behaviour; good progress in some subjects including science and ICT; strong procedures for monitoring the quality of teaching; good advice for career/education progression for school leavers; use of a ‘development room’ to support students back into lessons.

The report noted that the school required improvement in the following areas that are relevant to this project (i.e. teaching and learning in the sixth form):

> Standards on entry to the sixth form are broadly average. Students make satisfactory progress and reach average standards because of the sound provision. Attendance is average and improving and most students are on track to reach their targets. Progress is best in art, design and technology and ICT. Many students go on to higher education and the number of students who do not enter employment, training or further education is low. ....Teachers in the sixth form generally have sound subject knowledge and students’ progress in lessons is satisfactory. The school recognises that, although teaching has improved, in some lessons students are not guided well enough to think and find out things for themselves. As a result, improvements in progress are not as fast as they might be. (Ofsted, 2010:8)

The research involves biology, part of the science department, not mentioned by Ofsted as a department where students showed good progress and where lessons were of a high standard. This project aims to rectify some of these issues.

4.2.1 Staff

During the course of the re-design intervention, there are three teachers teaching the course. Due to timetable restrictions, the two teachers in the research team in the first year have two lessons each, while a third teacher takes another single lesson. The third teacher does not take part in the research. Teacher #2 (Lauren) leaves the school at the end of the first year to take up a position in another school. In the second year teacher #1 (Jenny) takes three lessons and the third teacher takes the other two.

Jenny has had 34 years teaching experience in a number of schools. She has been in the current school for five years. She has some limited experience using online learning resources through a Nuffield pilot science course and through a commercial site offering some resources and lesson presentations.

Lauren has been teaching for seven years, all in the project school. She has no previous experience in using a VLE, and this project is her first exploration into the virtual world.

The technician (Kevin) has worked in the project school for five years. The school is in a local authority that supplies a VLE, but it was not well regarded and he introduced Moodle, an Open Source VLE or Course Management System, in its place 'hosted' within the school.

> *"The LA VLE was not used, very few interactive tools, no quizzes, just a place to put stuff really. I just got it organised myself, there is no-one on SLT in charge, but Moodle is free and I can program and skin it, it's a lot of man hours but in the end if it gets picked up it will be brilliant." (Kevin)*

4.2.2 Design team and procedures

The course re-design (BLAST) team comprises the researcher, two subject (biology) specialist teachers who will teach the course, and the ICT technician who supports the school ICT systems.

Initially it was proposed that there will be regular meetings at the school every two to three weeks for the duration of the project. The researcher would visit the school after working hours for the meetings as well as communicate through email. There would also be further visits for lesson observations, data collection and student and staff interviews.

Although flexible, it is agreed that the meetings would follow a basic structure see Figure 4.2.

Meeting (date)

Agenda

1. Review of previous activities
2. Outline plans for next sessions sequences, activities
3. Site design
4. Technical issues
5. Resources for teachers – readings etc.

Next meeting ....

Figure 4.2 Template meeting agenda

Throughout the course of the BLAST project, in spite of staff changes and disruptive events, the meetings continue more or less as planned.

4.2.3 The researcher

As this is largely a subjective interpretative study of a real situation within an educational establishment, the background and place of the researcher is relevant to the design and interpretation of the intervention. The researcher is a ‘mature’ research student having worked in the secondary education sector in the UK for thirty two years. Twenty five years were spent teaching geography, humanities subjects and information communication technology (ICT) to students including the sixth form to A level standard. For the last seven years, he worked as local authority secondary consultant. He has extensive experience in school leadership, curriculum development, teacher training and school improvement. He has knowledge of ICT applications and experience of training in the use of learning platforms in schools. His interest in the themes of this study emerged from his work with schools attempting to implement ICT strategy to support the curriculum. Despite the exhortations from governments, BECTA and enthusiastic educational technologists, the schools he was supporting had not engaged in the seemingly ‘transformative’ potential of technologically enhanced learning environments. This, coupled with the issues of school to higher education transition, merged into an idea to re-design a course of study for a sixth form class that might offer some insights into how a successful implementation might be managed. Rather than study the situation from second hand, finding schools that had attempted to engage with the technology, using interviews and questionnaires to investigate the situation, a more direct and ‘messy’ research approach was taken to work closely with a team of teachers in a school to re-design a course from scratch, using design principles from the literature. The intervention would involve close contact with the school and teachers over a prolonged period of time.

One of the challenges of carrying out the qualitative elements of this project is the ‘data’ yielded by interviews, observations etc., requires selection and ordering by the researcher, all of which are open to personal bias. All of this data was obtained from social situations where the researcher’s own background and ideology all play a part in interpreting the environment, including the researcher’s own impact on the unfolding intervention. “Fact and interpretation are inseparable, and the selection of which events and data to include are, to some extent, under the control of the researcher” (Cohen et al., 2011:540). These issues are part of the challenges of reliability and validity inherent in this type of investigation. This account of the intervention will attempt to triangulate data and sources to minimise researcher bias. In order to emphasise the personal role of the researcher in this intervention, the narrative will continue in the first person.

The result is this project, based on the educational design research approach that attempts to link theory with practice in a collaborative research venture with practitioners.

4.2.4 Course specification

The intervention involves the re-design of an A level course in biology. A levels are taught over the last two years of UK secondary education, known as years 12 and 13. These high stakes examination courses are required entry to higher education, most students take three A levels, which is the usual entry requirement. The level and structure of examinations have been the subject of a great deal of debate in recent years and the specification for this biology course changed during the two years the students were studying. During the first year it was possible to take unit examinations in January and June, during the second year each unit examination was only available in June, therefore restricting early entry and possibility of re-takes before university entrance. Further changes are to be made to the examinations from 2015. A summary of the specification and the assessment is outlined in Table 4.1.

Unit Content	Scheme of Assessment	% of A level
Unit 1 Biology and disease	Examination 1 hr 15 minutes	16.7%
Unit 2 The variety of living organisms	Examination 1 hr 45 minutes	23.3%
Unit 3 Investigative and practical skills in AS Biology	Centre marked Practical Skills Assessment Centre marked Investigative Skills Assignment	10%
Unit 4 Populations and environment	Examination 1 hr 30 minutes	16.7%
Unit 5 Control in cells and in organisms	2 hrs 15 minutes	23.3%
Unit 6 Investigative and practical skills in A2 Biology	Centre marked Practical Skills Assessment Centre marked Investigative Skills Assessment	10%

Table 4.1 Summary of AQA A Level Biology Specification (for examinations up to 2014)

In each year group, the subject is allocated five teaching hours per week, shared between two teachers, one teaching two and the other teaching three lessons. Depending on the timetable, two of the lessons were usually a double session to facilitate extended laboratory work.

4.2.5 Students

At the start of the two year course, the 28 students have been divided into two classes, *(by the time of the second year, the number of students on the course had reduced to 21, resulting in one class, only 19 were available for the Q methodology evaluation at the end of the course).*

At the very start of the project the project team needed to introduce the students to the project and collect some data and information from them. There were three parts to this process; initial student group interviews; a short survey of student access to technology; and the initial MSLQ pre-intervention survey (see 3.7.5).

4.2.6 Initial student interviews

Jenny, Lauren and I meet to organise the first round of small group interviews with the students. We put them into groups of 5 or 6 and schedule the interviews to take place over two days so that interruption of their timetables and lessons is minimised. We allocate around thirty to forty minutes for each of the initial encounters. The aims of these interviews are fairly limited:

- To introduce the students to the project and to the consent procedures
- To enable them to ask any questions
- To explore some general issues concerning the transition from year 11 to year 12 in terms of learning, working environment etc.
- To explore general issues around their use of technology through a short paper based survey
- To outline the plan to complete the initial MSLQ survey later in the week

I meet the students in the laboratory adjacent to Jenny's teaching room. I gather them together around a table in the centre of the lab. I introduce myself and the BLAST project describing some of the rationale behind it. I hand out the information sheets for students and a copy for parents and go through the consent forms and explain the concepts of confidentiality and anonymity. I demonstrate the pen and special notebook I will be using during the interviews that will record the sound and link it with the written notes. The students are all happy to participate and complete the consent forms. They are initially quiet and self-conscious about answering questions.

It is five weeks into the new school year and they are keen and optimistic about their new courses, I ask each student in turn their names and the courses they are studying and as we move on to talk about differences between their experiences last year and this, their confidence grows and they become less inhibited by me and my notes (I only take occasional notes where themes emerge or issues need addressing later, after the interviews, I can click in the notebook and the audio automatically links to that place).

The students are all taking four courses including biology, they will think about dropping one after the first year when they are more familiar with the courses and have some feedback from module examination scores. The aim of grouping students for interviews apart from saving time, allows them to interact with each other as well as the researcher, and the groups give a fairly consistent account of their brief experiences of sixth form study. On describing the differences from the previous year, the following highlight typical responses;

> *"We have harder work, more work"*
>
> *"We do more by ourselves, we are sent away to do coursework"*
>
> *"The terminology is more difficult"*
>
> *"Homework is more difficult and more frequent"*
>
> *"We are expected to work more independently, and can choose when and where you do your work"*
>
> *"In some subjects we are talked at for most of the lesson"*
>
> *"Homeworks are finding things out for ourselves or doing questions"*

An initial design of the BLAST learning environment is online and students have been pointed towards it, though it has not yet been 'launched' at the time of the initial interviews. Some students have found it and some of the more inquisitive have explored some of the features. They have not used the school's VLE before in their lessons. As a focus for the discussions in the group interviews, I show the outline of the BLAST learning environment on the screen in the classroom and show the main features, I ask the students what they might like to see in the learning environment and how they would use it, a typical response is shown below:

> *"I would like to see extra work, lesson stuff, if you miss school, links to interesting resources, guides to what we need to learn, the syllabus, some exam papers to try out."*

All the students have access to the Internet at home, though not all have their own computer and access speeds in the locality are only adequate. High speed broadband has not yet come to this part of the world, although it is fast enough for watching streamed videos and the kind of interaction BLAST is aiming at. Further details of the results of the paper-based survey are summarised in the next section.

Some of the students have tried to access some of the quizzes, but the system has failed to record marks; I note this for the next meeting with Kevin.

4.2.7 Student use of technology survey

The project team wanted to survey the students to find out a number of issues regarding using the BLAST learning environment. We wanted to find out if all the students had access to the Internet at home, access to a suitable computer and had adequate bandwidth for the project. We were also interested in their (self-reported) level of competence so that we might gauge the need for technical support. Analysis from previous studies (see section 2.6), suggest that the ideas of students of this age all being digital natives is optimistic to say the very least. The survey can found in Appendix H.

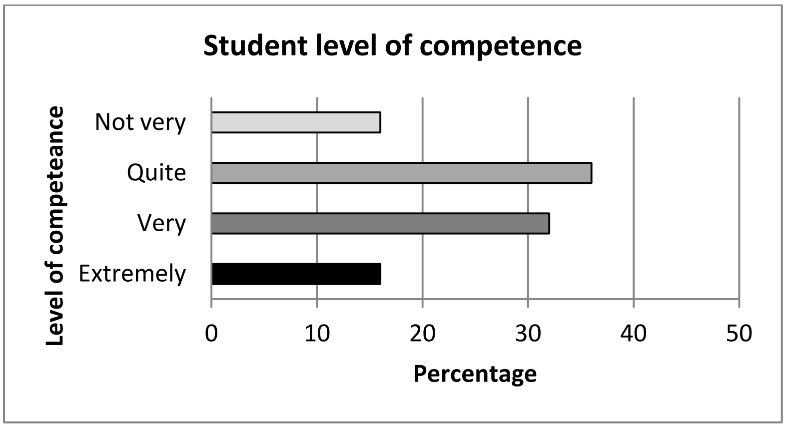


Figure 4.3 Students' level of competence at using technology (n=28)

In the self-reporting survey, the levels of 'competence' were described as follows:

- Not very competent – I can do the basics, but I struggle with anything a bit complicated.
- Quite competent – I can do most everyday things. I don't do things like change settings unless someone is there to help me.
- Very competent – I can do everyone I need to. I sometimes change the preferences and settings on programs. I can install and configure software, e.g. alternative browsers.
- Extremely competent – I am quite a geek! I use and understand most forms of technology and can adapts them to my own preferences. People come to me to help them.

The results show that 48% of the project students are in the 'Extremely' or 'Very' competent levels with 52% 'Quite' or 'Not Very' competent (Figure 4.3). The team find this reasonably acceptable; as we hope that the IT demands of using the BLAST learning environment will not be too great. We also feel that within the group itself, there are sufficient numbers of competent users to support the others.

In order for the students actively to participate in the project, they need to be able access the BLAST learning environment at home through a computer with access to the Internet (at the time of the project, the Moodle learning environment does not have full functionality through smartphones or tablet 'Apps'). The students were asked about their access to different types of technology (Figure 4.4).

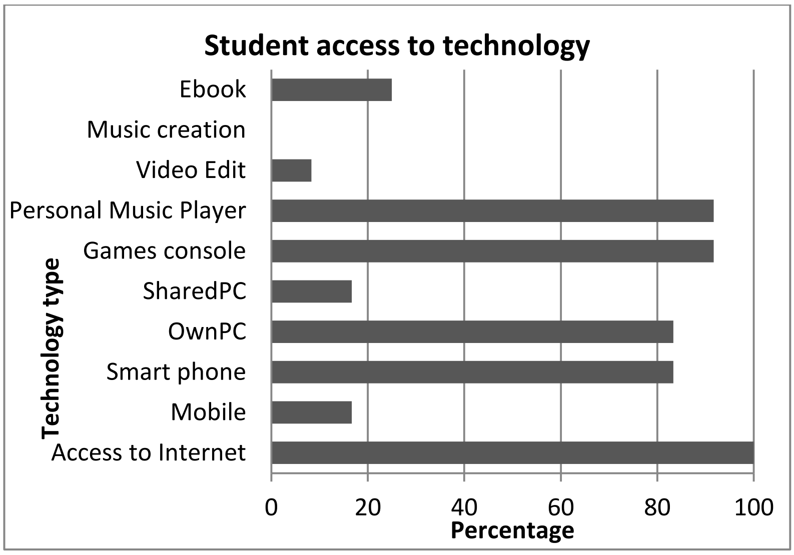


Figure 4.4 Students' access to technology (n=28)

The results show that they all have access to the Internet and all have either their own PC or shared access to one at home. All students use mobile 'phones and over 80% have smartphones (able to access the Internet through 'Apps').

The project team also wanted to see how the students used their technologies; previous research suggests that few students will frequently be using Web 2.0 for creating and publishing material, while most will be passive users of simple technologies. Figure 4.5 shows the frequency of the students' technology-based activities. The most frequent activities indeed are; using mobile 'phones, either standard or smart; and social networking (in this case meaning checking their 'Facebook' accounts) together with routine web browsing for either personal or school use. The more sophisticated or creative activities are far less frequently used; some students had never used these technologies. Overall, the results reflect those reported by Kennedy (2010), Crook (2012) and Beckman (2014) referred to earlier (section 2.6).

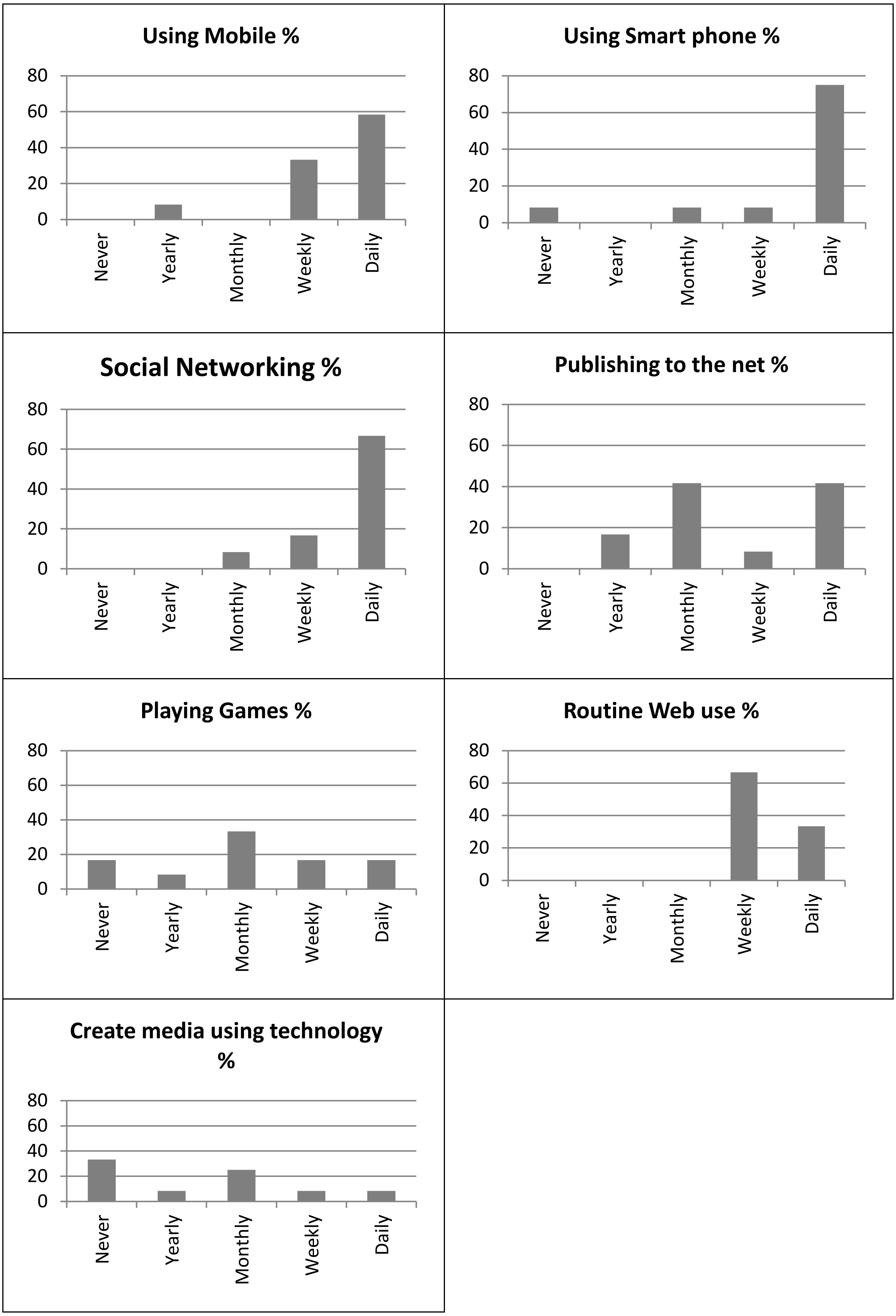


Figure 4.5 Students' technology- based activities (n=28)

4.2.8 Research ethics

As the research process involves actively working in a school, an enhanced ethical approval was required before embarking on this study. All the requirements of the

University's ethical protocols have been satisfied, including issues such as consent forms, security and anonymity, see Appendix A.

In addition to the usual safeguards, I obtained a check from the criminal records bureau (CRB), that all adults working closely with children and young people are required to hold. This was obtained through the local authority where the school is located.

4.3 Initial issues

There is a plethora of checklists, rubrics and design advice for anyone considering the re-design of an educational course into a blended learning environment. In accordance with the fundamentals of the EDR approach chosen, the team first look at the issues relating to the purpose of the re-design and have chosen to use the Quality Matters guidelines (Quality Matters, 2012) as a course layout and checklist model. This was used to design the structure and user interface of the learning environment before developing more sophisticated theoretical underpinning of the design incorporating concepts such as Garrison's Community of Inquiry (Garrison, 2011), or Laurillard's Conversation Framework (Laurillard, 2012).

Table 5.2 shows a summary of the Quality Matters criteria, and how the project team intend to adopt them in the BLAST design. All features will not immediately be available, but the intention is to have them in place by the end of the project.

Quality Matters Summary Criteria	Reflected in BLAST Over the 3 iterations
1. Course overview and Introduction	Clear relationship between the face-to-face elements of the course with the online elements, a graphical representation will be on the project site.
2. Learning Objectives	Include explicit learning objectives based on the taxonomy circles, (Atkinson, 2013), aligning objectives, activities and assessments.
3. Assessment and Measurement	A variety of assessments will be included in course, both online (MCQ, short answer questions etc.) and offline. Clear criteria will be available to students as will model answers and opportunities for self and peer assessments.
4. Instructional materials	Teaching materials will be varied and appropriate, including the class text book, Internet links to appropriate resources, further reading selected to develop the topic as well as video resources.
5. Learner Interaction and engagement	The design of the course is aimed at being attractive and easy to navigate, with a consistent layout. The activities will be varied, from individual tasks and MCQ, to group discussions and collaborative work. Clear guidelines will be given.

6. Course Technology	The technology and software required for students is designed to be easily and freely available. All resources and activities will be available through an Internet browser. Display of resources will be available on the browser without recourse to proprietary software.
7. Learner and Instructor support	Technical support and advice will be available in school and online through a forum to report difficulties.
8. Accessibility	The face-to-face, online and all course components are accessible to all students. Before the course goes online the students in the project course will all have access to appropriate technology to access the online components at home.

Table 4.2 Summary of intended Quality Matters (2012) criteria in the BLAST project

4.3.1 Teaching To The Test (TTTT)

Although often used derogatively, 'teaching to the test' is what teachers have to do in preparing students for high-stakes examinations. In the context of this project, the assessment criteria for the examination are published as part of the specification by the examination board (see Appendix D).

During the course redesign, other criteria will enter into the design process. It is the contention of this project that developing independent learning skills will not only help the students achieve their potential in the summative assessments, but also prepare them for the transition to higher education.

In the terms of this project, TTTT involves preparing a course that meets both the largely cognitive objectives of the examination and the metacognitive objectives of developing independent learning skills.

Identifying and communicating the goals and learning objectives to students as well as aligning them to the activities and assessments in the course is crucial in developing SRL skills in students as well as being central to good course design (Atkinson, 2013; Laurillard, 2012; Nicol and Macfarlane-Dick, 2006)

Nicol's first principle (2009), states that it is essential that staff and students share the same goals and understanding of what good performance is before they can succeed. While this is clearly important, goals should be used as more generally defining the purpose of the course of study. These should be distinguished from learning objectives that describe specific outcomes and how to achieve them. In general these learning goals are poorly articulated in schools and have become something of an administrative burden. Often they are written on the board for students, describing the tasks they going to do, or what they need to know. In terms of communicating shared objectives with students, outcomes describing individual teaching events have been shown to be far more effective that general topic or module outcomes (Atkinson, 2013). These learning session outcomes should align with assessment and the activities designed to achieve them. Many writers on learning objectives have adapted Bloom's (1984) original taxonomy, e.g. (Churches, 2009; Biggs and Collins, 1982), advocating lists of appropriate verbs reflecting the different domains.

Atkinson (2013), proposes another revision of the domains, separating a knowledge domain from the cognitive skills domain:

- Knowledge and understanding - subject domain
- Intellectual skills - or the cognitive domain
- Professional Skills - or the affective domain
- Transferable skills - or the psychomotor domain

The knowledge domain is limited to defining the subject area for illustrative purposes for the student, intellectual skills build from the base of the subject domain, knowing facts, towards higher order skills, familiar to Bloom's cognitive domain. The professional skills or affective domain are concerned with the individual's values, ability to empathise and collaborate, and some metacognitive skills. The transferable or psychomotor domain as reflected here is relevant in referring to progressively complex skills in scientific procedures. Atkinson (ibid) also advocated moving from the passive descriptive language of Bloom to using active verbs, thus focussing on the demonstrable outcomes of the learning.

Atkinson has created 'visual circles' to represent each of the domains, as an alternative to "restrictive, repetitive, formulaic and sometimes obstructive" learning outcomes (ibid:7). The structure of the circles follows the template shown in Figure 4.6. The explanation of the structure of the circle is described by Atkinson;

> "Each representation has the higher-level terms at the centre, proto-verbs, derived from pre-existing taxonomies with some adaptation. Surrounding these is a series of active verbs that articulate actions that individuals might undertake to generate evidence of their ability to represent the proto-verb. The final outer circle suggests the means by which a student might provide evidence of their having demonstrated successfully a particular active-verb, and hence proto-verb." (2013:7)

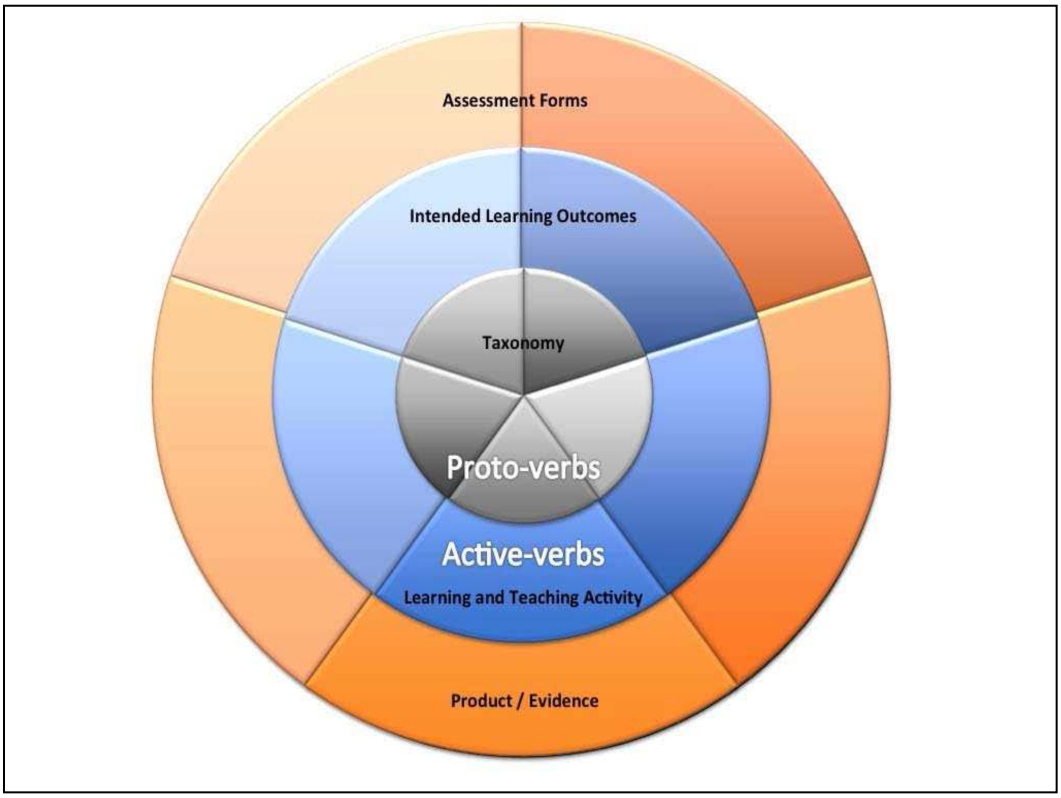


Figure 4.6 The structure of Taxonomy Circles (Atkinson, 2013:8)

The original taxonomy circles are included (Appendix C). These circles will be used in the project to identify appropriate learning domains and objectives and align them with suitable activities and assessment opportunities. These will aid the learning design process and help contextualise the objectives in terms of specific activities. The team consider these visual representations more flexible and intuitive than list of verbs. Selected examples will be included in the described learning designs.

4.3.2 Technology

The design team broadly want to re-design the A level biology course to encourage students to become more independent learners. To facilitate and encourage this, it has been decided to re-design the course as a blended or hybrid course, where students could develop higher order skills through a structured course hosted on a Virtual Learning Environment (VLE). The team want the VLE to support a number of features to support this aim including:

- Features that support individual and group activities
- A single location for resources, activities, assessment and communication
- The easy sharing of media resources through embedded videos e.g. YouTube
- Opportunities for safe online discussion forums
- Compliance with standards for 3rd party quizzes etc. e.g. SCORM

- Safe spaces for collaboration in Wikis and glossaries etc.

The Open Source VLE, Moodle was chosen for the BLAST project, because it met these requirements through being designed specifically to support social constructivist pedagogy (Moodle, 2013). For further details of the VLE software see Appendix J.

One of the priorities in choosing the software was the availability of open source or free versions. A summary of the software used in the BLAST project is included in Appendix J.

4.3.3 Training

At the start of the project, most teachers at the school are using technology at a low level; getting information from the Internet; using the school management system for administrative tasks, such a registers and reports, but a few have started using the new VLE, and those that have looked at it have just uploaded a few resources and worksheets. Neither of the BLAST teachers have used the VLE before the project. There have been a small number of short INSET sessions to teaching staff, focussing on some of the particular software tools by Kevin (the technician), but nothing on how or why to integrate using the technology with classes of students. This is a common phenomenon across the world (Jimoyiannis, 2008). Despite the large investments in educational technology in schools, “the application of ICT in school settings has been driven more by the accordance of technology rather than the demands of pedagogy and didactics of subject matter” (Jimoyiannis, 2010:1260).

In response to the challenges of attempting to teach with technologies, Koehler and Mishra identified three core components; content, pedagogy and technology and the relationships among and between them (Koehler and Mishra, 2009). They called the resulting framework TPACK (technology, pedagogy and content knowledge), see Figure 4.7.

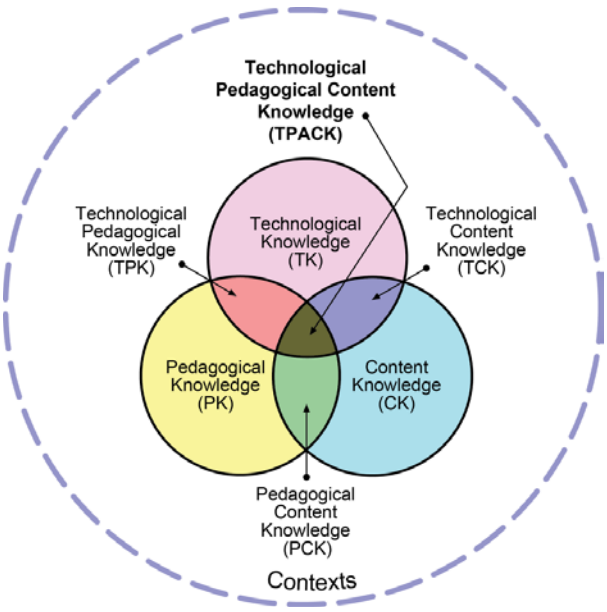


Figure 4.7 The TPACK framework and its knowledge components (Koehler and Mishra, 2009:63)

The three components of the framework prove to be useful for the BLAST team in organising discussions and meetings.

The content knowledge is held by the specialist biology teachers on the team, Jenny and Lauren. They are experienced teachers with a sound understanding of their fields together with knowledge of the particular examination specification they are teaching.

Pedagogical knowledge is a general area described as being “teachers’ deep knowledge about the processes and practices or methods of teaching and learning” (ibid:64). Both of the project teachers and the researcher have extensive knowledge and experience of teaching at this level and all share a common constructivist approach to teaching and learning. This area has been the subject of a great deal of discussion over the design of the learning activities in BLAST. The team have been particularly guided by the Conversational Framework of Laurillard (2012), the Community of Inquiry from Garrison (2011) and the feedback models of Nicol (Nicol, 2009a; Nicol and Macfarlane-Dick, 2006). These provide the main design principles for the development of the BLAST intervention.

Technology knowledge is always changing, becoming more sophisticated. This component refers to knowledge of the technology and how to use the technology. Conventionally this knowledge is held by the technicians like Kevin who support teachers and institutions. They understand how to use software and hardware, what buttons to press and how to re-size an image, or reorder a set of forum posts. Some of this knowledge is held by others, the teachers and researchers who are committed enough to spend time exploring and experimenting with software, which for the most part has not been developed for the education market. This is the area where most training sessions have been aimed.

> *"I have done some training, but the VLE is not in the training calendar, it has to be done in addition, I have shown staff how to upload resources, make quizzes etc, but it is a slow job, and teachers need to have more than one session."* (Kevin)

The TPACK framework emphasises that it is in the relationships between these components that its strength lies. While there have been some criticisms of the model that dispute the distinctions between the components and some of the definitions used there is evidence that the framework has been helpful for the development of training courses (Voogt et al., 2013).

The area that has been missing in many training courses for teachers has been in the Technological Pedagogical Knowledge (TPK) area. "This includes knowing the pedagogical affordances and constraints of a range of technological tools ... as they relate to pedagogical designs and strategies" (Koehler and Mishra, 2009:65).

Conole is helpful here in describing what 'affordances' technology can contribute to learning (Conole, 2013), where she identifies a set of positive affordances as well as a range of constraints that can be used as a checklist by teachers;

> ". . collaboration, reflection, interaction, dialogue, creativity, organisation, inquiry and authenticity. Constraints include time consuming (in terms of development), time consuming, (in terms of support), difficult to use, costly to produce, assessment issues, lack of interactivity and difficult to navigate" (ibid:89)

Attempting to integrate all the components is difficult and some would argue, too much for one framework. A development of the model has been advanced to support teachers of science (TPASCK), which has identified some of the relationships within a scientific content area (Jimoyiannis, 2010), he has also suggested the addition of a fourth component, 'Educational Context', as an important factor in applying the model. This model supported the BLAST designs.

Another framework valuable to the team is the Substitution Augmentation Modification and Redefinition (SAMR) model developed by (Puentedura, 2013; Puentedura, 2010), see Figure 4.8.

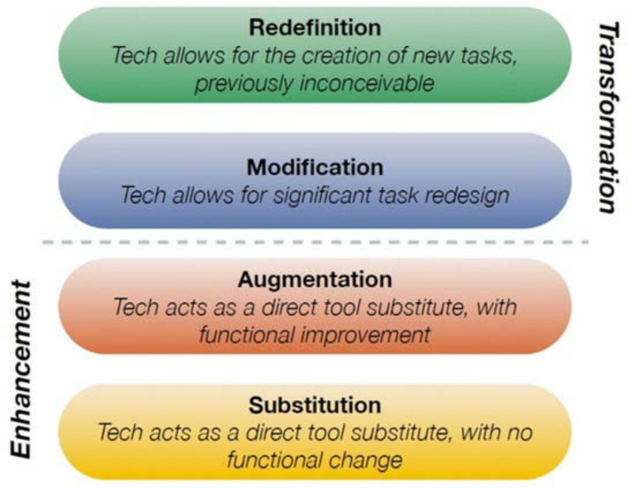


Figure 4.8 The SAMR model (Puentedura, 2013:np)

This model has been used alongside the TPACK framework (Puentedura, 2010) and as a framework for evaluating aspects of e-learning (Romrell et al., 2014). The BLAST team found this useful in examining learning designs, noting Puentedura's comment that it is not necessarily better to 'upscale' all activities to the Redefinition stage. Substitution/Augmentation may be the most appropriate in certain contexts (Puentedura, 2013).

4.3.4 Data collection methods

Timing	Data Collection methods
At the start of the project	• Meeting of BLAST team to design initial prototype • Small group interviews with students • Semi-structured interviews with teachers • Students' access to technology survey • Pre- intervention MSQL class survey into independent learning.
During each Iteration	• Regular meetings of design team to review and plan learning sequences • Observation of lessons – informal conversations with students • Monitoring of online activities and logs
At the end of each Iteration	• Semi-structured interviews with teachers • Evaluation meeting of the design team • Small group evaluation interviews with students
At the end of the project	• Questionnaire survey of students • Q method student evaluation of learning activities • Final evaluation meetings • Post-intervention MSQL class survey

Table 4.3 Summary of data collection timings

For the alignment of research questions and data collection and analysis see section 3.7. In summary, Table 4.3 shows the main data collection methods and timings during the intervention.

4.3.5 Reporting

In addition to the final report, the BLAST team will provide interim reports at the end of each phase. These reports summarise the progress made, evaluations from the project team and the students and strategies to develop and improve the next iteration. They will be made available to the team, the school senior management and the students.

4.3.6 Overall strategies and tools

In a blended learning course, one of the most important first steps for the team is to decide which activities are best suited to the classroom and which to the online environment. This includes issues such as the best use of the teachers' time, the engagement of students, whether the students need to be in the same physical place as the teacher or each other and so on. A selection of the most common activities is shown in Table 4.4, a number of the activities could be in either column, depending on the context, learning objective etc.

Activities appropriate for face-to-face teaching	Activities appropriate to online teaching
Introductions/personal interaction	Delivery of pre-recorded content, videos etc.
In person presentations	Asynchronous discussions (reflective dialogue)
Laboratory work and demonstrations	Reflection/journaling
Role Play	Assignments
Class discussions and group work	Individual research
Debates	Sharing documents
Socratic dialogue	Quizzes
Brainstorming ideas	Collaborative work (wikis etc.)
Spontaneous dialogue	Computer simulations
Live questions and answers	Peer/model answer review

Table 4.4 Activities appropriate to face-to-face and online environments

Another important issue discussed by the team is the organisation of these activities into coherent sequences, activities that are designed to be undertaken;

1. Before the face to face lesson
2. During the classroom lesson
3. After the lesson
4. Preparation for the next lesson

These four phases form the framework that Garrison and Vaughan use in their suggested strategies for implementing a blended learning course (2008:113)

Before looking at the prototype in detail, the project team discuss what activities and experiences would be appropriate for each of the above phases. This will inform our overall planning and set our agenda for further research and practice.

One of the issues we are concerned about is getting students to be prepared for the lessons. We want to provide engaging and accessible activities for students to do online before the lesson to encourage them to read listen or watch stimulus material. This would entail providing links to Internet sources, documents or references to the students' text book. Lauren and Jenny will research suitable sources for supporting the units of work the students will be studying. In order to check students' understanding we also consider the use of quick multiple choices quizzes that can be embedded in the VLE.

Both Jenny and Lauren take time to prepare active face to face classes with their students, structuring lessons so that there is a variety of tasks and formative assessment interaction. While both support constructivist approaches, they also see the benefits of direct instruction, where they see that one of the central roles of the teacher is that of the leader and manager of students' learning. The students rely on the teacher to create a well-designed course with activities that will enable them to succeed, pass their examinations and move onto the next phase in their career. They regard the face to face contact and regular interaction as vital in creating the personal relationships necessary for successful teaching, involving formal teaching, questioning and facilitation of individual and group activities. Both teachers hope that the use of the BLAST learning environment will relieve some of the pressure to cover content in lessons and create a supportive structure for students to become more responsible for their own learning and thus more independent learners.

Following a lesson, traditionally students would be asked to answer an examination questions or further reading. While this can be supported by online tools, we are looking for activities that can enhance the learning experience beyond just substituting activities; I refer the team to the TPACK framework (Figure 4.7) and the SAMR model (Figure 4.8). One of the skills Jenny and Lauren want to develop in students is their ability to reflect on issues raised in the class. Jenny suggests the possibility of using discussion forums or a reflective journal for students to use. We discuss how the learning environment could support group work and investigate the collaborative tools such as forums, wikis and glossaries available on the Moodle site. Something we also want to develop is some kind of 'advanced organiser' that would share the concept of the blended nature of the course with the students. I will develop the idea of using one the graphical software tools used mainly in the research domain mentioned previously in section 2.8.

As the students and the teachers are embarking on using an online learning environment for the first time, we plan to develop and use the ideas above in a gradual progressive manner, building on the skills of teachers and students as we go. We decided to start this project with a 'familiarisation' phase, the first iteration of the project, which involves creating a functioning prototype of the BLAST learning environment.

4.3.7 Initial design principles

The design team put forward the initial design principles that would guide the design of the learning environment in terms of layout and technology.

Some members of the team had seen other examples of online/blended courses and Table 4.5 summarises the consensus that arose.

Design principles for layout/technology	Strategies
Layout and navigation is clear, organised and engaging for the students	• Design team established to trial layouts and get feedback from students
Learner support is clear	• Provide support to students, including access to computers during the school day and after school
Teaching/Learning objectives/activities are clear	• Provide clear learning objectives for activities
Software tools are easily available	• Make sure all software required is free and freely available to students
Technology support is available	• Provide tech. support link on the front page

Table 4.5 Design principles for layout design

Design principles for activities/sequences	Strategies
Teacher Presence Establish simple patterns of learning sequences – to increase 'time on task' and readiness for lessons	• Design activities around the Conversational Framework • Provide examples of 'good performance' • Make available a variety of engaging resources • Make available online, lesson presentations and slides • Plan learning sequences in terms of pre-lesson, lesson and follow-up activities • Create regular online discussion forums to consider stimulus materials • Assign a variety of assessment types to monitor student progress and provide feedback
Provide access to VLE, induction and resources	• Provide access to VLE and induction for teachers and students • Provide access to resource tools, collaborative and assessment tools
Establish 'Social Presence'	• Provide clear guidelines for participating in discussion groups, etc. use of avatars. • Introduce use of rubrics and expectations of contribution • Introduce regular patterns of communication between students and teachers

Table 4.6 Initial Design Principles for activities and sequences

In addition to those for the layout and technology of the learning environment, the team summarised the principles that would guide the design of the teaching and learning activities in the course (Table 4.6).

At the start of the project, it was envisaged that there would be three cycles of development of the learning environment, each one becoming progressively more sophisticated as the staff and students became more familiar with the technologies and the new activities. The cycles have been termed; Familiarisation, Establishment and Consolidation, describing the main themes of each iteration. These initial cycles are shown in Table 4.7.

	As intervention matures, the prototype becomes more sophisticated →		
	Familiarisation	Establishment	Consolidation
Features	Basic	Standard	Sophisticated
Functionality example activities	• Resource access • MCQ • Simple forums • Organisation of information • Communication	• Resource creation • Quiz creation • Conditional release	• Assignment collaboration using wikis • Quiz CBM • Peer assessment

Table 4.7 Features of the maturing prototype, adapted from McKenney and Reeves (2012:126)

4.4 Design stage #1 ‘Familiarisation’

This section will use the design narrative form described earlier (3.6.3), to show how the first prototype was developed. It starts with a description of the design principles adopted for the prototype and how they align with the research questions of the project. I outline some of the discussions of the project team and how these develop into the learning environment. The section includes reference to teacher presence, where the structure and shape of the platform is developed, how the social presence is encouraged, how opportunities for assessment are produced and the development of the underlying technology upon which the project depends. The section concludes with a review of the first prototype, some evaluation from the project team and students and links to the development of the second iteration.

4.4.1 Design principles

Neither the teachers nor students have experience of teaching or learning with a learning platform in a blended or hybrid context. The first iteration is designed to familiarise the teachers and students with the BLAST learning environment. The first project team meeting ensures that all members have logins to the VLE software with access rights that allow for course creation and editing. This includes me as I am not a member of staff, just one of the issues of being the outsider member of the team, an issue that will arise again during the project. During the first meeting, the team decides on realistic and achievable objectives for the familiarisation phase, these ideas are expanded later.

Design principles for activities/sequences	Strategies	Nicol Principles (Nicol, 2009)
Teacher Presence Organising Information	• Design informed by Conversational Framework • Establish clear performance models • Design of curriculum/sequences • Structure of course pages • Evaluation from students • Design revision plan for module test at the end of the first iteration	• Encourage positive motivational beliefs and self-esteem (11) • Help clarify what good performance is (1) • Encourage time and effort on challenging learning tasks (2) • Provide information to teachers to help shape the teaching (12)
Access to resources	• Provide access to resources • Lesson presentations easy to access • Internet links to selected sites	• Encourage time and effort on challenging learning tasks (2)
Assessment & feedback	• Set MCQ (various) for self test • Video and short answer	• Deliver quality feedback (3)
Social presence	• Simple teacher led forums for discussing issues • Glossaries created by students	• Encourage interaction and dialogue around learning (6)

Table 4.8 Design Principles for the Familiarisation phase

One of the most important roles of the researcher in this project is to provide access to literature and theoretical frameworks underpinning the re-design of the course. Throughout the project I provide the teachers with abstracts and summaries of relevant papers and research. In addition I intend to provide short explanations to the students about the activities they are expected to undertake. These will take the form of 'The research says ....' summaries, including from the key ideas and principles underlying the intervention (Laurillard, 2012; Garrison, 2011; Nicol, 2009a; Nicol and Milligan, 2006a; Nicol and Macfarlane-Dick, 2006).

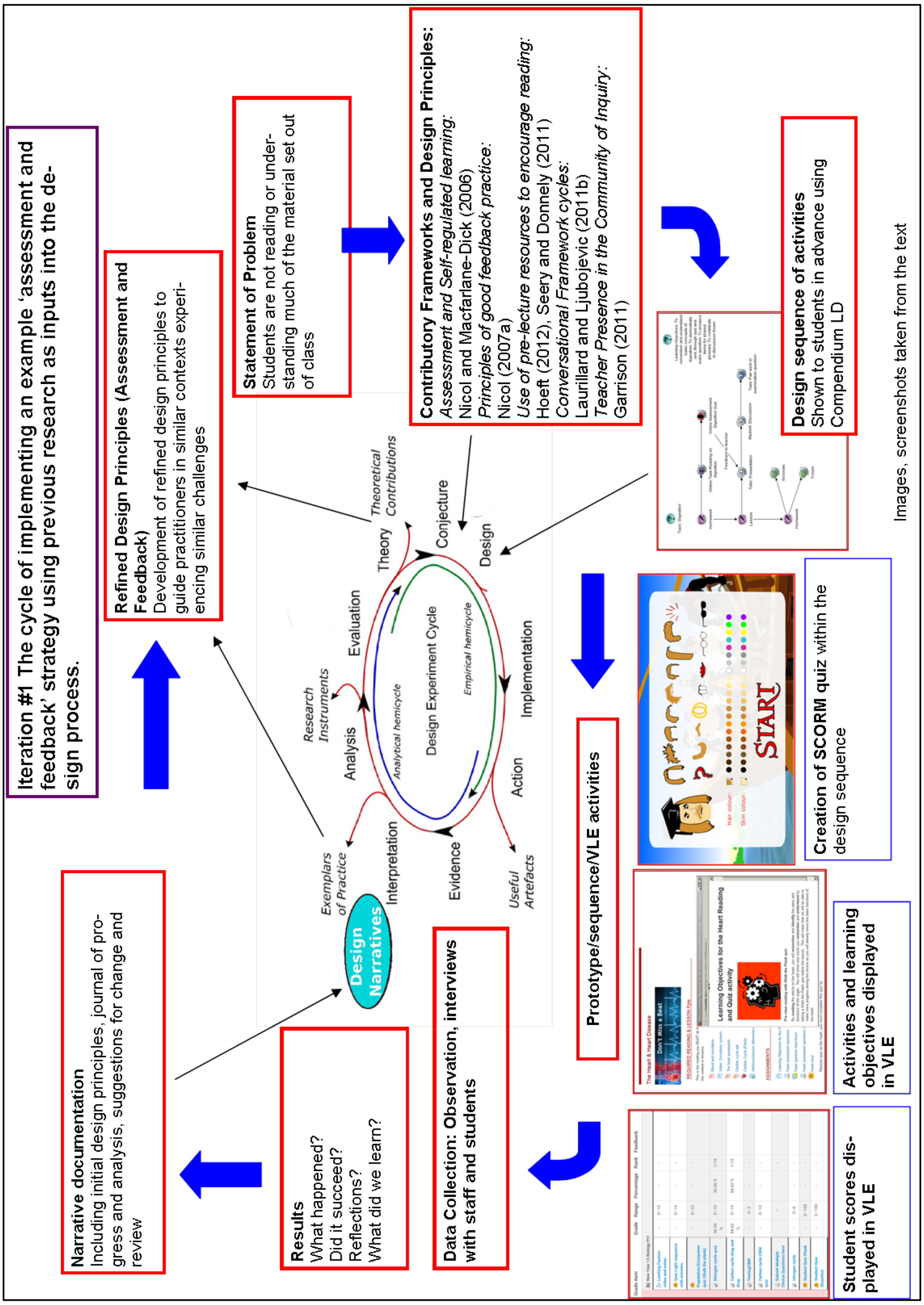


Figure 4.9 Diagram to illustrate the design research process iteration #1 (after Mor (2013)

Figure 4.9 provides a summary of the design-research process, showing the cycle of development from the identification of the challenge, the selection of previous work and the subsequent prototyping and production of tentative design principles.

4.5 Learning design and layout

This section will develop the ideas in the design principles show in Table 4.8. This includes some of the discussions of the project team and the rationale behind these early designs.

4.5.1 Teacher Presence

Garrison and Vaughan (2008), identified three essential elements that should be communicated to students and staff before the introduction of a blended learning course; a description and rationale for the process; the structure of the course and expectations of staff and students and the establishment of a system of support and resources to underpin the learning environment. These elements will be communicated to the students in class and within the BLAST site.

The importance of the teacher as the designer and organiser of learning is emphasised by those who support a constructivist approach (Laurillard, 2012; Garrison, 2011). While the specific role of the teacher might change, the central importance of the teacher as the designer of the learning environment remains. Teacher presence can be summarised as “the design, facilitation and direction of cognitive processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes” (Anderson et al., 2001:5). This involves three key roles that lie at the heart of the development of the BLAST learning environment; instructional design and organisation; facilitation of discourse; and direct interaction (ibid). Some of these ideas within the first iteration will be described here, and in the following section on social presence. The initial ‘visible’ part of teacher presence is the appearance of the learning environment. The team has discussed how the BLAST platform should look and the initial front page is shown in Figure 4.10 and Figure 4.11.

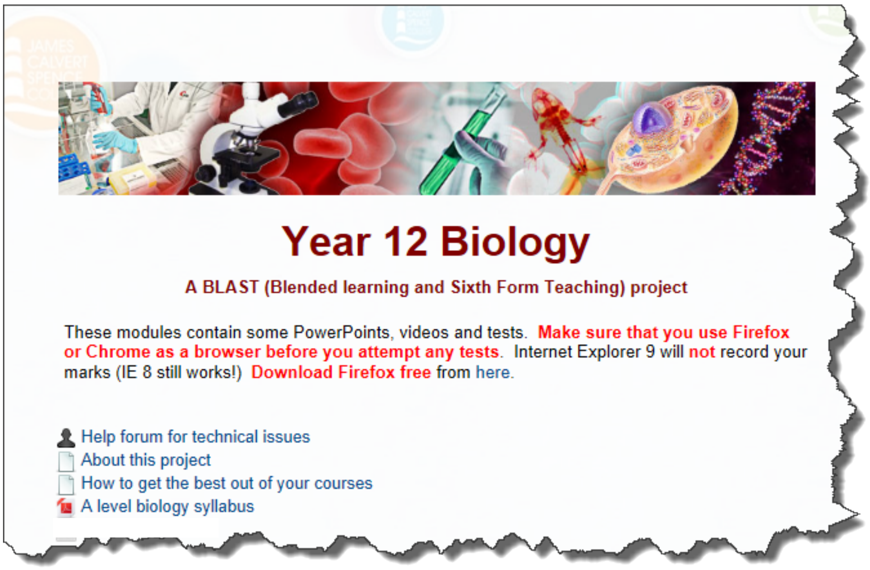


Figure 4.10 The initial front page of the BLAST learning environment

This initial prototype design first looked for guidance from existing courses and the Quality Matters rubric (Quality Matters, 2012). The course starts with a general statement followed by the individual topics of the course. While the course is introduced in class, some additional guidance on using the resources and activities is also included as reinforcement on the site. The first section includes links to a technical forum where students could report difficulties with the site; some notes about the BLAST project itself; some guidance on how to get the best out of the course and the A level course syllabus.

A note at the start of the course has been inserted referring to the choice of browsers when using the site. At this early stage there are already difficulties in configuring the Moodle application with Internet Explorer to allow the SCORM quizzes to record marks into the learning environment. While the school computers do not use Internet Explorer as a default browser, most of the student's home computers do and they have therefore been advised to change to Firefox which was known work with SCORM.

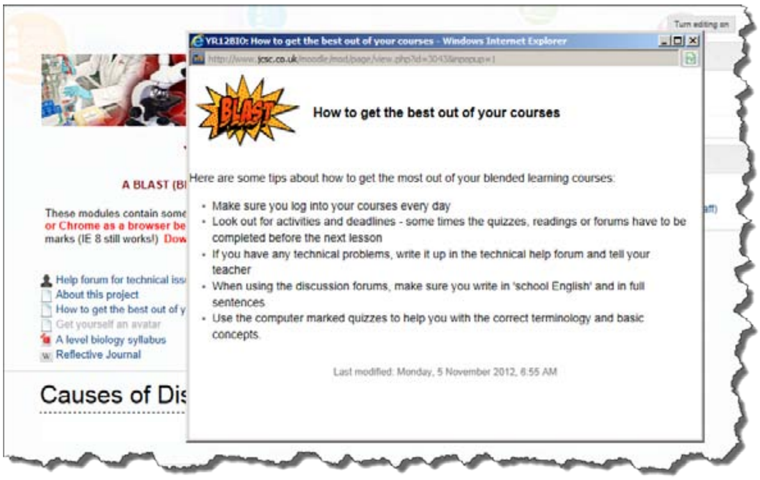


Figure 4.11 'Pop-up guide' to BLAST

The prototype design for the topics is shown in Figure 4.12. The project team want to divide the page up into easily recognisable sections that would be predictable and consistent across the site. Guidance and instructions would be given in the lessons, but all the information would also be available on the site, including lesson presentations and any readings referred to.

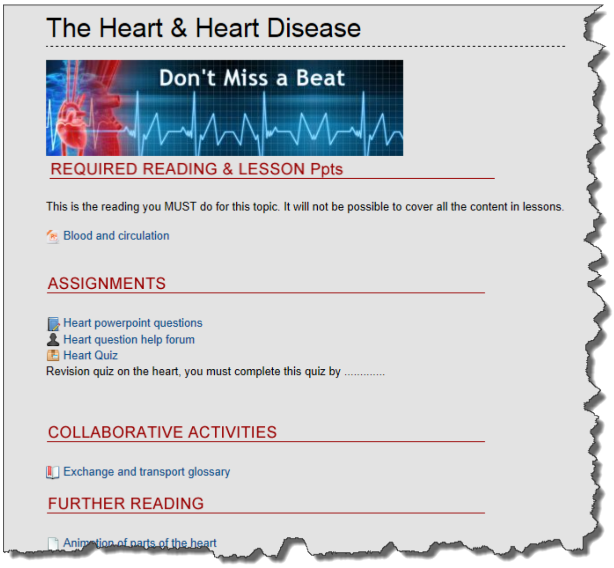


Figure 4.12 Initial design for content topics

4.5.2 Access to resources

One of the decisions the team has to make is the format of the resources made available to the students. The resources will consist mainly of documents, presentations and lists of links to other websites. We want these to be easily accessible to all the students who might not necessarily have the proprietary software available on their computers. It has therefore been decided that as far as possible, all presentations originally created in

Microsoft PowerPoint, will be converted to ‘Flash’ with the free iSpring presenter software, thus enabling the student to see the presentation on the screen in the browser without having to save the document and open it in their own version of the software. An example of the resulting ‘pop-up’ presentation is shown in Figure 4.13.

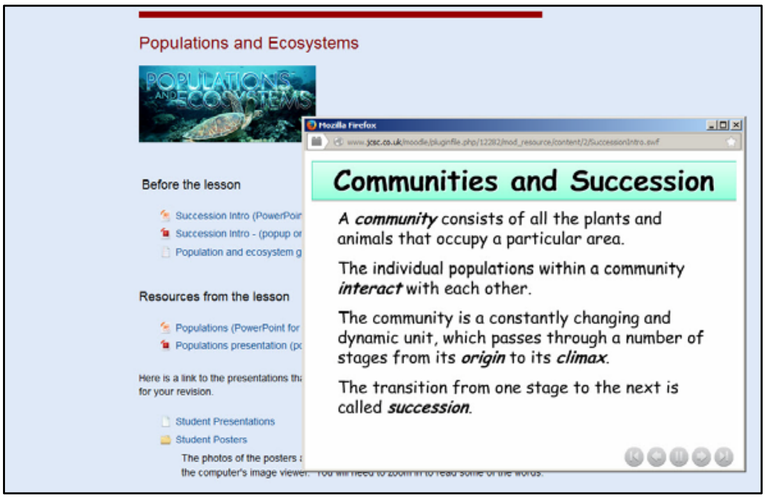


Figure 4.13 ‘Pop-up’ of converted PowerPoint class presentation

The alternative to having presentations ‘popping up’ is for a dialogue box to appear whenever a link to a presentation is clicked as in Figure 4.14.

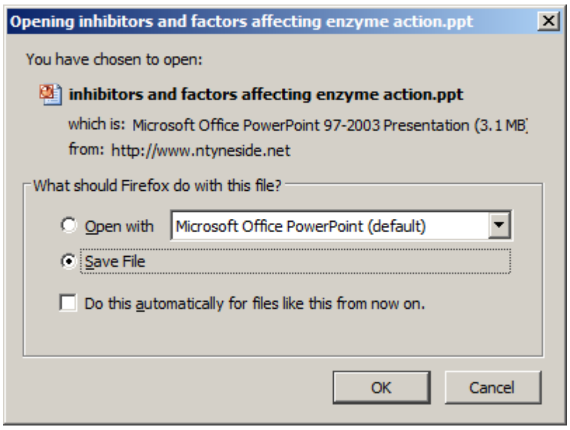


Figure 4.14 Dialogue box when PowerPoint link is clicked

Jenny and Lauren have started to edit the site themselves and are adding resources and Internet links after some demonstration from me and Kevin. There has been some delay while waiting for software to be installed on the teachers’ laptops and some reluctance by teachers to use the conversion software to enable presentations to ‘pop up’ on screen rather than for the student to have to save it onto their computer or open in the PowerPoint application. We agree that both versions would be made available to students who could choose how to view the resource.

In addition, all documents created in Microsoft Word will be converted to PDF format with the free CutePDF creator, for the same reasons. Links to other websites would be created within the Moodle environment, where they would open in a new browser window. Figure 4.15 shows one of the initial designs for the topic content, showing the resources available and some of the draft activities. We decide that the labels need more detail and explanation.

Figure 4.15 An initial design for topic content

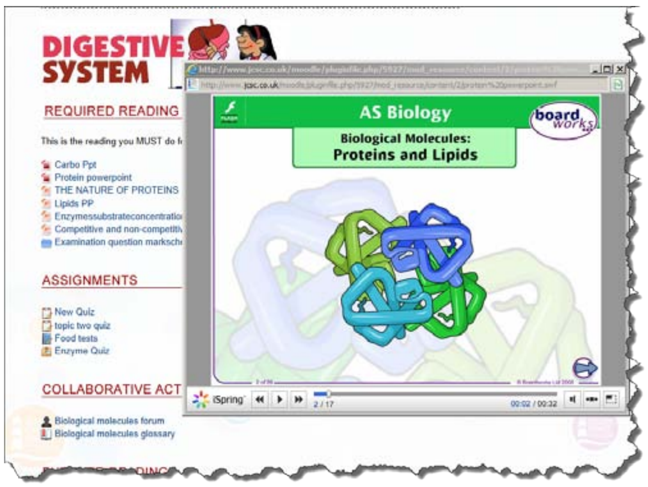


Figure 4.16 ‘Pop-up’ of converted 3rd party resource

Figure 4.16 shows some 3rd party resources that the school has purchased, being integrated into the project site.

The initial response of the students has been very positive, they like having support resources available online, especially the lesson presentations, sample examination questions and helpful links for further reading:

"I find the site helpful, I can go back and look at the lesson presentations".

"I like the fact that everything is all in one place"

"I think it is quite well organised, I can usually find what I am looking for"

4.5.3 Assessment and feedback

One of the simplest assessment types available on learning platforms are multiple choice questions (MCQ). These come in a variety of forms and are 'marked' by the system with feedback available immediately to the student.

While there are those who emphasise the limitations of using MCQ; they promote low level memorisation of facts and do not encourage high-level cognitive learning; feedback is very limited; and their use is driven by time and cost saving rather than pedagogical priorities, Nicol (2007a), provides a framework that maps the potential use of MCQ to formative assessment that contributes to the development of learner self-regulation (Nicol and Macfarlane-Dick, 2006). The project team will be using these principles (Figure 4.17) and the examples he provides as a starting point for the use of MCQ in BLAST.

Good feedback practice

1. Helps clarify what good performance is
2. Facilitates the development of self-assessment and reflection in learning
3. Delivers high-quality information to students about their learning
4. Encourages teacher and peer dialogue around learning
5. Encourages positive motivational beliefs and self-esteem
6. Provides opportunities to close the gap between current and desired performance
7. Provides information to teachers that can be used to help shape teaching

Figure 4.17 Seven principles of good feedback practice, (Nicol, 2007a:55)

These principles are supported by a substantial body of research and have been discussed in more detail previously (section 2.1.2). In summary "teachers can influence this appraisal through targeted interventions such as providing many low-stakes feedback opportunities, by fostering learning communities, by focussing on learning goals rather than marks and by linking formative tasks to summative assessments" (Nicol, 2007a:55).

Nicol's paper includes case studies of the principles being applied in a number of HE settings. The project team discuss these and decide which are applicable to our course redesign. We find that there is a clear progression in terms of sophistication that we will consider over the course of the project. A number of the examples are not applicable to our course or students. In addition I provide the team with a number of later examples not included in Nicol's brief paper. These include Hoeft's paper on *Why University Students Don't Read* (2012); Seery and Donnely's *The implementation of pre-lecture resources to reduce in-class cognitive load* (2011) and Howard's *Just in time teaching in sociology or how I convinced my students to actually read the assignment* (2004). All of these papers are very readable, (but only available through university subscription, thus creating a further barrier to teachers accessing educational research) and pertinent to the concerns of the teachers in the team. The common factors emerging show that the use of MCQs can engage and support students' learning. The following is a plan that we created using the research above (Table 4.9):

Strategy	Application of Nicol's Principles	References
1. Introduce pre-class quizzes to reduce 'cognitive load' in new topics	Clarifying goals (1) Self assessment (2) Opportunities to repeat MCQ (6)	(Seery and Donnelly, 2011) (Nicol, 2007a)
2. 'Just in time' quizzes before classes to ensure reading & make sure students can read the material	Self assessment (2) Immediate feedback (3) Feedback shapes subsequent teaching (7)	(Howard, 2004) (Hoeft, 2012) (Nicol, 2007a)
*3. Students create MCQ themselves (quality of questions improves over time)**	*Actively formulate the question and alternative responses(1)* *Teacher monitors progress and gives feedback (3)* *Peer dialogue when pairs construct MCQ (4)*	*(Nicol, 2007a)* *(Fellenz, 2004)*
*4. Use confidence based marking CBM to encourage reflection and consideration before answering**	*Reflection (2)* *Motivation (5)*	*(Nicol, 2007a)*
* The strategies in italic are planned for the later iterations		

Table 4.9 Application of Nicol's (2007a) principles to MCQ strategies

We intend to implement the first two strategies in this first iteration. We want to introduce the students to the MCQ within a context of the sequences of lessons in each topic. Jenny and Lauren are particularly interested in not just getting the students to read the text book or reading assigned to them, but also in the concept of reducing cognitive load when introducing new demanding material. They hope that by asking students to read introductory texts before class and testing basic understanding of terms and concepts in a MCQ, the lesson will be able to start at a higher level, with the class making faster progress. This might also impact on the structure of subsequent lessons, "..with some ideas seeded in the pre-lecture resource .. in the lecture, time would then be devoted to allow students to discuss in small groups their findings ..” (Seery and Donnelly, 2011:9). One of the issues discussed by Hoeft, is the nature of the readings required and the possibility of students not being able to access the resources through lack of formal reading ability, she notes that poor reading levels of ‘freshmen’ contribute to the failure of some students to read the material (Hoeft, 2012:10). We test this out on occasions by getting students to read aloud from the textbook during the lessons. On the whole, students’ reading skills are appropriate for this level of work.

Figure 4.18 Learning objective ‘pop-up’ from BLAST for reading and quiz activity

Figure 4.18 shows the ‘pop-up’ the students see for the learning objectives for the task of reading an online article about the heart and then completing a Walk the Plank multiple choice quiz before the lesson. The learning objectives for this activity are simple. They have been derived from the cognitive domain visualisation circle (Atkinson, 2013), in Appendix C. The proto-verb is level 1 ‘remember and understand’ with the activities and assessment evidence taken from the outer circles. This is the format we intend to use for communicating lesson activity learning objectives to the students.

The Moodle application has MCQ quiz features built-in and further question types are available to download from the online library. In addition, some third party suppliers have created more entertaining quiz formats. Examples used this project are shown in

Figure 4.19 and Figure 4.20, these are designed to appeal to younger students (contentgenerator.net). These applications use Flash technology to display the quizzes and SCORM standards to feed the marks into the learning environment database.

Figure 4.19 Start screen from ‘Walk the Plank’ quiz

Figure 4.20 ‘Walk the Plank’ quiz screen

Other quiz applications provide a greater variety of question types and feedback facilities, using sequencing, drag and drop, placing items on a background image etc. Figure 4.21 shows the question types available in one 3rd party quiz designer, an example of such a question is shown in Figure 4.22 and Figure 4.23.

I have access to a third party databank of science quizzes appropriate for GCSE level, these would make good introductory revision tests prior to more advanced work. These questions have been created by the Fuse Creator software, of which I have a licensed copy. Lauren and Jenny will provide me with the quiz questions and I will create the quizzes to demonstrate the different layouts possible.

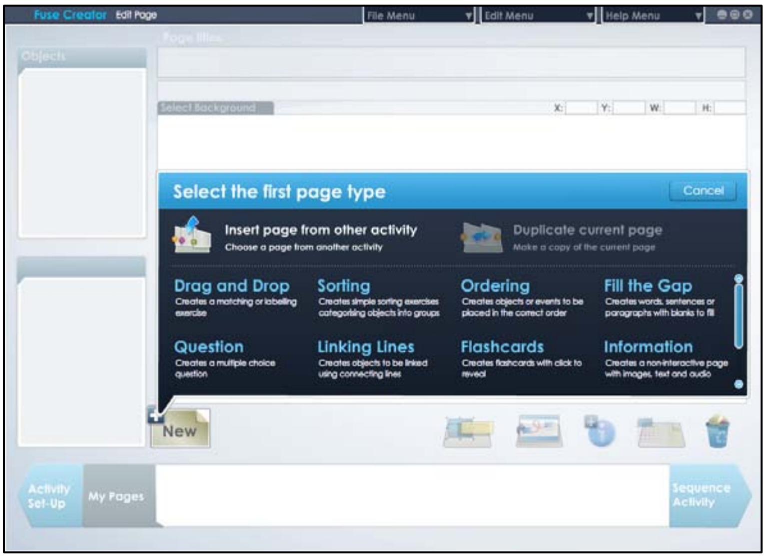


Figure 4.21 Question types available in Fuse

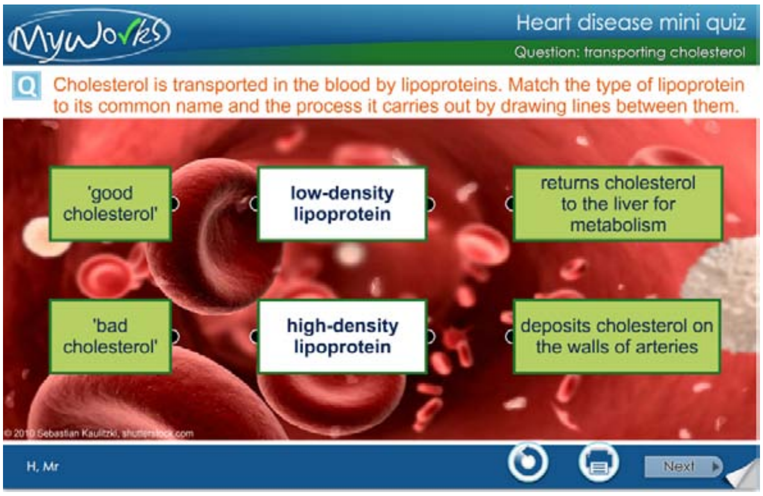


Figure 4.22 A question from a commercial data bank

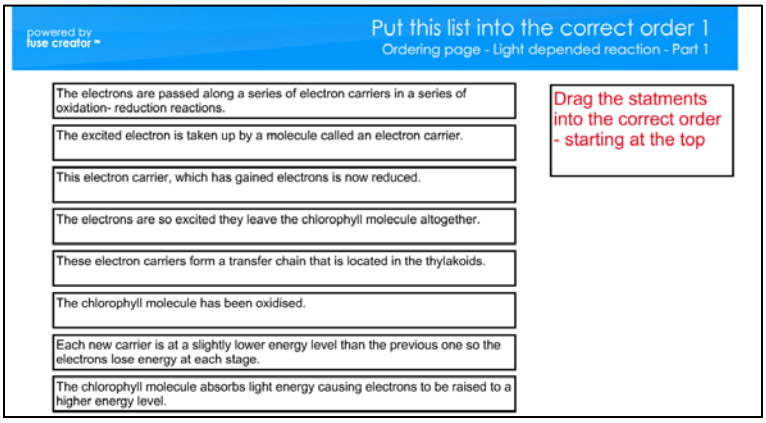


Figure 4.23 Sequencing activity using Fuse Creator

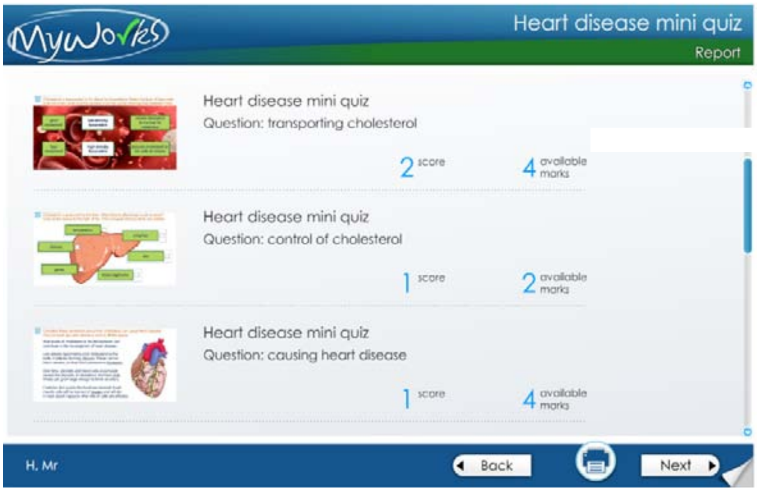


Figure 4.24 Feedback report from Fuse Creator activity

Figure 4.24 shows some of the feedback reports available.

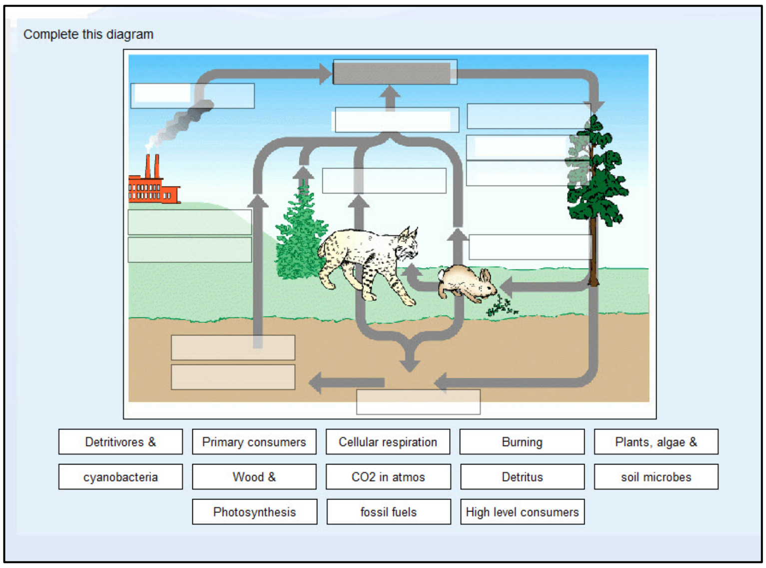


Figure 4.25 'Drag and drop' activity using a Moodle plug-in

Figure 4.25 shows a 'drag and drop activity using a free add-in from the Moodle library.

One of the strengths of using MCQ is the immediate feedback to the teacher and student from the test. The tests can be configured to allow the student to repeat the quiz a number of times and the grade can be configured to record the highest, more recent or average marks. In the first instance we decide to allow the students to repeat as many times as they like with the highest score being recorded in the grade book. A student's view of their grade book is shown in Figure 4.26.

Grade item	Grade	Range	Percentage	Rank	Feedback
New Year 13 Biology Pt1					
Limiting Factors video and notes	-	0–10	-	-	
Quiz Light sequence with answers	-	0–16	-	-	
Population/Ecosystem quiz (Walk the plank)	-	0–10	-	-	
Nitrogen cycle quiz	30.00 %	0–10	30.00 %	1/15	
Carbon cycle drag and drop	84.62 %	0–10	84.62 %	1/15	
TestingCBM	-	0–2	-	-	
Carbon cycle CBM quiz	-	0–10	-	-	
Submit Multiple Choice Questions here		–		-	
nitrogen cycle	-	0–6	-	-	
Student Quiz Plank	-	0–100	-	-	
Student Quiz ShootOut	-	0–100	-	-	

Figure 4.26 Moodle grade book (student view)

The initial student response to these MCQ has been positive. While not all students have yet fully engaged with the site, those that have, like the idea and format of the quizzes so far:

> *"I like the quizzes – I can do them as many times as I like til I get the answers right"*
>
> *"I prefer the Walk the Plank format!"*
>
> *I like doing the different types of questions – a mix of multi-choice, drag and drop and matching – I think it tests knowledge well"*
>
> *"I can get the marks straight away, but the gradebook doesn't seem to work for me"*

These responses show that the immediate feedback and the activities have engaged some of the students. As well as developing the sophistication of the question types, Lauren and Jenny are working on strategies to get more of the students engaged with the online quizzes and the site as a whole.

4.5.4 Social Presence

According to Garrison, "social presence is the ability of participants to identify with a group, communicate purposefully in a trusting environment" (2011:23). He records however that establishing social presence can be challenging.

Although the class meets several times a week in person, the project team want the students to use asynchronous discussion forums online for a number of reasons:

- We want to develop students' ability for reflection, to allow them time to consider their responses before they post on the discussion board.
- We want to give students the opportunity to view and respond to a variety of stimuli, including each others' work, video, examination scripts etc.
- Develop the class based community by extending discussions online

Learning through discussion is an important aspect of Laurillard's Conversation Framework (2012), as described in section 2.9. We want students to have the opportunity to experience learning in all of Laurillard's cycles. In particular we want to develop the Peer Communication and Modelling cycles (PCC and PMC), where students are able to 'modulate' their concepts and actions through being able to share them with their peers.

I share some references with the team, referring to some of the research on this topic, although most comes from the HE sector. Most of these sources refer to the potential benefits mentioned above, emphasising the nature of educationally valuable talk (EVT), discussed by Uzuner (2007), and how students might use discussion forums to promote their learning. Ellis et al. (2006), identified four ways that students reported they were using discussion; to challenge ideas; to develop ideas, to acquire ideas and to check ideas. Most of these sources contain suggestions as to how students could become engaged with the discussion forums. We want to be able to take advantage of the results of the studies. The following list summarises the most relevant and helpful suggestions:

- Discuss norms and expectations of contributing to discussions, including length, number of posts etc. and whether to attach images or other documents.
- Encourage students to use evidence to support any opinions that they offer.
- Explain often why they are being asked to contribute to discussions, how it will benefit them.
- Display the discussions to the class and use them to further students' skills.

Neither of the teachers have facilitated or moderated student discussion boards before and we decide to include only simple teacher-led discussions in this first iteration. One of the first discussion forums is to ask students to research some important laboratory equipment, give some background and attach an image to check students' technical ability and their engagement with task (Figure 4.27).

Figure 4.27 An example of a section of a discussion forum

In future forums Lauren and Jenny intend to develop role plays, peer assessment, the marking of model examination scripts and discussions of controversial issues.

One of the ways that students can become engaged with using discussion forums is to be in control of their own 'avatar' or image that accompanies each contribution they make. Initially Kevin allowed all students to pick their own image as an avatar, but he has just changed this policy. Now only the teachers can have their own avatar, students avatars will default to the image of the student held in the school's administration database. We have discussed reversing this policy, but to no avail, it seems that this has been a technical challenge that justifies keeping the policy in place.

Despite applying the suggestions from the literature, some of the students' initial responses were not very positive:

> *"Why do we need a forum when we see each other every day?"*
>
> *"It seems just extra work"*
>
> *"Some people will just wait for others and copy what they say"*
>
> *"I don't want other people seeing what I write"*

Although some did see some benefits:

“I can take the time to think before I post a response”

“I think this is a good way to share discussions – you can see how the discussion develops afterwards”

The teachers persevere and explain/justify every time a forum is expected. We had considered using grades to provide some form of ‘incentive’, as this had been mentioned by some studies, reasoning that students are very grade conscious and may respond to this extrinsic motivation. We decide against it, mainly because we want the students to see the intrinsic benefits of contributing and on a more pragmatic note, they know the assessment structure of the exams and thus extra criteria cannot be added by teachers. During this iteration we will continue to develop the activities, making them as interesting as possible, while planning to address some of the concerns in the next iteration.

4.5.5 An initial design sequence

Here I will describe one of the first sequences the team planned for use in the BLAST learning environment, bringing together some of the features, tools and activities mentioned previously, and showing how the design has been informed by the Conversational Framework. The sequence is represented in the CompendiumLD format in Figure 4.28 and shown on the BLAST learning environment in Figure 4.29. The sequence comprises three main activity groups, pre-lesson, lesson and post lesson activities.

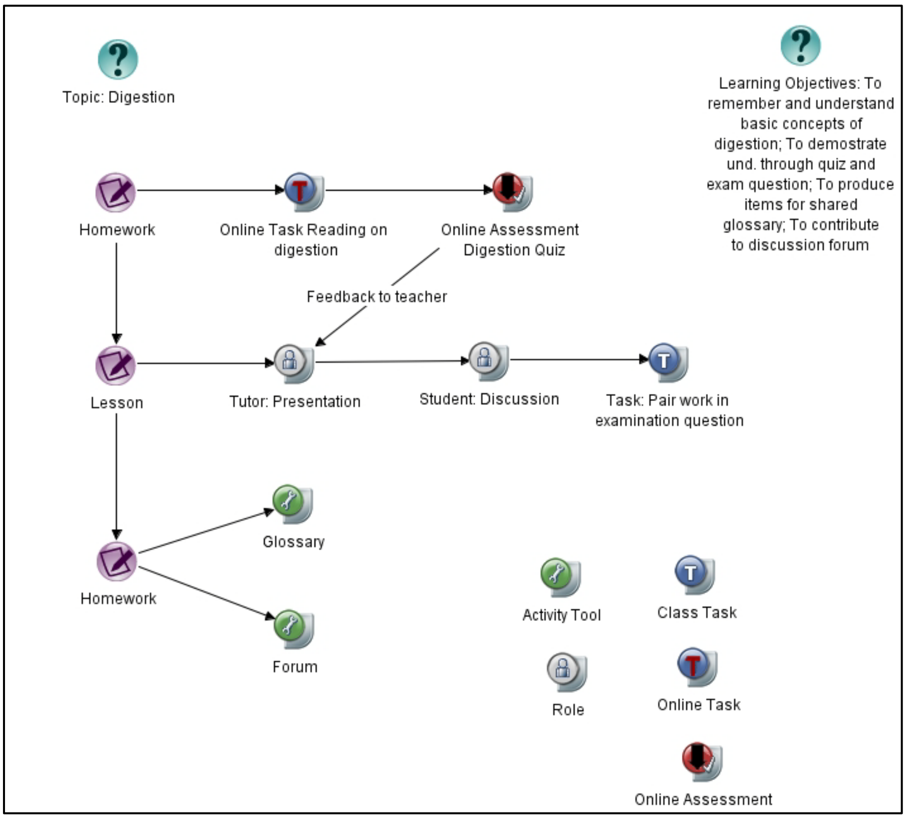


Figure 4.28 A short sequence of activities displayed in CompendiumLD

The pre-lesson activities include a short reading on the topic of human digestion and a MCQ based on the central concepts in the article. The teacher wants to ensure that the students have understood the main ideas before the lesson, enabling the teacher to start at a higher level, and attempting to reduce the cognitive load on the students. As shown in Figure 4.28, there is a link between the quiz and the tutor presentation in the following lesson. The aim here is for the teacher to check the online quiz results in order to get some feedback on the student's understanding, and so fine tune the lesson.

Figure 4.29 Activities for the sequence displayed in the BLAST environment

The lesson activities are fairly conventional, consisting of the tutor presentation (uploaded to the BLAST site), a teacher led class discussion to raise further issues and a question and answer session to gauge student understanding, followed by some pair-work where students attempt to plan answers to related examination style questions. To consolidate the sequence, the teacher has allocated specialist terms to each student, who must define and illustrate them in a shared glossary before the next lesson. She has also started a discussion forum based on some of the issues raised in the reading and the lesson; students are also expected to contribute (Figure 4.30).

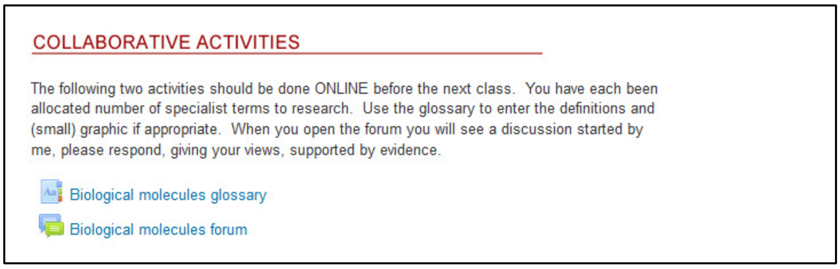


Figure 4.30 Collaborative activities from the sample sequence

The students respond well to the sequence and appreciate the linking of class and home work. In the next iteration we aim to be more explicit and share the sequence plans with the students on the BLAST site. The only ‘failure’ of the implementation of the sequence is the inability of the BLAST site to store and display the quiz score from the students’ test. This will be discussed further in the technology section.

In the terms of the Conversational Framework this sequence mainly comprises the teacher Communication Cycle (TCC), where the teacher introduces and shares learning goals and concepts, questions students about their understanding and uses examples to help explain new ideas. The peer communication cycle (PCC) is also explored through both class-based and digital discussion opportunities. There is also an example of students learning through the production of the glossary. While this is a simple sequence, it does give the teachers an introduction to using the quadrants and learning cycles of the Conversational Framework. The complexity of the Conversational Framework is made more accessible by the use of visual interpretations of its elements.

Figure 4.31(a) illustrates learning by acquisition, where the teacher's concepts (TC) and models of practice (TPME) are explained through presentations, lectures and demonstrations as well as digital resources found in the BLAST environment. Students can modulate their own understandings, but at this stage are not asked to perform any actions.

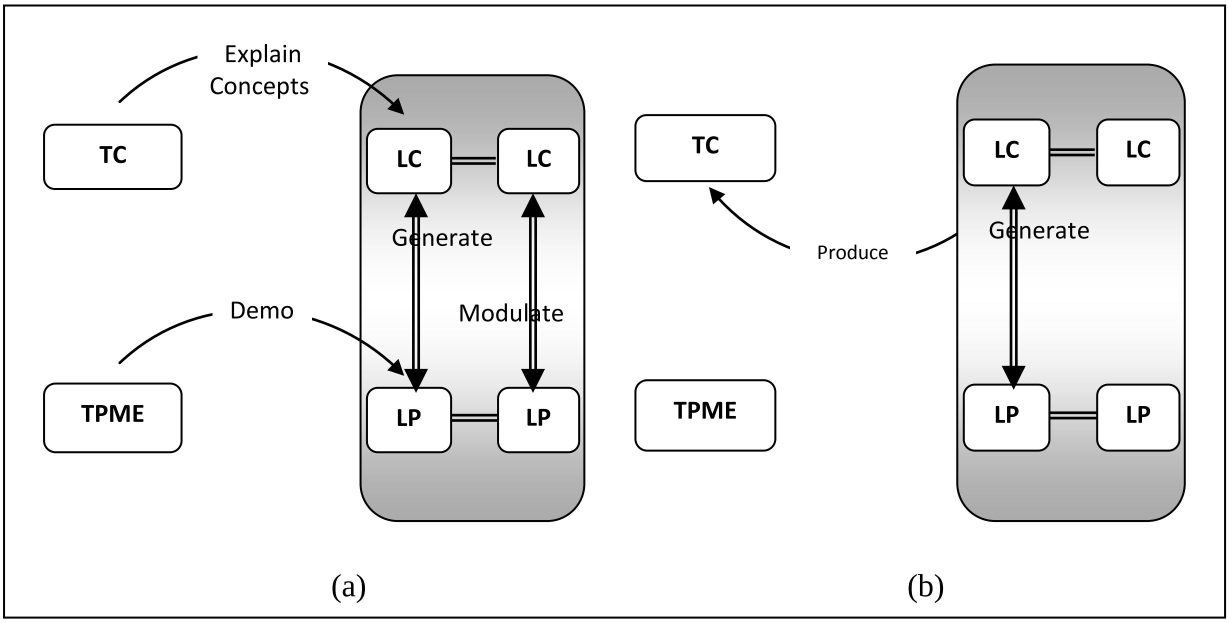


Figure 4.31 Learning through (a) acquisition and (b) production mapped to the Conversational Framework (Laurillard, 2012:97)

Figure 4.31(b), shows the students learning through submitting work back to the teacher, in this sequence, the online quiz, with its own feedback and the glossary, where the teacher can check for understanding.

Moving to the PCC, the teacher has structured the class work and online discussion forum to allow the students to develop their ideas and modulate these through discussion with their peers; this is shown visually in Figure 4.32.

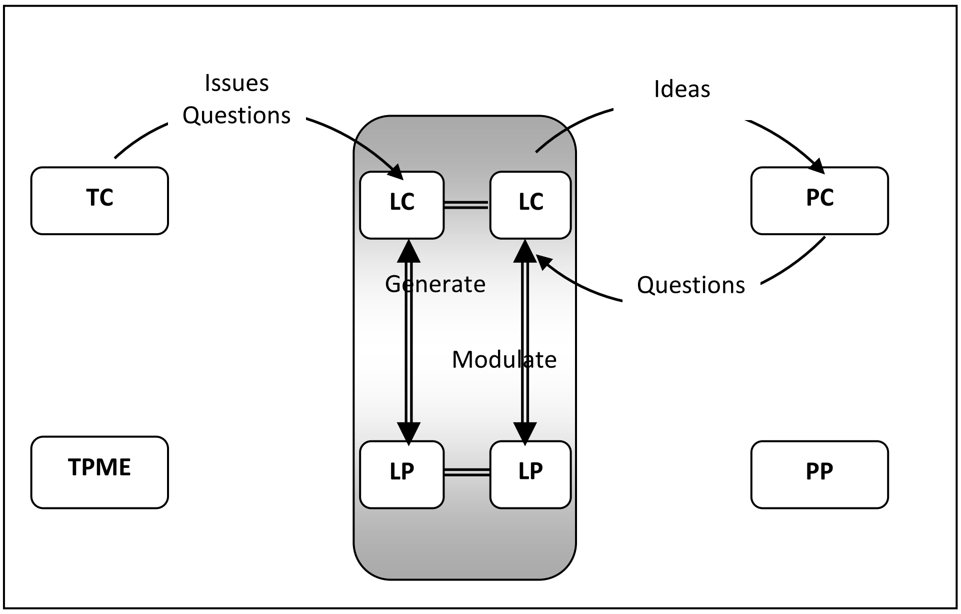


Figure 4.32 Learning through discussion mapped to the Conversational Framework (Laurillard, 2012:99)

4.5.6 Technology issues

On reading much of the press and indeed educational journals, it is assumed that technology is the least of the issues in developing a learning environment. After all, the technology is ubiquitous and students are assumed to be digital natives. However, far from being trivial, issues of getting the technology to work in the ways intended, is crucial to the functioning of the learning environment and therefore the project.

Reflecting on the first BLAST meetings, I observe that there are different agendas from the participants. Kevin wants a system to control and design from a technical, efficient viewpoint, he wants to write the code to customise the default settings of the Moodle learning environment, to fit in with his design of the school website, in terms of layout, colour schemes and navigation etc. Jenny and Lauren want resources to be available to support the syllabus and maximise student outcomes with the adoption of activities that support this end. I as the researcher also want the students to achieve the best they can, but in a study environment designed from sound research procedures. I will reflect here on some of the issues of getting the technology to work. Hopefully as the project progresses, these issues will diminish.

Many of the early issues are around permissions granted to the teachers and myself in terms of editing the learning platform. Kevin wants to control access quite closely and we are finding that having to email every issue to him rather inconvenient. This changes over the course of this phase, so we soon have full editing rights over the course, though (understandably) not administrative rights over the platform. Here are some of the technical issues that are causing problems, some being solved quickly, others will be returned to as they restrict the functionality of the platform:

- Moodle plugins not enabled
- Video formats not recognised
- Grading tools not displaying properly
- Teachers laptops needing additional software installed
- CSS styles conflicting with Moodle functionality e.g. editing tools not being available to students
- Configuration of Moodle features
- Grade reporting failure using SCORM and Internet Explorer etc.

One example of difficulty is shown here; the VLE software allows a great deal of customisation to the layout of courses. Kevin has customised the software to his own design and has locked down one of the most useful features; that of the user being able to hide or 'dock' the navigation bars on the left and right of the screen, allowing more space for the actual course content. This has been discussed in project meetings but Kevin will not change the layout, saying it is consistent with the school website layout and not necessary. This raises issues about not only design and audience, but leadership and authority on the project and the school itself. In the project school, there is no member of the senior leadership team who is responsible for 'learning with technology', - some schools nearby have post of assistant head teacher with responsibility for e-learning etc. who would be responsible for and line manage technical staff. At this school there is no such arrangement and Kevin as the network technician is left to design and administer the network and learning environment without any 'educational ' oversight.

One of the major technical issues has been the unreliability of the system as a whole. Because there is no budget for the school's VLE, it is hosted inside the school on a spare server, rather than being hosted commercially. This results in the system being wholly dependent on the school's Internet access. If either the school's network or

Internet access fails, no student can access the BLAST site from within the school or from home. The system has crashed a number of times, a majority at weekends when technical support is not immediately available. As the project has developed and the technical team see that the service is being used more and more, the system has become more reliable with fewer crashes.

4.5.7 Technology use by students

One of the ongoing issues of concern is the failure of the SCORM quizzes to report results into the Moodle gradebook. This occurs when the students use Internet Explorer as the browser. The SCORM links works well with Chrome or Firefox browsers.

Fifty two percent of students in the initial technology survey reported that they were ‘quite’ or ‘not very’ competent in terms of changing settings etc. on their PCs at home. We did expect the others, who claimed to be competent, to start using the alternative browsers. However, despite constant reminders and helpful tips on the site, not one student has yet reported changing their browser at home from Internet Explorer. I have suggested to Kevin that we offer a technical workshop where students can bring in their laptops for help in installing the software.

Another issue regarding students’ digital literacy is their apparent lack of knowledge about ‘file types’, we had to do a great deal of explaining when discussing how to view common file types such as PDF or Microsoft Office files.

When attempting to add images to glossaries or forums, which is quite a straightforward task, students commonly attached enormous graphics that could not be displayed satisfactorily on the screen. Another session about resizing graphical images is required.

4.5.8 Review of the first stage

By the end of this first stage or iteration we have a functioning learning environment available for students in school and at home. The majority of students have been using the site regularly for resources, activities and assessments. In this review section I will consider how far the project has met the criteria set out in the initial design principles at the start of the iteration. I have summarised these here for convenience in Table 4.10:

Design principles for activities/sequences	Strategies
Teacher Presence Organising Information	• Learning design informed by the Conversational Framework • Establish clear performance models • Design of curriculum/sequences • Structure of course pages • Evaluation from students • Design revision plan for module test at the end of the first iteration • Teachers becoming familiar with the Conversational Framework
Access to resources	• Provide access to resources • Lesson presentations easy to access • Internet links to selected sites
Assessment & feedback	• Set MCQ (various) for self test • Video and short answer
Social presence	• Simple teacher led forums for discussing issues • Glossaries created by students

Table 4.10 Summary of Familiarisation phase design principles

The initial priorities for this first interaction have been for both staff and ```students to become familiar with using a blend`ed learning environment. The teachers have become more familiar with creating and editing objects for use within the BLAST learning environment, with guidance and training from me and Kevin the IT technician.

Regular visits from me to the school, interviews with students and meetings have raised the profile of the project. Staff are very busy with other responsibilities and classes, from threats of inspection to lesson observation from senior staff. This has meant that there has been limited time for reflection to develop the innovations. Though as Lauren has stated:

> *"Having you visit and expecting the site to develop has put me under pressure to get things done, I think otherwise it would fall in the list of my priorities."*

In terms of the teacher presence category, the BLAST learning environment has been established with a clear layout structure that is consistent and easy to navigate. A variety of resources and activities has been made available to students, including revision resources and activities for the module test, and the feedback comments have been favourable. We have not yet developed the explicit blended sequences of face-to-face and online activities. These will be one of the priorities of the next phase, including the use of the Teaching and Learning Activities (TLAs) stemming from the LDSE project (LDSE, 2011) and the graphical representation of sequences (Open University, 2011), although I have used the Conversational Framework to analyse the activities planned for the students and introduced the model to the teachers through example activities and the diagrams. The aim will be to create learning designs that allow the students to learn through all of the learning types and quadrants described in section 2.9. In addition we will be looking at developing more effective communication systems to remind students about new materials on the site and upcoming deadlines. This is mainly in response to some students not visiting the site as often as we would like. We also want to encourage students to keep a learning journal which has been cited by some to develop metacognitive skills and foster independent learning. Another facility that the team would like to develop is the 'conditional release' of resources and activities that would force the students to access them in a certain order, thus imposing more of a structure to the site. Although seemingly at odds with the concept of encouraging student autonomy and independence, we feel that the students still need a great deal of structure to help them develop these skills and to see the benefit of using the site.

Access to resources has been well received, with the students especially appreciating the lesson presentations being available online. A variety of other resources have been made available including links to web sites, RSS feeds from science current affairs sites and third party documents and videos. The students would very much like the sound and even the video of the teacher-led sections of lessons, as is often available in higher education. They have requested that Jenny make some YouTube like videos for some of the sections of the practical parts of the course. We will be looking at the possibilities of doing this in the next phase. One of the strategies for developing the students' creative talents in the next iteration is for students to create and upload their own content to the BLAST site; these will include posters, photographs and group presentations.

During this first iteration, we have used MCQ and other forms of computer marked assessments to support reading, test basic concepts and vocabulary and to engage the students in revision activities. In order to move on the higher level skills advocated by Nicol (2007a), we intend to ask the students to create their own MCQ in the next phase. We intend to put the students into groups to encourage their interaction and discussion of the topics.

Students have participated well in the teacher-led discussion forums that we have created. Although initially reluctant to contribute, most are now participating in the discussions. In the next phase we will address some of the students' issues about 'free-loaders' by creating a forum structure where students cannot read others' posts before they have created their own.

4.6 Design stage #2 'Establishment'

In this iteration the project team want to build on the work achieved in the previous iteration. The teachers and students are now mostly comfortable working with the BLAST learning environment and it has become a core feature of the course. The main developments, outlined in more detail later in this section concentrate on; being more explicit in the representation of the learning designs for the teachers and the students; incorporating a formal tool to encourage students' critical refection; instituting an addition form of communication with the students through SMS messaging; giving students more opportunity to create and publish their own work on the learning platform; engaging the students further in the assessment process, by giving them the opportunity to create items for multiple choice quizzes and refining the use of discussion forums in order to address some of the issues arising from the student feedback in the first iteration. The learning designs will be further analysed through the use of the Conversational Framework.

4.6.1 Design principles

The strategies and associated design principles for this phase are outlined in Table 4.11, and emphasised in italic. The project team meet to discuss the priorities and stages of this iteration phase. We are all conscious of time constraints and pressures of upcoming interim examinations and the possibility of an Ofsted inspection. Despite the amount of work involved, the teachers are keen to continue the additional meetings, preparation work and research reading that the project entails.

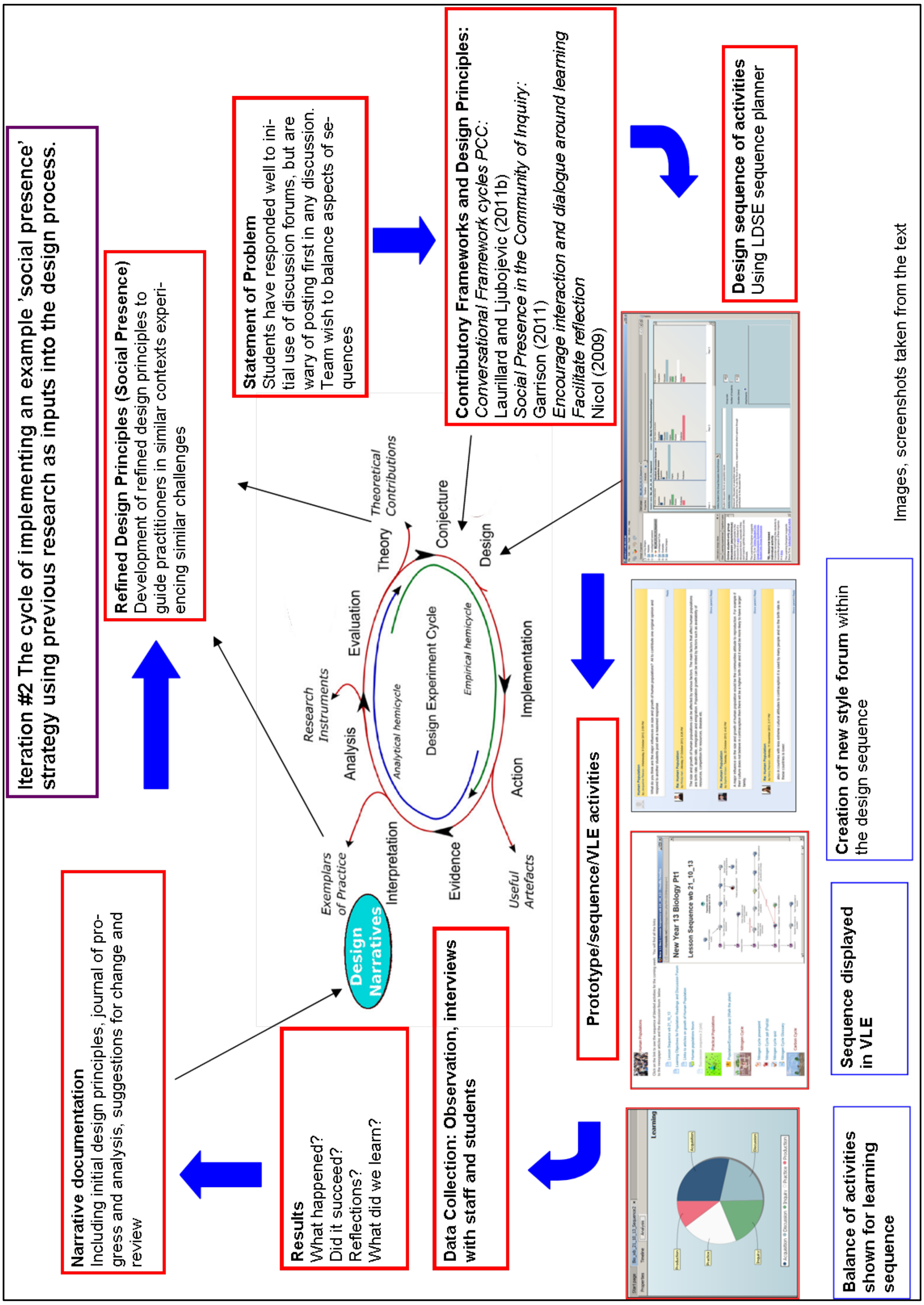


Figure 4.33 Diagram to illustrate the design research process, iteration #2, after Mor (2013)

Figure 4.33 provides a summary of the design-research process from an example activity taken from this iteration.

Design principles for activities/sequences	Strategies	Nicol Principles (Nicol, 2009)
Teacher Presence Organising Information	• *Conditional release of activities* • Establish clear performance models • *Design of curriculum sequences clear to students via sequence maps* • *Teacher reminder system via SMS messages* • *Incorporate Student journal* • Evaluation from students	• Encourage positive motivational beliefs and self-esteem (11) • Help clarify what good performance is (1) • Encourage time and effort on challenging learning tasks (2) • Provide information to teachers to help shape the teaching (12)
Access to and creation of resources	• Provide access to resources • Lesson presentations easy to access • Internet links to selected sites • *Students create and upload own resources, presentations, posters etc.*	• Encourage time and effort on challenging learning tasks (2)
Assessment & feedback	• Set MCQ for self test • *Students create own MCQ* • *Activities to act on feedback*	• Deliver quality feedback (3) • Provide opportunities to act on feedback (4)
Social presence	• *Q & A Forums for model answer marking* • *Journal activities*	• Encourage interaction and dialogue around learning (6) • Facilitate reflection in learning (7)

Table 4.11 Design principles and strategies for the Establishment phase of the project

4.7 Learning design

This section of the iteration will describe how the project team have approached the idea of learning design and its representation. This has involved additional work from the teachers who have been forced to adapt their way of planning and representing their topics in terms of schemes of work and lesson plans (although they have to continue to document their plans in the traditional way for accountability purposes within the school). This is illustrated through an example topic in the syllabus.

Table 4.12 outlines a sequence of activities for a human population topic in a tabular form, together with the learning cycles appropriate for the activities. Jenny has additionally created individual lesson plans as required for the school. The activities in the table have been mapped to Laurillard’s learning cycles (see section 2.9). The team meets and discusses the teaching and learning activities (TLA) available in the LDSE and their properties (see Appendix I).

	Topic: Human Population			Learning Cycle
		TLA Equivalent	Time	
1	Previous lesson set homework to plan the preparation of posters based on population growth curves etc.	Group Practical Activity	1 hour	PMC
2	Preparation of posters in pairs	Group Practical Activity	1 hour	PMC
3	Initial feedback and discussion of assessment criteria	Tutor guided class discussion	15 mins	TCC
4	Peer evaluation of posters	Peer assessment	30 mins	PCC
5	Update notes on population growth curves after peer activity – posters uploaded to BLAST platform	Resource based individual activity	15 mins	TPC
6	Practical lab activity checking bacterial growth on samples (regular class monitoring)	Group practical activity	20 mins	TMC
7	(Home) read/select/summarise newspaper article available from BLAST	TEL resource based individual activity	1 hour	TPC
8	Students present their summaries	Student presentation	20 mins	TCC TPC
9	Class discussion on population growth and factors effecting birth and death rates	Tutor guided class discussion	20 mins	TCC TPC
10	Tutor presents short video clip on human population growth	Tutor presentation	10 mins	TCC
11	In pairs, students prepare a short lesson they will teach on aspects of the demographic transition model to be filmed next session – lesson time (30 mins) plus homework	Group practical activity	30 mins	PCC PMC
12	For the last 20 mins of the lesson, students work on practical mathematics calculations with reference to recent examination requirements	Individual practical activity	20 mins	TPC
13	In addition to the lesson preparation homework, students contribute to a discussion forum on human population issues	Online student-only group discussion	30 mins	PCC
14	Students film their lessons	Group practical activity	45 mins	PCC PMC
15	Peer assessment of films with assessment criteria	Peer assessment	30 mins	PMC

Table 4.12 Text based representation of teaching/learning sequence

While we agree on the usefulness and properties of most of the TLAs, we feel that the default ‘peer assessment’ TLA does not cover the learning types of the planned activity, which will be in pairs, therefore we change the properties to include elements of discussion and inquiry as the students will be checking facts, comparing texts and applying assessment criteria. Initially, I transfer the basic information from Jenny’s plans into the LDSE software, and the timeline and properties of some of the activities are shown in Figure 4.34, Figure 4.35 and Figure 4.36.

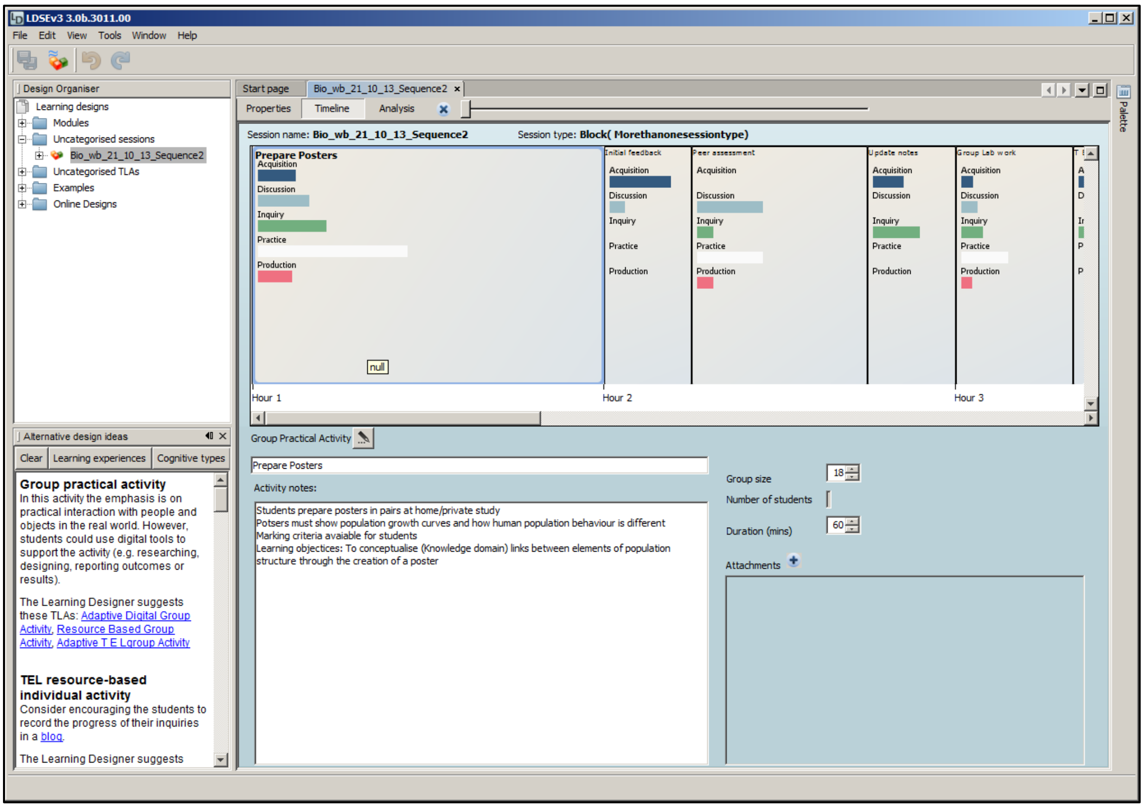


Figure 4.34 LDSE screen showing timeline and highlighting Group Practical TLA (preparing posters)

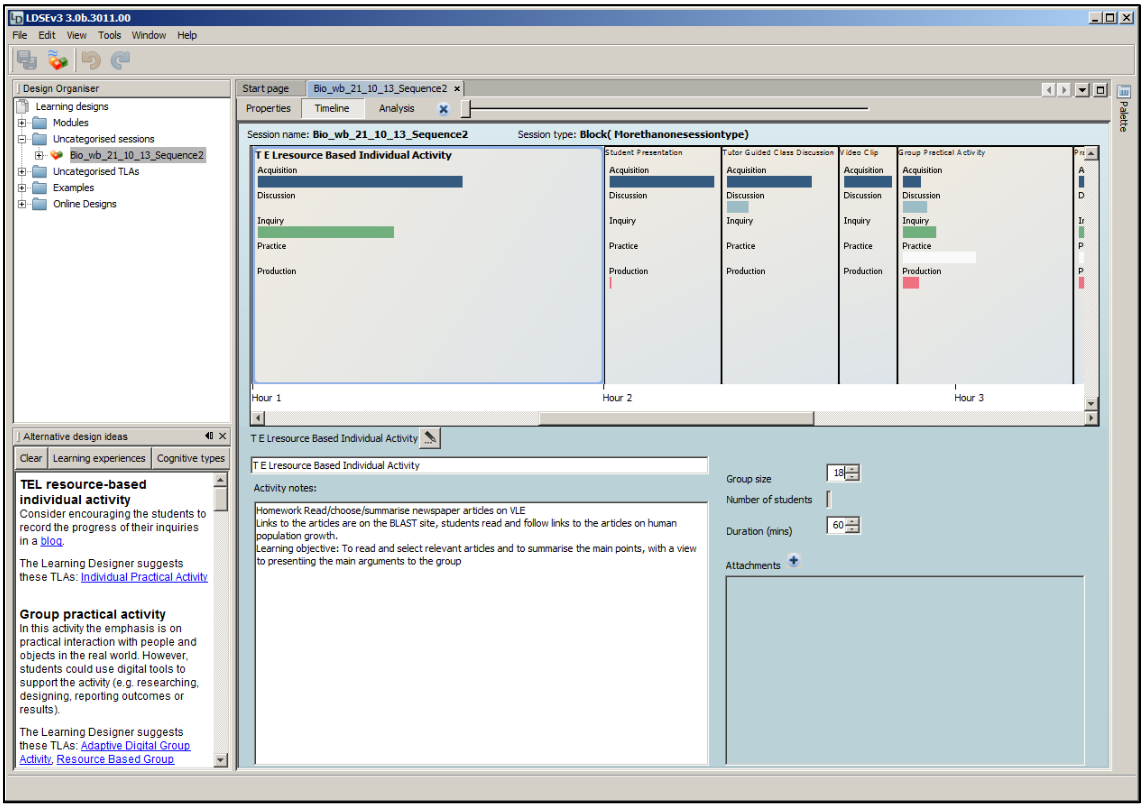


Figure 4.35 LDSE screen showing timeline and highlighting TEL resource based activity (online homework task)

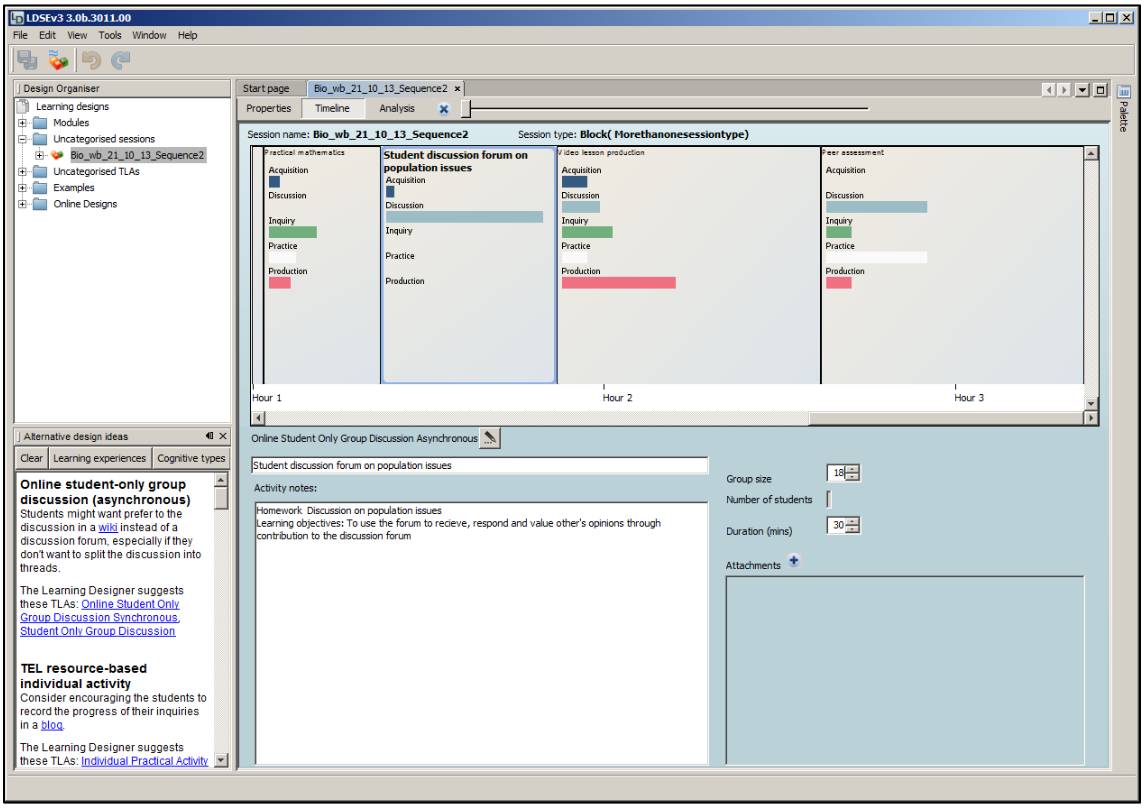


Figure 4.36 LDSE screen showing timeline and highlighting Student Discussion Forum

The analysis of the sequence is shown in Figure 4.37, where the properties of individual TLAs in the sequence have been aggregated into the pie chart. This final version of the sequence shows that the 'types' of learning described by Laurillard (2012) are quite evenly distributed across the sequence. With a content-heavy course such as this, it is inevitable that 'acquisition' will be a dominant type, but Jenny planned the sequence using the available TLAs to create a balanced sequence of activities that meet the requirements of the syllabus, assessment practice and active learning that engages the students and gives them opportunities for both collaborative and independent learning.

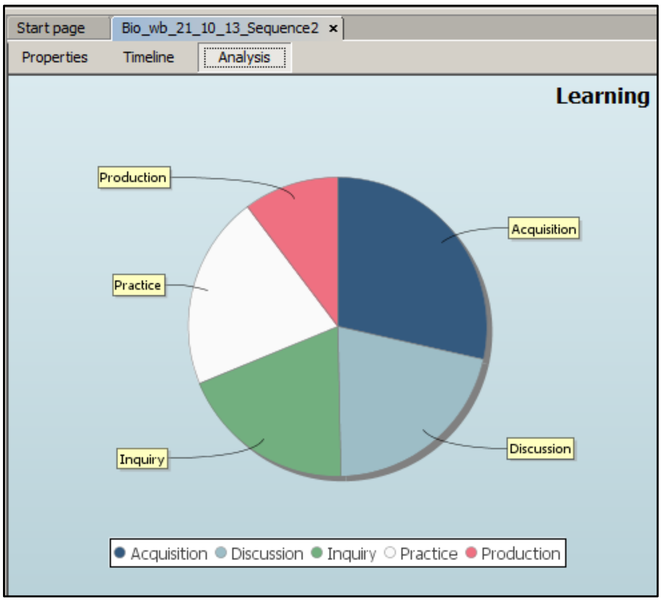


Figure 4.37 LDSE analysis of learning sequence

The LDSE tools, designed to scaffold and represent teaching and learning activities, seem at first sight, rather complicated. But when the layout becomes familiar and the concept of the TLA and its properties are understood, the tool is fairly easy to use (although there are issues with screen refreshing and not a conventional means of saving sessions). Building sequences of TLAs is fairly straightforward and these can be shared as .ldse files that can opened with anyone with the software (there is also an online version for planning and sharing designs).

The planning and creation of the LDSE tool involved consultation with a number of stakeholders (all in higher education) (Laurillard et al., 2011). Some of the responses illustrated that many lecturers found it difficult to see beyond the content into the possibility of generic patterns that could fulfil other pedagogical objectives. While Laurillard notes that “using educational research findings ... is not a common practice in higher education” (ibid:4), Jenny and Lauren are keen to see what research could add to their repertoire. Also unlike higher education, there seems to be a greater willingness in schools to share teaching ideas (there is a plethora of forum sites devoted to specific examination specifications, run by and for teachers). Teachers commonly share schemes of work and lesson plans.

One of the central issues of the LDSE consultation was that of ‘balancing structure and free expression’, where lecturers wanted some structure, but also the flexibility of creating their own designs. The project teachers thought the balance of LDSE was about right, although the extra time commitment was apparent:

> *"The grouping of the TLAs was really useful, I hadn't really thought about it in those terms before"* (Jenny)
>
> *"The TLAs made me think more about the opportunities that the online learning platform offered"* (Lauren)
>
> *"Also looking at the properties of each TLA made me think far more about the balance in my lesson, I want to put these (timelines and charts) up in my classroom, I could certainly use these sequences again with some adaptations"* (Jenny)
>
> *"I'm not sure if I could do this with all my topics, as you (researcher) are here to sort the software, it's not so bad"* (Jenny)

As part of the BLAST project, we want to engage the students and the team thinks it is important that they see the 'big picture' of topics, rather than just individual lessons and homework tasks. To this end, we want to show the students the sequence of activities that makes up the topic. The representation from LDSE, while useful for teachers is not appropriate for a student audience. The learning sequence is transferred into CompendiumLD, where the sequence can be viewed as a 'mind map', clearly identifying class sessions, homework and how activities are linked together. Figure 4.38 shows the graphic output from CompendiumLD, and as a 'pop-up' in the BLAST platform in Figure 4.39. Screen shots of some of the other activities in the sequence are shown in Figure 4.40 (online homework) and Figure 4.41 (student forum).

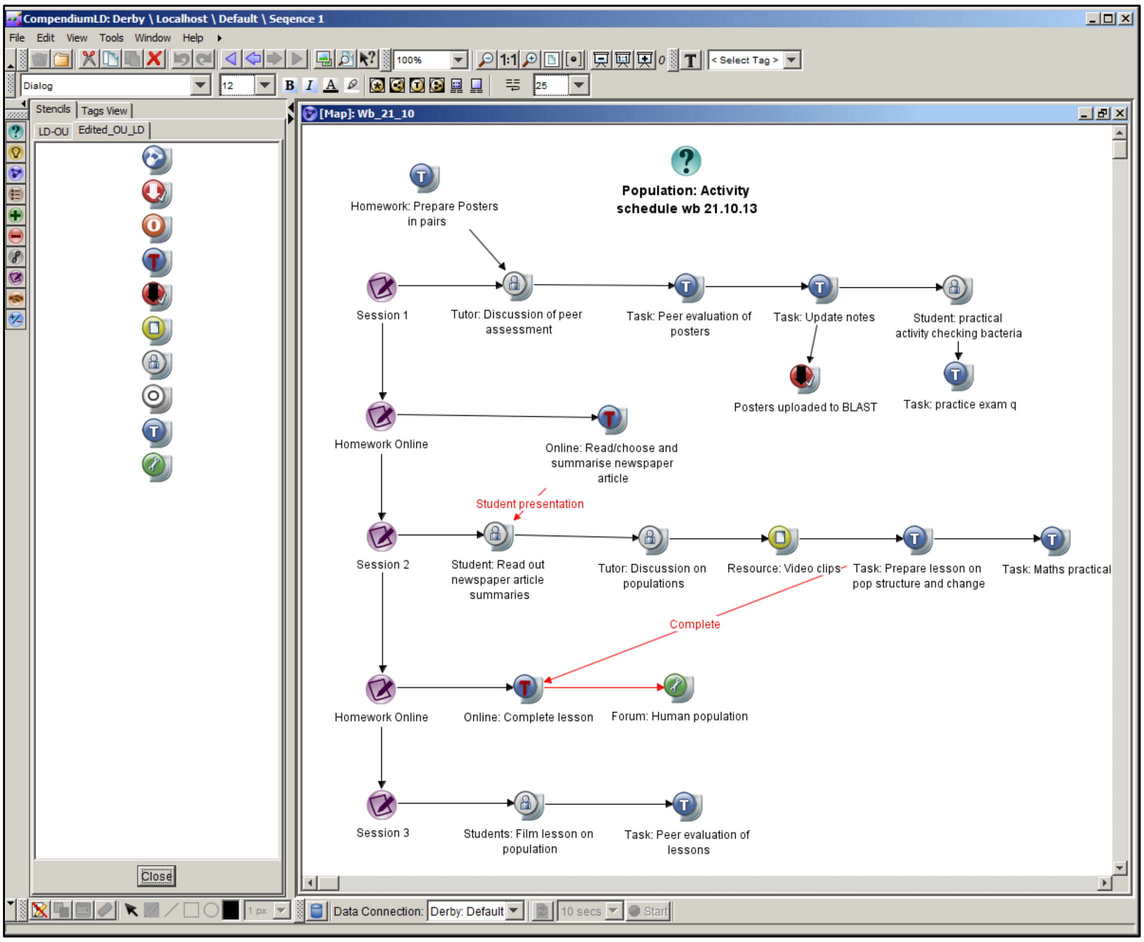


Figure 4.38 Learning sequence output from CompendiumLD

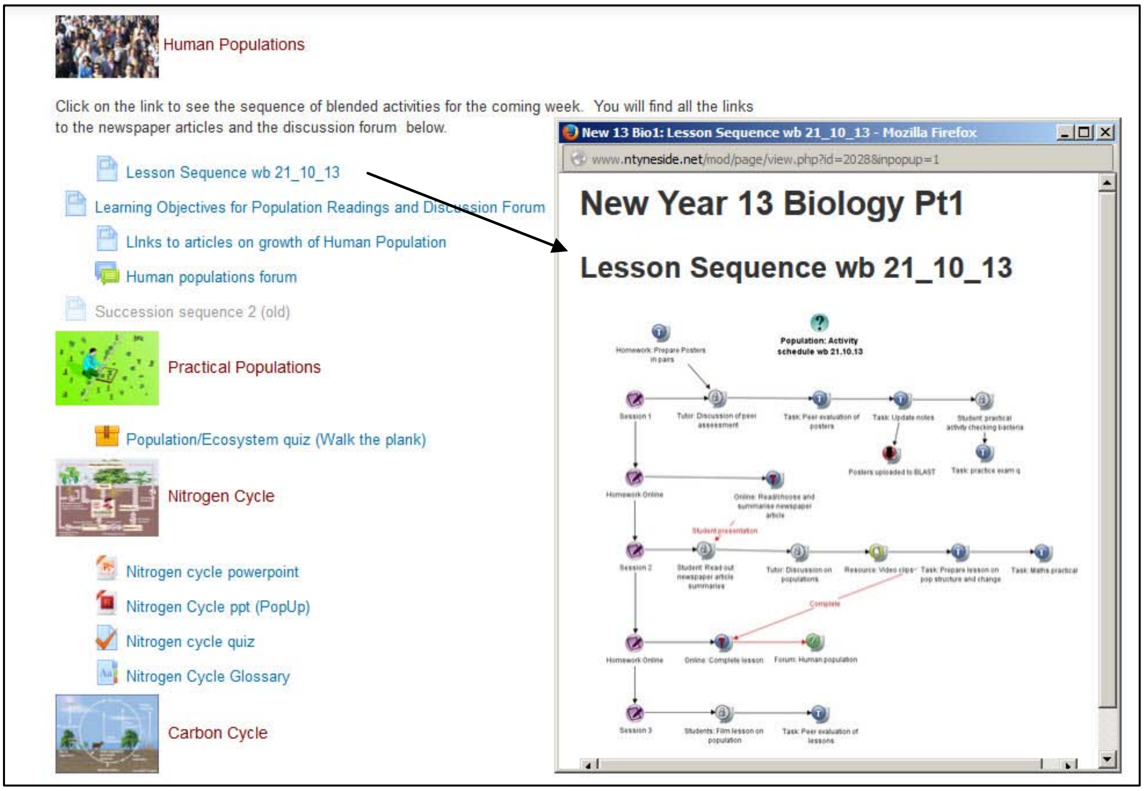


Figure 4.39 Learning sequence displayed for students in BLAST

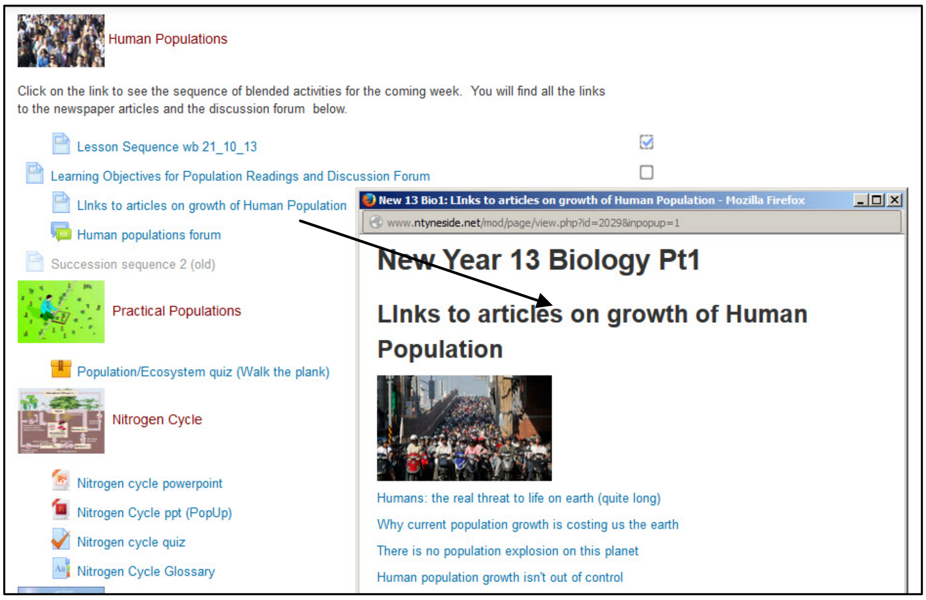


Figure 4.40 Online read/select and summarise activity

Figure 4.41 Student discussion forum on human population

In terms of the Conversation Framework, in addition to learning through acquisition, discussion and production described in the first iteration, this sequence has also included elements of learning through practice (laboratory work involving bacterial growth), and collaboration (group creation of posters and the video production of a lesson, together with peer evaluations). Collaborative learning is illustrated in Figure 4.42. Learning through collaboration is a far more complex activity. This type of learning involves all four quadrants of the Framework (Figure 2.8), tuition, discussion, imitation and practice. During these activities the students are actively exchanging ideas and products with their peers, modulating their actions through discussions and through observations of others' productions as well as models. In Laurillard's terms, this kind of activity is likely to involve more iteration between the learners and teachers.

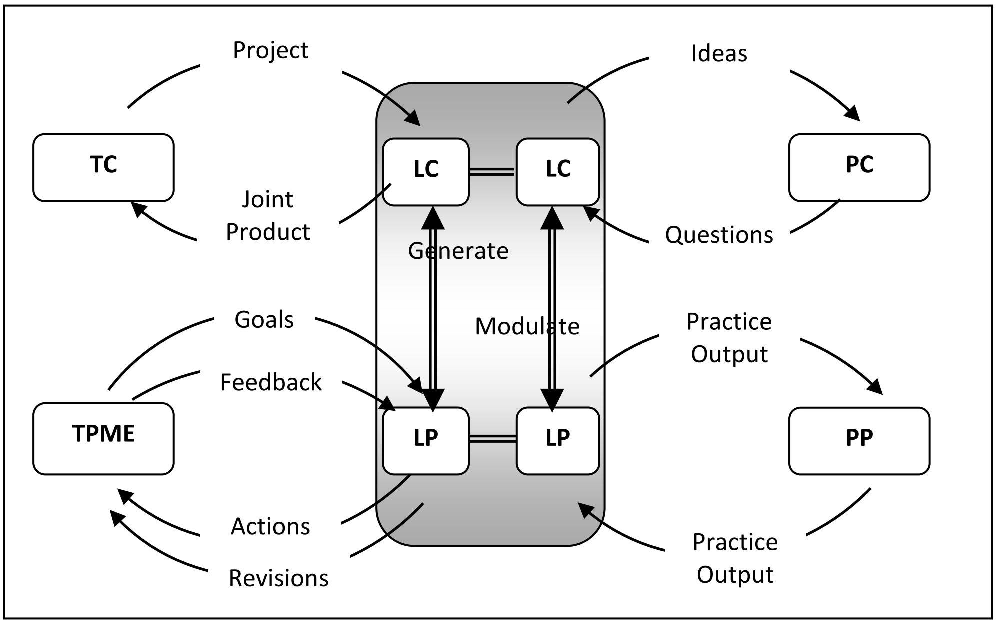


Figure 4.42 Learning through collaboration mapped to the Conversational Framework (Laurillard, 2012:99)

The combination of the LDSE design tool, the mapping capabilities of Compendium LD and the build-up of the Conversational Framework through these visual aids is certainly helping the team to see how the structure of their teaching and learning sequences can be mapped against theoretical models.

4.7.1 Teacher Presence

At a BLAST team meeting, Lauren bemoans the lack of time-management of some of the students in meeting deadlines and getting work handed in or uploaded on time. Someone remembers a newspaper article on the 'nudge unit', real name – 'the cabinet office's behavioural insights team', a research team set up to change behaviour by making small changes to the choices people make. The article reported on a number of initiatives that the unit has worked on, with some success, including getting more people to pay their car tax, installing insulation and paying court fines (Benedictus, 2013; Haynes et al., 2012). One of the effective ways employed was to send out personalised text messages, which, according to unit saved a great deal of money. A further search into educational uses of SMS text messaging brings up a number of studies that support its use in communications with students (Goh et al., 2011; McClean et al., 2010). While much of the use was administrative, other uses were in student support and asking questions from staff. We decide to try out a simple system of assignment reminders to the class. Not surprisingly there are administrative obstacles to overcome, mainly because of student welfare issues. There is already a system in the school, whereby members of staff write a memo to office staff who then send out text messages to parents of students from a central school number, where records are kept. We thought this was too cumbersome to be useful and so ask the class if they are willing for Jenny and Lauren to have their mobile telephone numbers for contact. They all agree and Jenny and Lauren put the class into a group for easy texting. In order to retain some aspects of safeguarding, the teachers keep records of all their texts to the students. Inevitably with the use of this technology, there are some issues of lack of coverage, students not accessing their messages etc., but on the whole the students like the regular messages about deadlines, upcoming TV programmes and other useful information.

> *"It helps me keep organised"*
>
> *"I feel part of the class, getting these messages"*

Goh et al's study reported that SMS messaging "stimulated students' self-regulated learning through better time management and improved extrinsic and intrinsic goals, cognitive and meta-cognitive strategies and values" (2011:14). While not being a major part of this study, this simple technique does add another strand to the communication cycle between the teachers and students, even at an administrative level, getting students to feel part of a community. The team may develop this in the future. One of the uses of mobile technology discussed in McClean et al's (2010) article is in the use of in-class voting systems, however, since the loss of the local authority advisory service, the loan of these devices has stopped and the thought of getting an application that would work on students' own non-standard devices is felt to be too time-consuming and distracting.

At the heart of this study is the aim to develop independent learning skills in the project class. The term 'metacognition' is by now familiar to schools, teachers and some students as a result of 'study skills' training and 'learning to learn' courses that have been developing in the popular realm of training days and curriculum innovation. The project school has not developed a separate 'learning to learn' course, but some teachers have integrated some 'study skills' into their routine teaching. 'Metacognition' has been defined in a number of ways – most of them based on a fundamental idea of Dewey's that students can learn more from reflecting on experience than from the experience itself (Dewey, 1933), cited in Tanner (2012).

This concept aligns with the ideas of independent learning and SRL outlined in section 2.1. During a literature search I find an article concerning the promotion of student metacognition in an undergraduate biology course in the United States (Tanner, 2012). I share this with the biology teachers in the project team as it contains useful practical ideas on how metacognition strategies can be introduced into a course. Tanner provides examples of self-questions that "students might ask in the process of planning, monitoring and evaluating their learning in the context of a single class session, a homework assignment, an exam, or an entire course" (ibid:114). An extract from Tanner's extensive set of student self-question is shown in Table 4.13.

Planning	Monitoring	Evaluation
• What is the instructor's goal in having me do this task? • What are all the things I need to do to successfully accomplish this task? • What resources do I need to complete the task? How will I make sure I have them? • How much time do I need to complete the task? • If I have done something like this before, how could I do a better job this time	• What strategies am I using that are working well or not working well to help me learn? • What other resources could I be using to complete this task? What action should I take to get these? • What is most challenging for me about this task? Most confusing? • What could I do differently mid-assignment to address these challenges and confusions	• To what extent did I successfully accomplish the goals of the task? • To what extent did I use resources available to me? • If I were the instructor, what would I identify as strengths of my work and flaws in my work? • When I do an assignment or task like this again, what do I want to remember to do differently? What worked well for me that I should use next time?

Table 4.13 Self-questions to promote metacognition in active learning/homework tasks (Tanner, 2012:115)

Some of these questions are routinely shared with students in their class and feedback sessions, Tanner makes the point that one of the most useful ways to build metacognitive awareness is to create a classroom culture 'grounded in metacognition', "a more subtle way that metacognition can be integrated into the fabric of the course and become part of the everyday language of both teacher and students" (ibid:116).

However, we want a way to involve the students more explicitly in reflective activity. It is becoming more common in higher education to use reflective journals as a formal tool to engage students in their own learning processes (Tanner, 2012; O'Connell and Dyment, 2011; Langer, 2010). Reviewing the literature, "It would appear that most researchers and instructors, in the guise of jurists who have reviewed the case of journals, have concluded that journals are one form of good pedagogy" (O'Connell and Dyment, 2011:48). The project team hope the following benefits will accrue:

- Develop student/teacher relationships through individual feedback and communication
- Focus the students on the learning process
- Develop critical reflection
- Enable students to organise their working habits

We create an individual Wiki for each student on the BLAST learning environment, readable only by the individual student and teachers. We adapt some of the self-questions suggested by Tanner into simple prompts at the start of the journal for students to respond to (Figure 4.43).

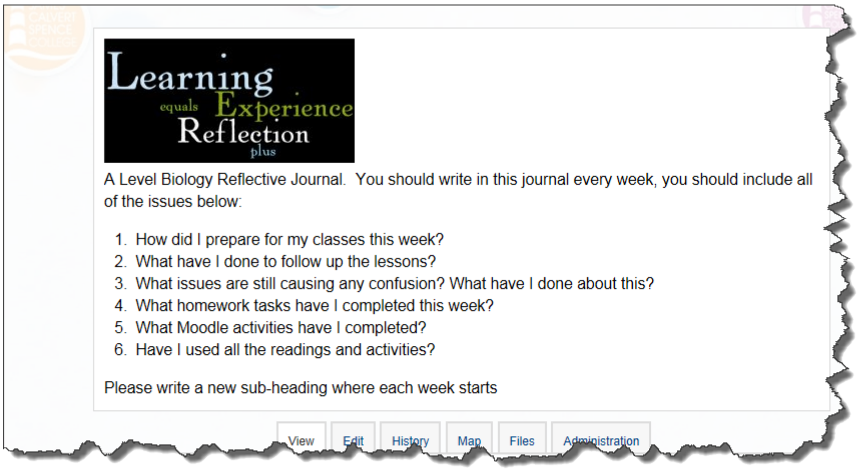
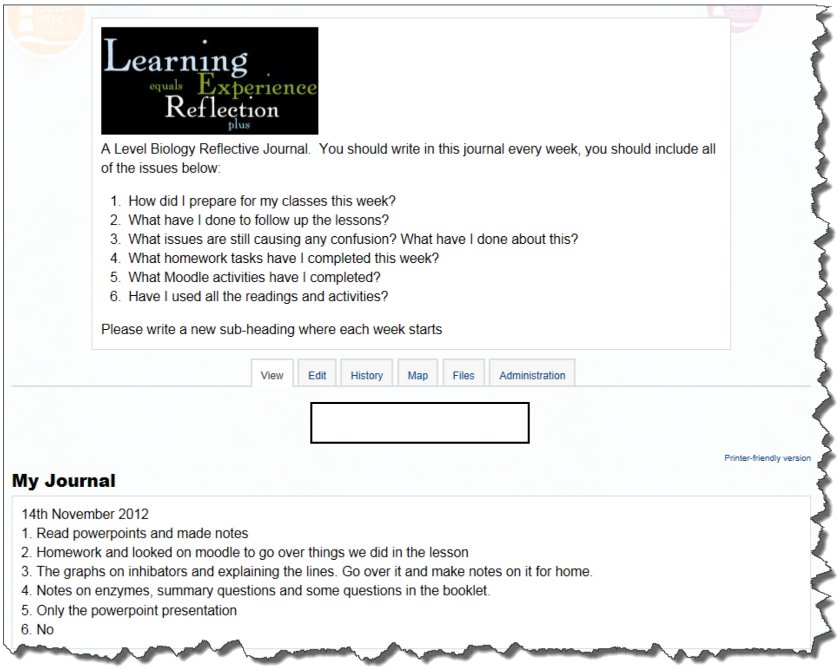


Figure 4.43 Student prompts for reflective journal

The intention is for students to complete the journal on a weekly basis. We introduce the idea to the students in class and explain the benefits that research suggests come from completing learning journals. We start with a very simple structure that we plan to open up later as students become familiar with the format and students and teachers develop a dialogue through the journal.

The process does not go well. The students are not convinced by our exposition of the benefits of the activity. They do not understand what they are supposed to do and why. A typical entry from a student's journal is shown in Figure 4.44.



Learning equals Experience Reflection plus

A Level Biology Reflective Journal. You should write in this journal every week, you should include all of the issues below:

1. How did I prepare for my classes this week?
2. What have I done to follow up the lessons?
3. What issues are still causing any confusion? What have I done about this?
4. What homework tasks have I completed this week?
5. What Moodle activities have I completed?
6. Have I used all the readings and activities?

Please write a new sub-heading where each week starts

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Printer-friendly version

My Journal

14th November 2012
1. Read powerpoints and made notes
2. Homework and looked on moodle to go over things we did in the lesson
3. The graphs on inhibators and explaining the lines. Go over it and make notes on it for home.
4. Notes on enzymes, summary questions and some questions in the booklet.
5. Only the powerpoint presentation
6. No

Figure 4.44 A typical student journal entry

We persevere. Although he teachers encourage the students to communicate via the journal, the response is quite negative:

"We already have easy communication with the teachers"

"It's just a waste of time"

"I don't see the point"

"How will this help our grades?"

After four weeks, in spite of attempting to answer the questions, explaining the process and benefits and more cajoling of the students, the teachers finally give up and accept that this is not a battle worth winning. Although continuing with informal and task specific metacognitive references, the reflective journal is dropped. The teachers were initially convinced of the benefits of the activity, but the resistance from the students eventually wears them down:

"It's not worth it. They clearly are not convinced. If I push any more it will spoil the other positive responses to the learning environment." (Jenny)

"I don't have the time to devote to this, I suppose I could have spent more time responding individually to each student, but I don't think even that would have worked" (Lauren)

Our experience is not unique. Langer reports on a number of studies on using reflective journals and "although most students initially responded negatively to the exercise, 90%

of them eventually admitted that the journals helped them clarify their ideas and thoughts" (2010:339). We do not find any such change in attitude and as a team we decide not to invest more time and stress into an activity that though important, is only one strategy in our project. We reflect on the events surrounding the activity and consider what we might have done to improve the students' take-up and engagement.

Further reading of the literature shows that there are a number of challenges in using reflective journals with students. O'Connell and Dyment (2011) state that proponents of journaling underplay the challenges in the most favourable context. They identify a number of issues that make the process difficult to implement successfully, some of which are relevant to this study include; inadequate training; writing for the instructor; annoying 'busy work'; assessment; time requirements and quality of reflection.

We thought our training would convince the students; it didn't. On reflection we might have included more models of good/poor journals, tried different structures with starter sentences etc. The students who completed their journals were clearly writing for the teacher, they gave exactly what the prompt asked and no more, there was little attempt to share personal information and students' learning. Certainly students regarded the journals as more 'busy work', as they initially did with forums, and could not engage with the idea of the process. Perhaps we could have introduced some assessment into the process to provide some incentive. There has been much debate about whether journals should be assessed and what the criteria should be (Dyment and O'Connell, 2011; O'Connell and Dyment, 2011), we decided that this would add an unnecessary burden on the students and teachers. The teachers finally come to the conclusion that the time necessary to successfully implement the process would not have been justifiable either for the students or themselves. Finally, there is the question of the quality of the reflection that students include in their journals "the research that evaluates the quality of reflection found in student journals casts a reasonable doubt on their effectiveness" (O'Connell and Dyment, 2011:55) especially if externally motivated by assessment.

The context of our situation also presents further challenges, the age of the students; many of them are still quite immature and the nature of the process is quite sophisticated; they are instrumental in their use of time, they cannot see that investment of their time and energy would improve their grades.

4.7.2 Access to, and creation of resources

One of the aims of this iteration is for students to be able to produce and upload resources to the BLAST learning environment. In the example sequence analysed, students have collaboratively produced both presentations and posters that have been checked against marking criteria and peer assessed by other students, thus illustrating examples of learning by discussion, practice and collaboration. The presentations have been converted by the teacher using iSpring so that they can be seen on the learning platform. These are shown in Figure 4.45 and Figure 4.46.

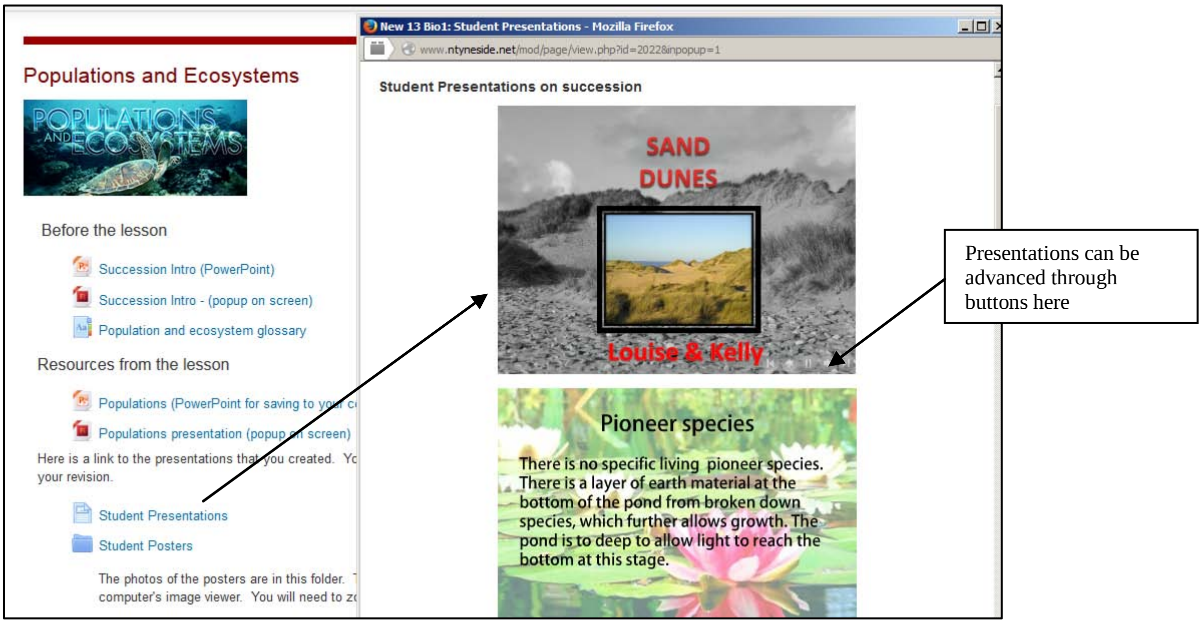


Figure 4.45 Student presentations within the BLAST learning environment

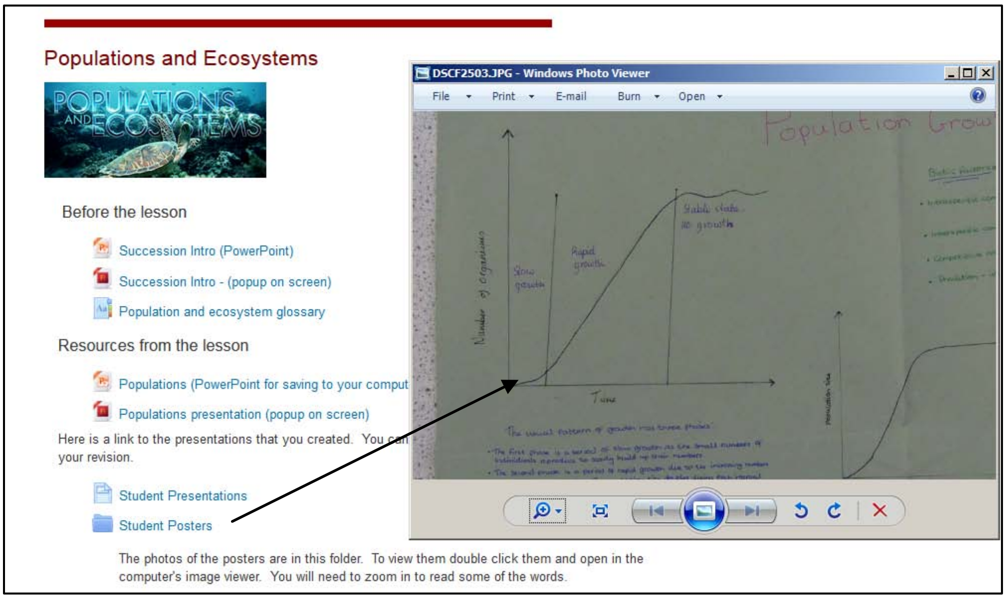


Figure 4.46 Student posters uploaded into the BLAST learning environment

4.7.3 Assessment and feedback

In wanting to emphasise learner self-regulation, the creation of MCQ by the teacher does little to involve the student, apart from completing the tests. To encourage students to become more involved in looking at assessment criteria and the concepts to be tested, the project team decide to ask the students to construct their own MCQ. There is some literature to support this idea, Fellenz (2004), developed an assignment for his business studies university course, where, after receiving some guidance and discussion on the creation and use of MCQ, students submitted multiple choice items that could be used to test higher-level of learning. In his case he introduced Bloom's taxonomy of educational objectives, concepts of bias and the limitations of this test format. The student submitted items later appeared in a term examination. Some of the benefits reported by Fellenz were that students engaged with the concepts of the course at high cognitive levels; by working in pairs, the activity promoted collaborative learning and peer support and critique and the experience improved their preparation for the MCQ used in examinations.

The BLAST project class are by now familiar with the use of MCQ to support their learning of basic concepts and applications in the course. In order to develop this idea with the biology class, we have given the group a class introduction to the structure and format of MCQ, and used a variety of good and not so good examples to show them. In addition, we have used a 'conditional activity' tool in the learning platform, that prevents students from proceeding to a task until a particular condition has been met, in this case reading the 'Ten tips' document that reminds them of the guidance given about the design of good quality MCQ, see Figure 4.47. Students worked in pairs and had to submit the questions, which were checked for accuracy before being included in a 'Walk the Plank' quiz for the whole class (Figure 4.48).

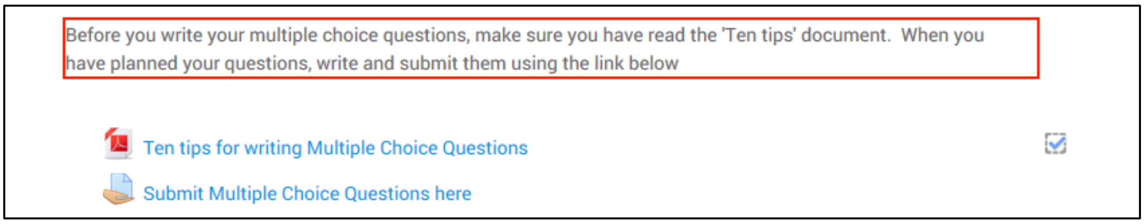


Figure 4.47 Conditional activity prior to the submission of multiple choice items

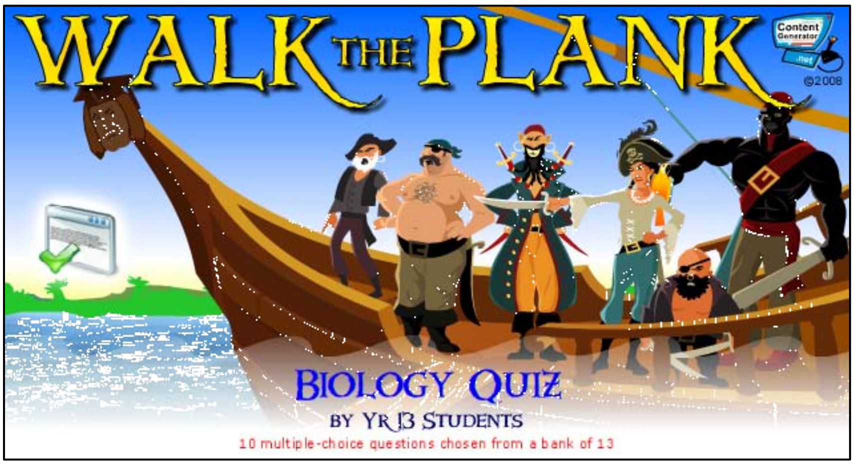


Figure 4.48 Student created Walk the Plank Quiz

One of the issues highlighted by Fellenz was the time required to develop the skills in the students to produce high quality questions. However, Nicol (2007a) reported that in his study of a similar nature with first year university students, that the process was the important factor and that it didn't really matter if the quality was not that high "as this is something that even teachers find difficult" (ibid:62). This is what we have found in our class. The students did find it difficult, but they liked working in pairs and they had to engage with the topic they were studying in far more depth than usual to design questions and feasible distracters. Although the quality was not very high, the fact that the quiz appeared on the BLAST course site and all the students completed it was engaging for the students. It is to become a regular feature of the course, with students developing skills as they create more examples.

In his commentary on Fellenz's assignment, Nicol relates the activities to his seven feedback principles (Figure 2.1)(2007a:61), those that relate to the BLAST study are included:

- Students create the MCQ by themselves; hence they must actively formulate the question in relation to the subject content and determine the assessment criteria. (This is a powerful implementation of Principles 1 and 2)
- The tutor monitors and gives general feedback (Principle 3)
- Peer dialogue and feedback are provided during MCQ creation in pairs (Principle 4)
- The development of the items is cyclical with early feedback being used to improve performance on the later items (Principle 6)

The response from the students is positive:

"It took a long time to write the questions, especially the wrong answers!"

"I thought it was a good idea to see our questions in the Walk the Plank"

Jenny also reports positive attitudes and outcomes from the task:

> *"The pairs worked hard at the task, they certainly studied that part of the topic more carefully. Some of the questions were quite good, others had to be revised. I am sure they will improve over time."*

In addition to MCQ, the team also want a more reflective open-ended assessment opportunities. One of the initial designs involved the use of a short video, embedded into a series of short answer questions that are submitted online for the teacher. The example shown in Figure 4.49, uses a video from a science website, other videos used come from the school's YouTube library.

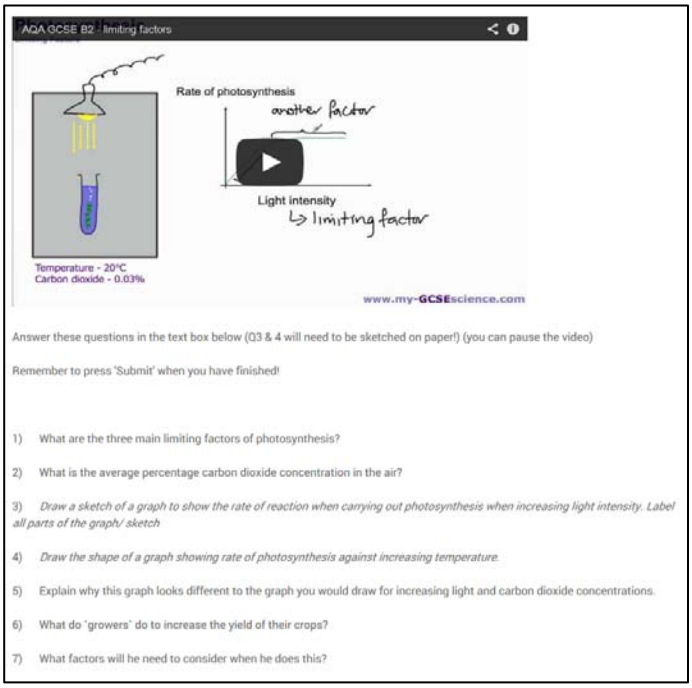
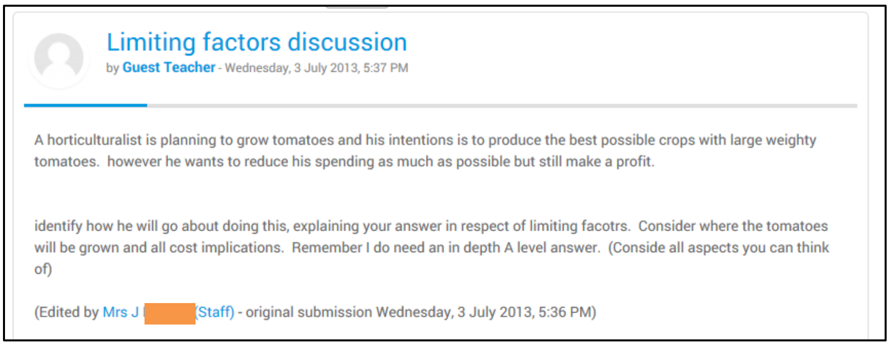


Figure 4.49 Short answer questions from video stimulus

One of the advantages of this type of question is that the student can watch, pause and rewind the video as many times as they like without disturbing others in the class. This type of question can support any kind of stimulus, from video to an article or website. It enables students to write in the sort of style and length that would be expected in a shorter answer examination question. Feedback is posted directly back to the student as an annotated version of the student's own response. This is one of the ways that technology can augment the traditional homework task of answering examination style questions.

4.7.4 Social Presence

The students have responded quite well to the use of discussion forums, but one of the issues mentioned by the students and others e.g. (Ellis et al., 2006) is the reluctance by some to be first to post on a discussion, or be afraid of 'free loaders' waiting to copy responses. The project team have responded by creating 'Q and A forums' a forum type in Moodle that requires students to post a response to a forum before being able to see other students' posts. This has been useful in discussion forums where students have been asked to grade an examination answer (Figure 4.52 and Figure 4.53) to the criteria or where specific ideas are asked for (Figure 4.50 and Figure 4.51).



Limiting factors discussion

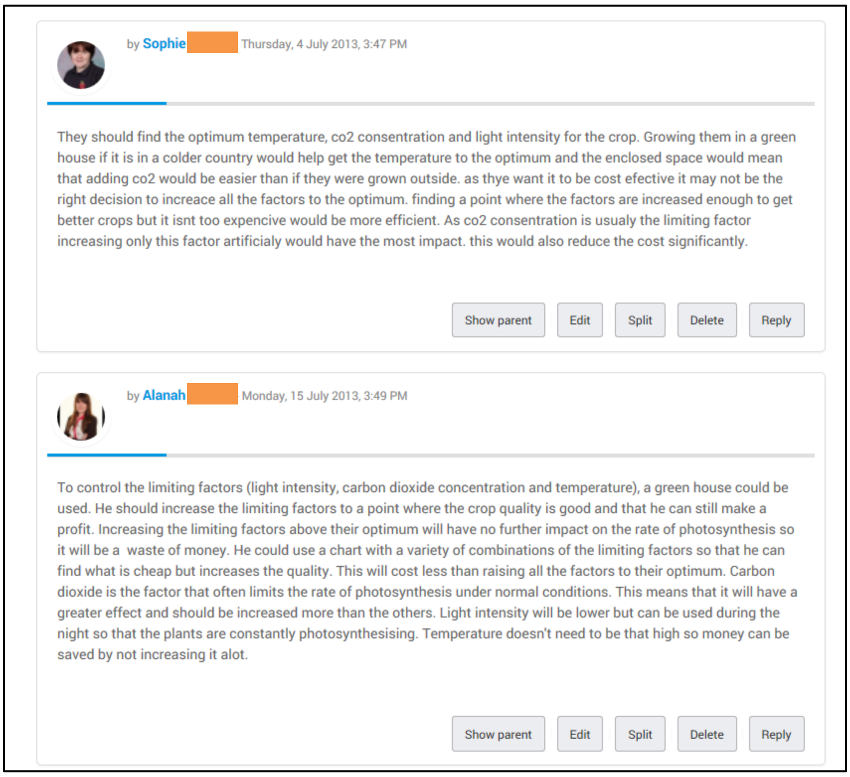
by Guest Teacher - Wednesday, 3 July 2013, 5:37 PM

A horticulturalist is planning to grow tomatoes and his intentions is to produce the best possible crops with large weighty tomatoes. however he wants to reduce his spending as much as possible but still make a profit.

identify how he will go about doing this, explaining your answer in respect of limiting facotrs. Consider where the tomatoes will be grown and all cost implications. Remember I do need an in depth A level answer. (Conside all aspects you can think of)

(Edited by Mrs J [redacted] (Staff) - original submission Wednesday, 3 July 2013, 5:36 PM)

Figure 4.50 'Q & A' Discussion forum instructions for role play



by Sophie [redacted] Thursday, 4 July 2013, 3:47 PM

They should find the optimum temperature, co2 consentration and light intensity for the crop. Growing them in a green house if it is in a colder country would help get the temperature to the optimum and the enclosed space would mean that adding co2 would be easier than if they were grown outside. as thye want it to be cost efective it may not be the right decision to increace all the factors to the optimum. finding a point where the factors are increased enough to get better crops but it isnt too expencive would be more efficient. As co2 consentration is usualy the limiting factor increasing only this factor artificialy would have the most impact. this would also reduce the cost significantly.

Show parent | Edit | Split | Delete | Reply

by Alanah [redacted] Monday, 15 July 2013, 3:49 PM

To control the limiting factors (light intensity, carbon dioxide concentration and temperature), a green house could be used. He should increase the limiting factors to a point where the crop quality is good and that he can still make a profit. Increasing the limiting factors above their optimum will have no further impact on the rate of photosynthesis so it will be a waste of money. He could use a chart with a variety of combinations of the limiting factors so that he can find what is cheap but increases the quality. This will cost less than raising all the factors to their optimum. Carbon dioxide is the factor that often limits the rate of photosynthesis under normal conditions. This means that it will have a greater effect and should be increased more than the others. Light intensity will be lower but can be used during the night so that the plants are constantly photosynthesising. Temperature doesn't need to be that high so money can be saved by not increasing it alot.

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Figure 4.51 Student responses to a 'Q & A' forum

The students said that they would not have been able to write their responses if everyone had been able to see their answers before writing their own. After writing their first post, students could then respond and comment on others' posts.

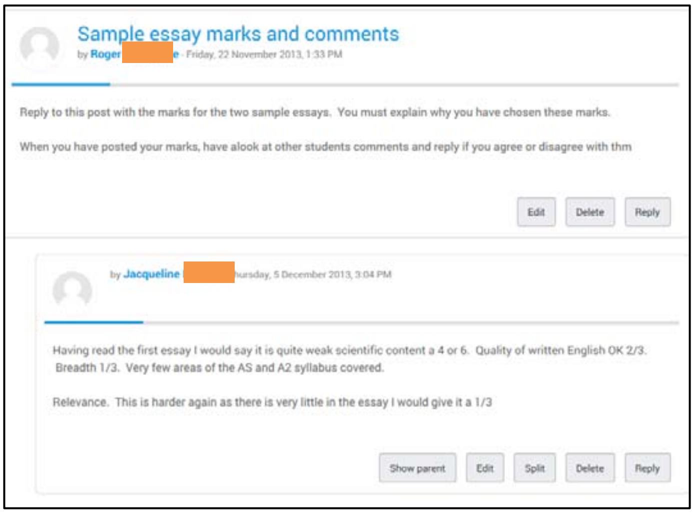


Figure 4.52 'Q & A' Forum for sample examination paper marking

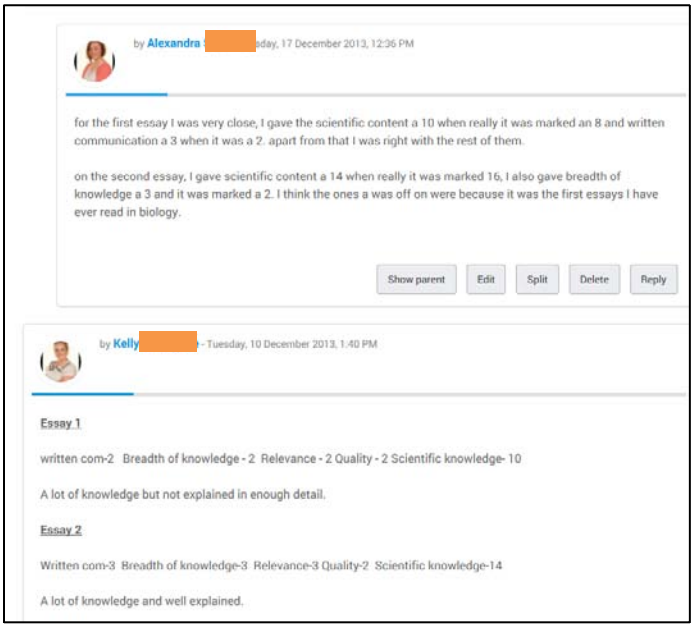


Figure 4.53 'Q & A' Forum student responses

The students have responded well to the change in approach:

> *"I don't really like forums much, but I prefer them when everyone has to post first before seeing what you have written"*

> *"It's better now that people can't just copy what you have written"*

> *"It's interesting to see what others have written"*

The BLAST team are continuing to develop ideas around the management of discussion forums and how to convince students of the benefit of reflective dialogue and online discussions.

4.7.5 Review of the second stage

The major themes of this second 'establishment' phase of the project have been to normalise the use of the BLAST environment by the staff and students. The team have used the learning design tools and the Conversational Framework more frequently to plan and evaluate the sequences of activities. The use of the visual diagrams has been particularly useful in seeing the coverage of the learning cycles within the series of activities. The students also have benefitted from the Compendium representations that appear on the website and give them the 'big picture' of the week's work.

As far as particular developments in this phase are concerned, the team are disappointed that the students' use of the reflective journal is not sustainable. The team recognise that the preparation for this innovation was insufficient to convince the students of its benefit to their studies. We decide that we would prepare models and a slower progression when introducing it again.

More encouragingly, sending out SMS messages to students to remind them of assignment deadlines etc., has proved to be quite successful, it has clearly tapped into the students' own mode of communication and they have been very receptive to its development.

Further refinements of the use of MCQ and discussion forums have also been successful, as the teachers are becoming more confident in their creation and use. The change in the format of the some of the discussion forums has encouraged students to contribute and addressed their criticism of 'free loaders'.

Further plans to encourage more 'active' participation in the learning environment have also been well received by the students. These have involved the opportunity to upload posters and presentations to the learning environment to be shared with other students. The students also responded well to being asked to write their own multiple choice questions for inclusion into the class quizzes. After a few practices, the students have become quite adept at writing questions with convincing distracters, which has encouraged deeper reading and understanding of core concepts.

The next phase of the project will continue to use the BLAST environment for the activities described in the first two iterations, and develop some new refinements and activities, in particular the development of a type of multiple choice question that requires the students to reflect on how certain they are of the answer and the use of an online wiki for students to work collaboratively on an essay. The final phase will consolidate the work of the previous phases, reinforcing the blended learning practices developed over the course of the project.

4.8 Design stage #3 'Consolidation'

In this last phase of the project, the team want to consolidate the work done in the previous iterations. As well as the using the established techniques and activities described previously, we want to use the learning design tools to create series of activities that cover all the learning cycles of Laurillard's Conversational Framework. The bulk of this section will show an example of a series of activities designed with the aid of the LDSE tool using a range of the TLAs available in the application. The resulting sequence will be analysed using the Conversational Framework. As a separate innovation, a new refined type of multiple choice question will be introduced to the students in order to increase the reflection and thought behind their answers, see Table 4.14, (new developments have been emphasised in italic).

Design principles for activities/sequences	Strategies	Nicol Principles (Nicol, 2009)
Teacher Presence Organising Information	• Conditional release of activities • Establish clear performance models • Design of curriculum sequences clear to students via sequence maps • Teacher reminder system via SMS messages • Evaluation from students	• Encourage positive motivational beliefs and self-esteem (11) • Help clarify what good performance is (1) • Encourage time and effort on challenging learning tasks (2) • Provide information to teachers to help shape the teaching (12)
Access to and creation of resources	• Provide access to resources • Lesson presentations easy to access • Internet links to selected sites • Students create and upload own resources	• Encourage time and effort on challenging learning tasks (2)
Assessment & feedback	• Set MCQ for self-test • *Development of CBM quiz types* • Activities to act on feedback	• Deliver quality feedback (3) • Provide opportunities to act on feedback (4)
Social presence	• *Collaborative writing in group Wikis* • *Peer assessment*	• Encourage interaction and dialogue around learning (6)

Table 4.14 Design principles and strategies for the Consolidation phase of the project

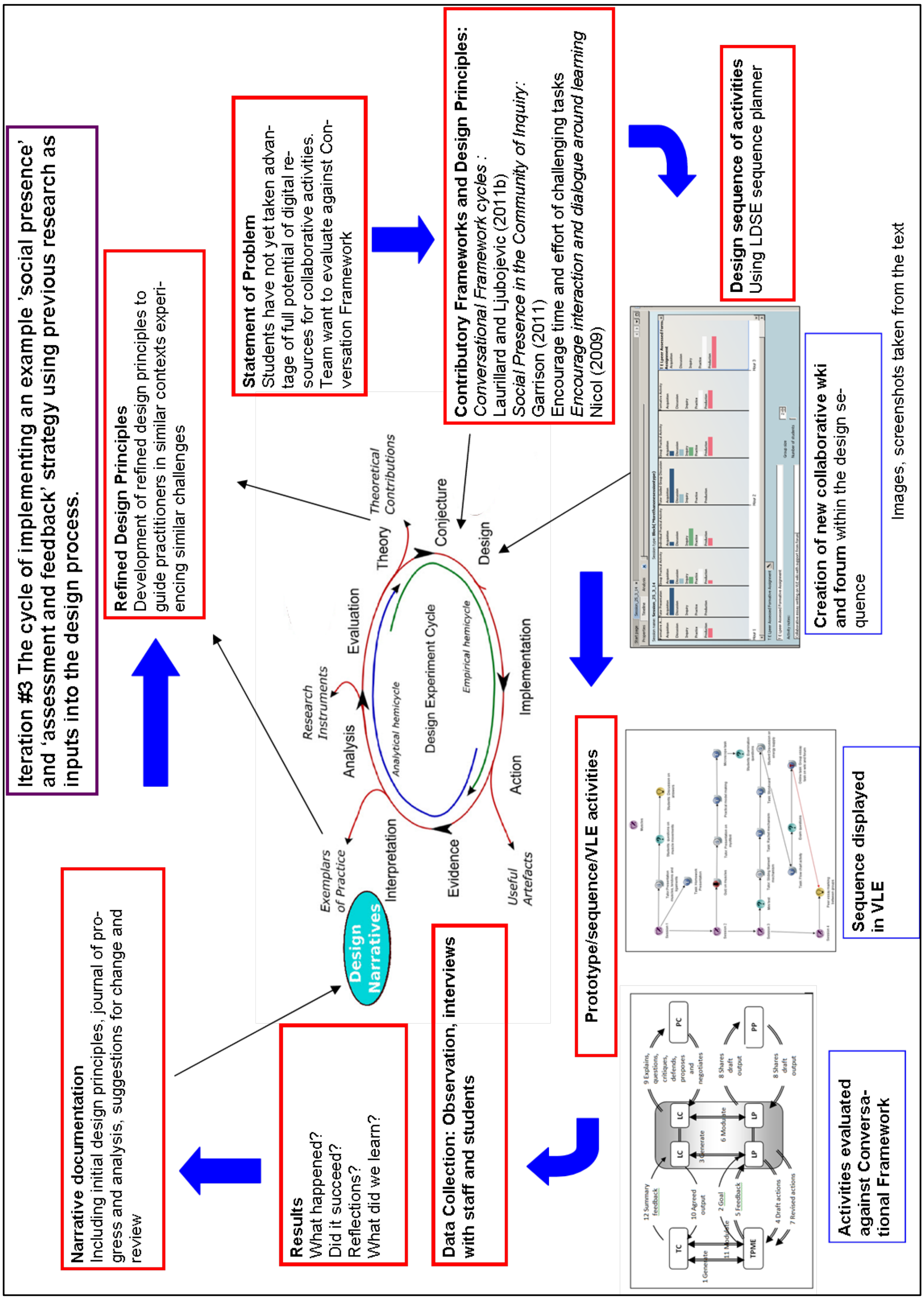


Figure 4.54 Diagram to illustrate the design research process, iteration #3, after Mor (2013)

Figure 4.54 shows a summary of the design process in this iteration.

4.8.1 Learning design

The sequence selected for discussion here illustrates the developments that have been made to the use of the BLAST learning environment. The topic of work described below will demonstrate how the activities have become more sophisticated since stage 2, these have been mapped to Laurillard's Conversational Framework and planned and represented using the learning design tools.

	Topic: Muscles			Learning Cycle
		TLA Equivalent	Time	
1	Tutor presentation and questions	Tutor presentation	20 mins	TCC
2	Individual task: questions with resources	Res based Ind act	20 mins	TPC
3	Discussion of students' answers	Tutor guided group discussion	20 mins	TPC
4	Homework, research and create presentation	Individual practical activity	40 mins	TPC
5	Online muscle quiz	TEL based formative assignment	20 mins	TPC
6	Group discussion	Tutor guided group discussion	15 mins	TCC
7	Tutor presentation and questions	Tutor presentation	15 mins	TCC
8	Practical model making in groups	Group practical activity	20 mins	TPC
9	Microscope task	Individual practical activity	20 mins	TPC
10	Examinations questions on topic	Resource based individual activity	25 mins	TCC TPC
11	Mini test on topic	Formative activity	15 mins	TPC
12	Tutor presentation and questions	Tutor presentations	15 mins	TCC
13	Demonstration and group practical activity	Group practical activity	20 mins	TPC TMC
14	Storyboard creation	Individual practical activity	20 mins	TCC TPC
15	Discussion	Tutor guided discussion	20 mins	TCC PCC
16	Small group creation of flowchart	Group practical activity	20 mins	PMC
17	Examination question practice	Formative activity	20 mins	TPC
18	Small group collaborative essay writing, with support forum	TEL supported peer assessed formative assignment	3 hrs	PCC PMC
19	Peer marking/feedback between groups		1 hr	PCC PMC

Table 4.15 Sequence of activities mapped to TLAs and learning cycles in tabular form

The list of activities is shown in Table 4.15, mapped to the TLAs and learning cycles and Figure 4.55 shows the sequence we present to the students at the start of the topic, showing the 'big picture' of the sequence of the activities, what they will be doing in class and at home using the BLAST learning environment. A more detailed analysis of the collaborative activities surrounding the use of a wiki will be discussed later.

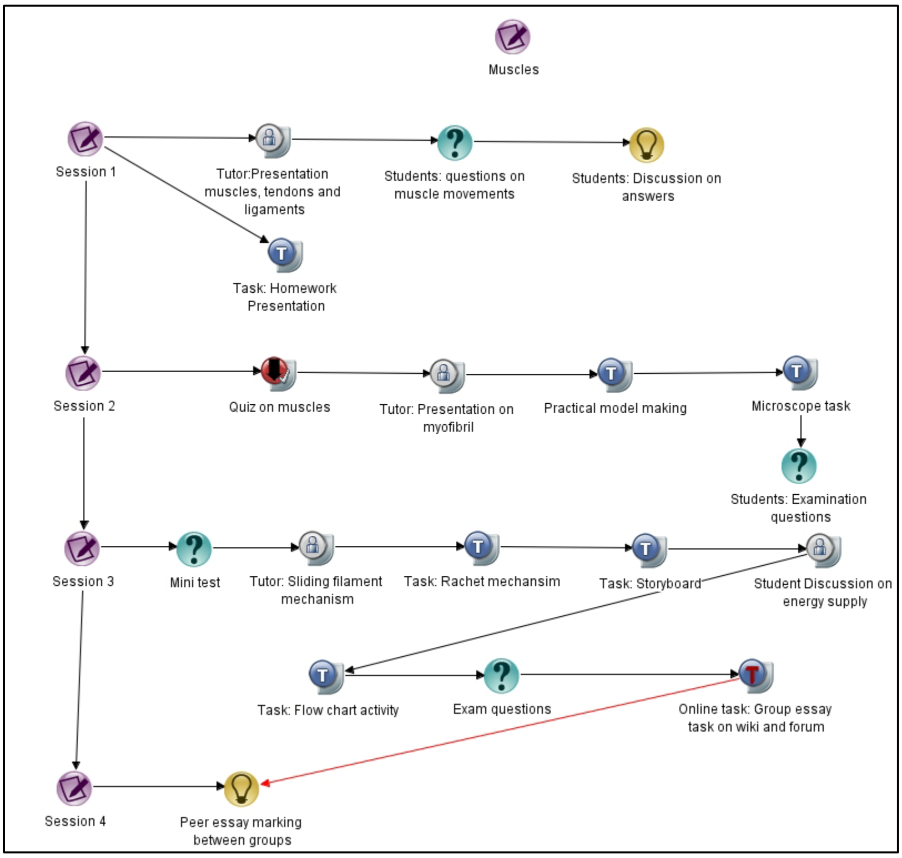


Figure 4.55 The teaching sequence displayed in CompendiumLD

The sequence is displayed in more detail in the LDSE design environment in Figure 4.56 and Figure 4.57, together with the learning type analysis pie charts. The learning design for this topic has been particularly focussed on providing a variety of learning activities.

Throughout the topic sequence, the teachers clearly control the goals and resources available through the introductory classes and presentations (available on the learning platform). Students are therefore secure that the subsequent tasks and activities are aligned with the examination specification. As a result, acquisition of knowledge remains a major goal of the topic, represented in the analysis charts. This topic has been designed to offer students opportunities for practicing their writing skills, discussing ideas with the teacher and their peers and undertaking some structured inquiry work.

The topic culminates in a ‘model’ essay on the topic, written in small groups using a wiki on the BLAST learning environment.

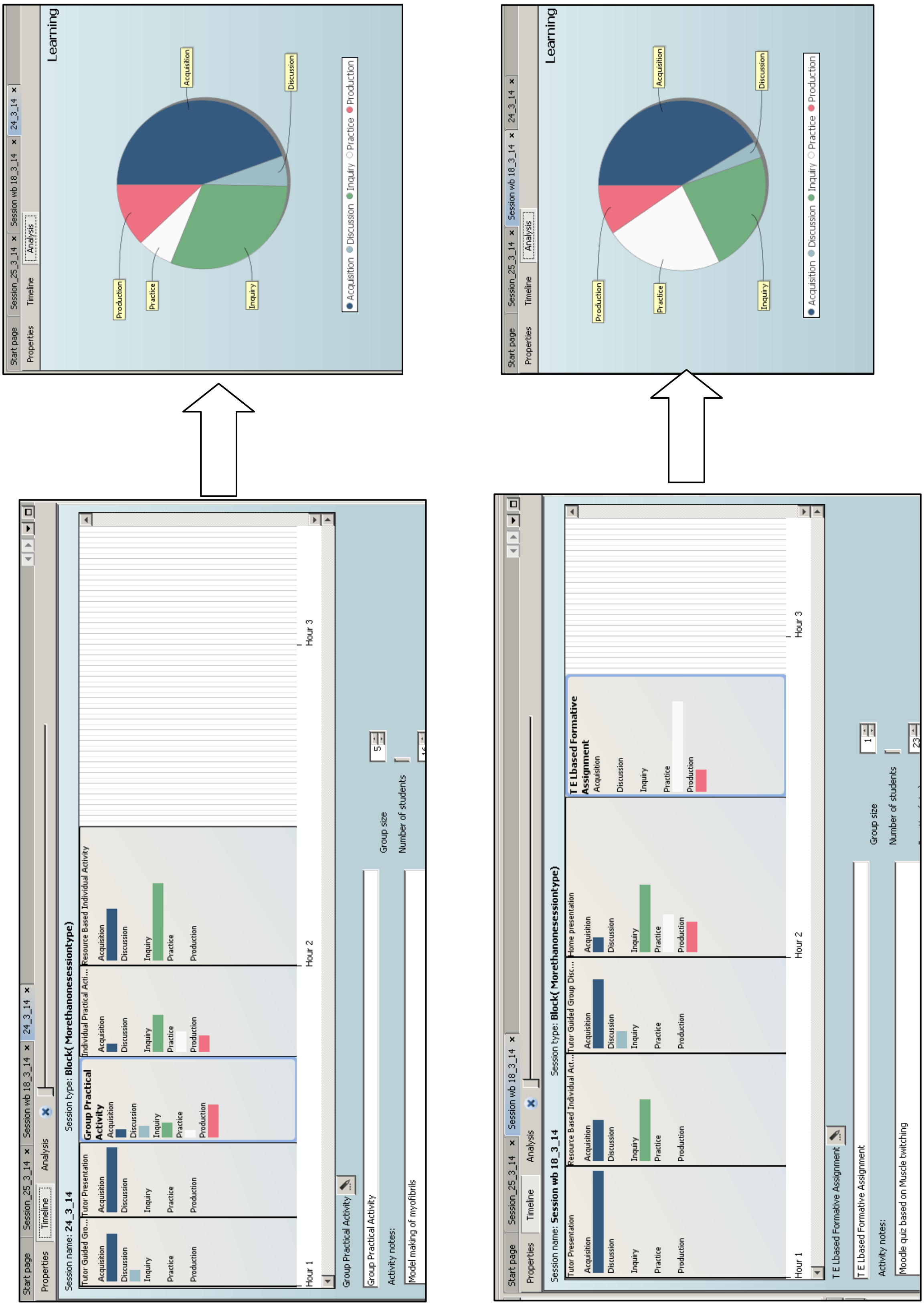


Figure 4.56 Sequence of TLAs and analysis for the first (left) and second (right) set of activities

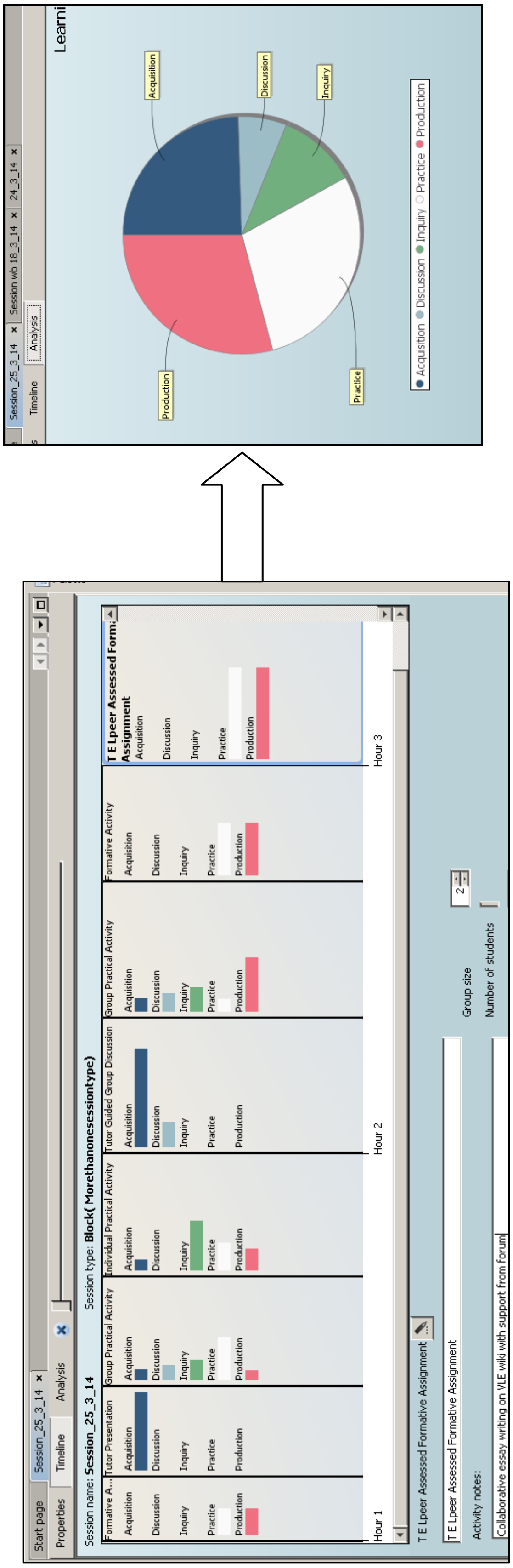


Figure 4.57 Sequence of TLAs and analysis for the third set of activities

Students following this course have undertaken a number of collaborative activities that have fulfilled the criteria of Laurillard's collaborative activities in the Conversational

Framework, for example, creating posters and video lessons. However, these have not really taken advantage of the potential of digital technology. One of the ways in which technology can support collaborative learning is through the wiki. A wiki is a web-based application that allows a number of users to co-edit the document. Images and attachments can be applied to the resulting document. A history of who edited which part of the document and when, is available, thus retaining a complete log of the creation process. According Laurillard, the wiki fulfils a number of the requirements of collaborative learning, namely; the means to discuss a task; the means to construct and revise representations of the task goal and the means to share these representations (2012:196).

To support the discussions about the task, we offer a parallel discussion forum for the wiki, so that the wiki itself is used just to present the edited and shared output. We want to use the wiki and its forum for students to engage in conversations, discussions about what to include, what is important, the resources available and the structure of the resulting essay. In order for this to be effective, the team meet to discuss the guidance and support that we will give the students. We come up with a structure, based on a consensus of readings about using wikis. The class is introduced to the task in class and a demonstration wiki is modelled. Further instructions are shown on the BLAST learning environment, Figure 4.58, together with some tips for collaborative writing that have to be read before the students can open the wiki (based on conditional access), see Figure 4.58 and Figure 4.59.

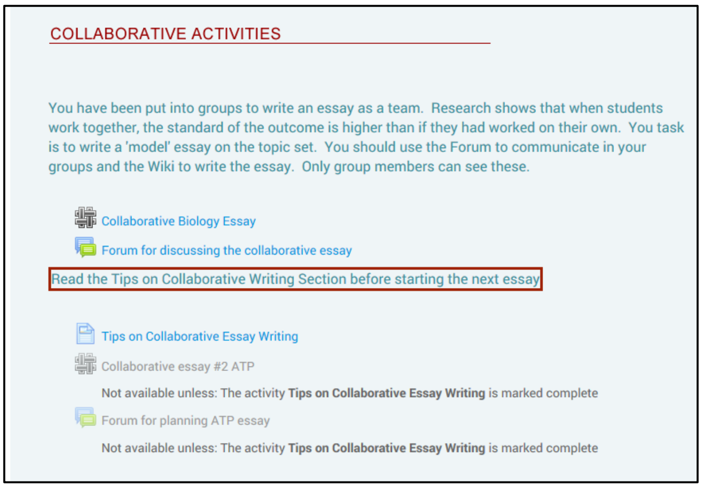
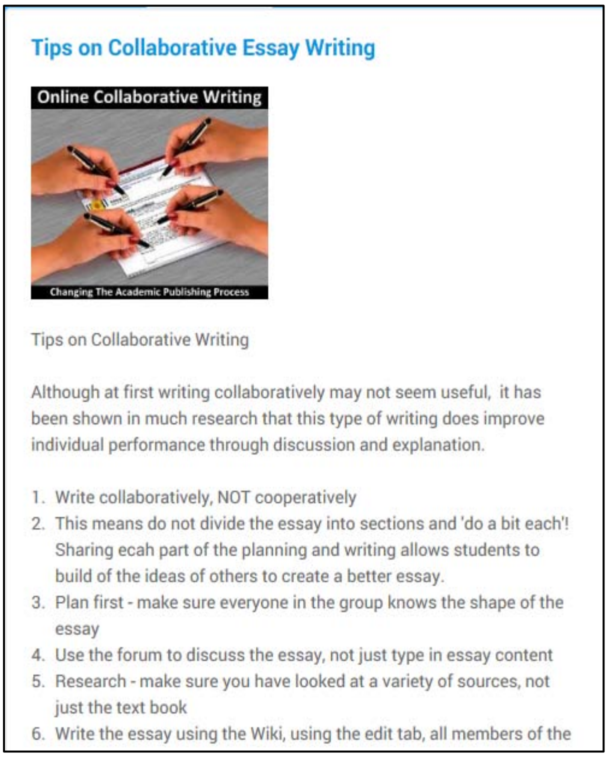


Figure 4.58 Instructions for using the wiki


Tips on Collaborative Essay Writing

Online Collaborative Writing

Changing The Academic Publishing Process

Tips on Collaborative Writing

Although at first writing collaboratively may not seem useful, it has been shown in much research that this type of writing does improve individual performance through discussion and explanation.

1. Write collaboratively, NOT cooperatively
2. This means do not divide the essay into sections and 'do a bit each'! Sharing ecah part of the planning and writing allows students to build of the ideas of others to create a better essay.
3. Plan first - make sure everyone in the group knows the shape of the essay
4. Use the forum to discuss the essay, not just type in essay content
5. Research - make sure you have looked at a variety of sources, not just the text book
6. Write the essay using the Wiki, using the edit tab, all members of the

Figure 4.59 Tips for students using a wiki

The description of the activity below is based on a "generic pedagogical pattern for collaborative learning, designed to elicit the successive cycles in the Conversational Framework" (Laurillard, 2012:207), mapped to the learning cycles (Figure 2.9 and Table 2.6), the numbers in the text refer to labels in Figure 4.60.

The students collaboratively produce a 'model' essay on the topic we have just completed (1) (TMC), students are already aware of the marking criteria for examination essays (2).

The students use the supporting discussion forum to suggest improvements, other resources, relative importance of ideas and structure Figure 4.61 (PCC). Students create draft contributions (3)(4), (TMC). The examples and mark schemes feedback analyses to the students about their performance (5), (PMC).

During the students' contribution to the wiki, they modulate (6) their concepts, justify decisions (9), and generate revised actions (7) (PCC, TMC). We aim to encourage the students to continue this cycle until the final output is agreed (10), (PCC, TMC).

Having completed the work, each group then opens their wiki essay for consideration by the whole class (peer assessment), and by the teacher for formal assessment and feedback (10, 12), (PCC, TCC). The teacher can establish the relative contributions from members of each group by accessing the wiki history Figure 4.63.

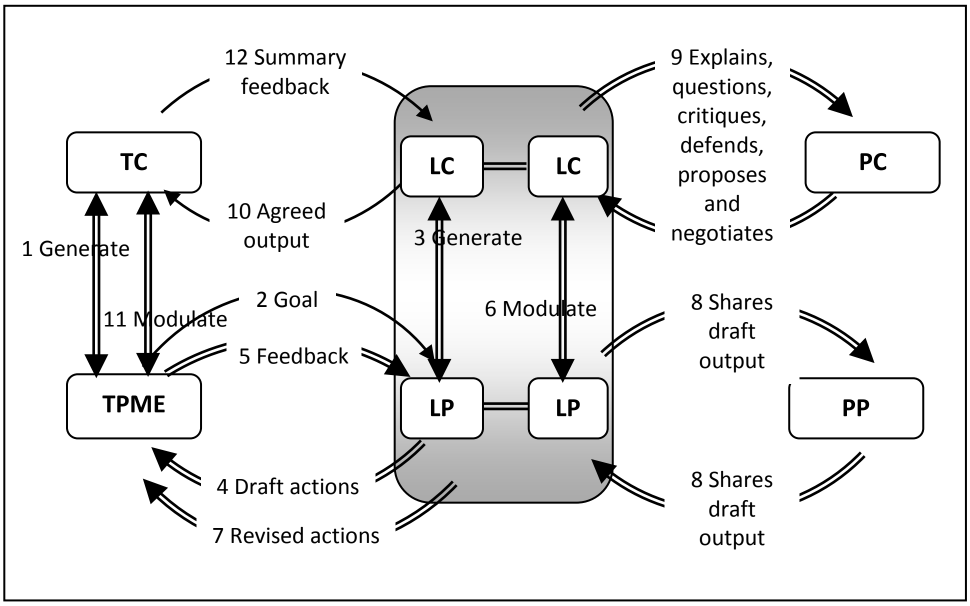


Figure 4.60 Pedagogical pattern for collaborative learning mapped to the Conversational Framework (Laurillard, 2012:208)

The students, although finding the task difficult, respond well to the activity, and report a willingness to repeat it:

"I found it quite difficult"

"I would like to try it again"

"We met in school to discuss and plan the sections"

"The essays were really good! We all got high marks!"

Jenny was also positive about the outcomes from the students:

"I was really pleased with the essays, they were some of the best the class has produced, I will definitely use this again – although it took them longer than I expected"

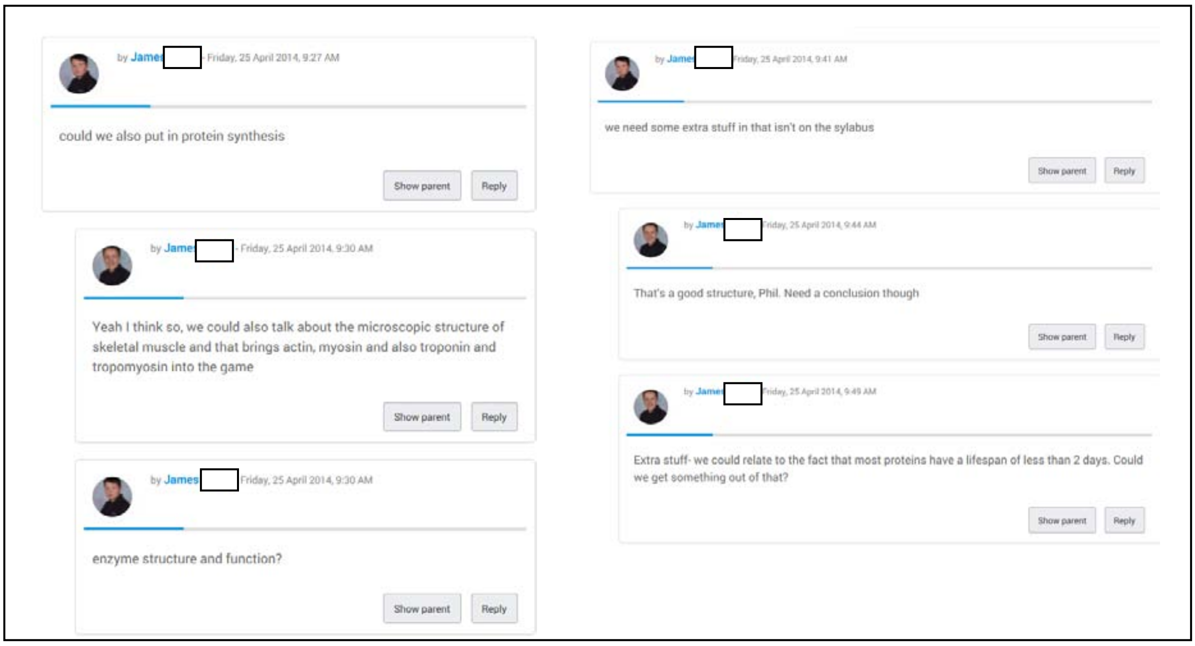
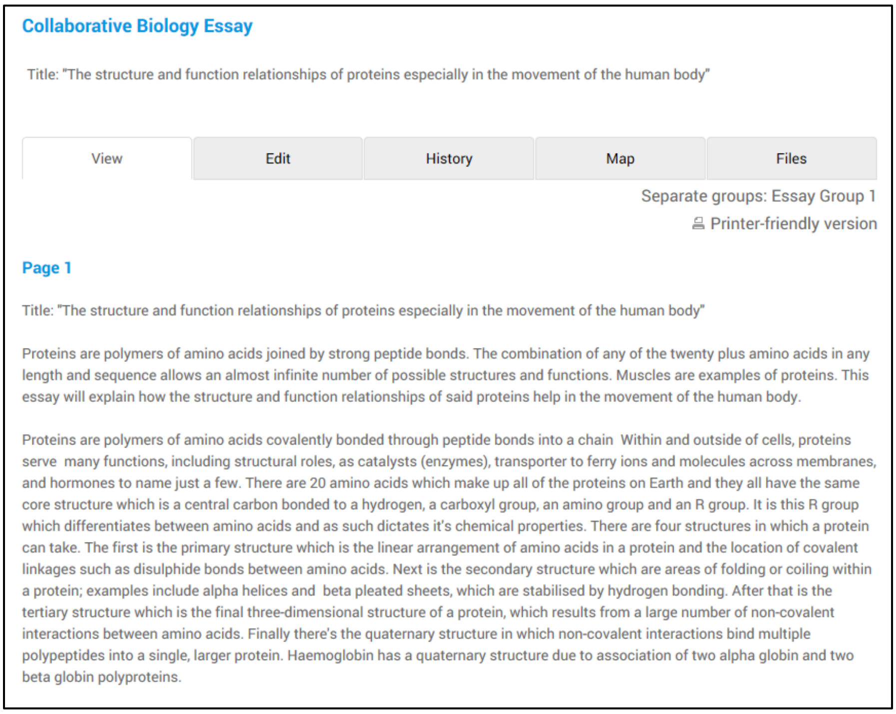


Figure 4.61 Example forum posts discussing wiki task



Collaborative Biology Essay

Title: "The structure and function relationships of proteins especially in the movement of the human body"

View	Edit	History	Map	Files

Separate groups: Essay Group 1

Printer-friendly version

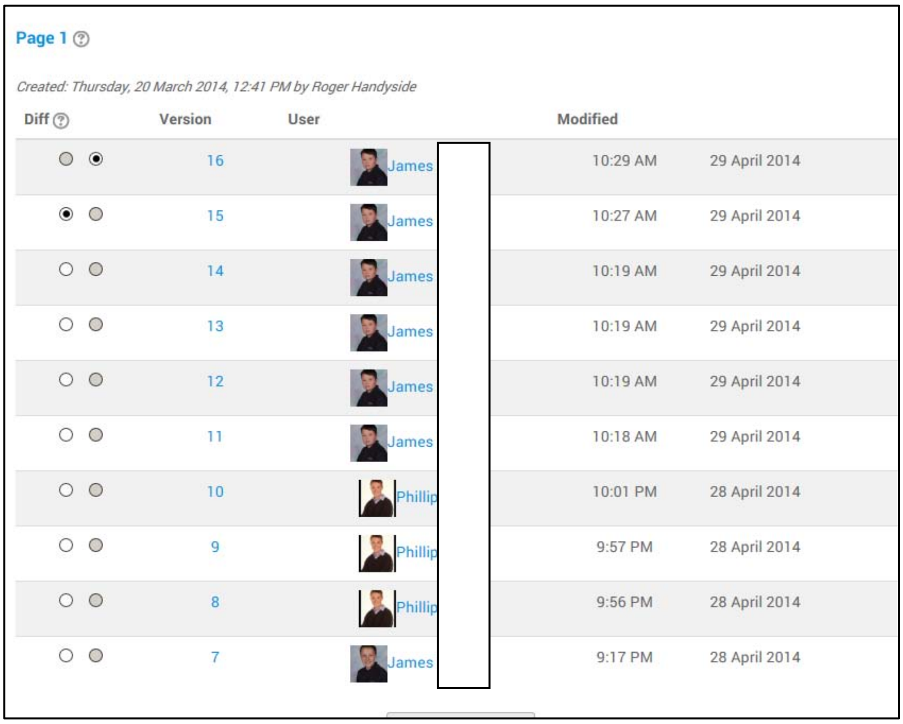
Page 1

Title: "The structure and function relationships of proteins especially in the movement of the human body"

Proteins are polymers of amino acids joined by strong peptide bonds. The combination of any of the twenty plus amino acids in any length and sequence allows an almost infinite number of possible structures and functions. Muscles are examples of proteins. This essay will explain how the structure and function relationships of said proteins help in the movement of the human body.

Proteins are polymers of amino acids covalently bonded through peptide bonds into a chain Within and outside of cells, proteins serve many functions, including structural roles, as catalysts (enzymes), transporter to ferry ions and molecules across membranes, and hormones to name just a few. There are 20 amino acids which make up all of the proteins on Earth and they all have the same core structure which is a central carbon bonded to a hydrogen, a carboxyl group, an amino group and an R group. It is this R group which differentiates between amino acids and as such dictates it's chemical properties. There are four structures in which a protein can take. The first is the primary structure which is the linear arrangement of amino acids in a protein and the location of covalent linkages such as disulphide bonds between amino acids. Next is the secondary structure which are areas of folding or coiling within a protein; examples include alpha helices and beta pleated sheets, which are stabilised by hydrogen bonding. After that is the tertiary structure which is the final three-dimensional structure of a protein, which results from a large number of non-covalent interactions between amino acids. Finally there's the quaternary structure in which non-covalent interactions bind multiple polypeptides into a single, larger protein. Haemoglobin has a quaternary structure due to association of two alpha globin and two beta globin polyproteins.

Figure 4.62 Extract from students' wiki 'model' essay



Page 1

Created: Thursday, 20 March 2014, 12:41 PM by Roger Handyside

Diff	Version	User	Modified	
	16	James	10:29 AM	29 April 2014
	15	James	10:27 AM	29 April 2014
	14	James	10:19 AM	29 April 2014
	13	James	10:19 AM	29 April 2014
	12	James	10:19 AM	29 April 2014
	11	James	10:18 AM	29 April 2014
	10	Phillip	10:01 PM	28 April 2014
	9	Phillip	9:57 PM	28 April 2014
	8	Phillip	9:56 PM	28 April 2014
	7	James	9:17 PM	28 April 2014

Figure 4.63 Extract from an example 'history' of wiki creation

4.8.2 Assessment and feedback

While the use of multiple choice questions and tests has proved to be useful and popular, there seems to be a habit among some students to spend very little time actually thinking through the alternatives, before selecting an answer. Jenny and Lauren think that a number of students rush through the tests just to see how they get on, before going back to consider their incorrect answers. We want the students to take more time and care over the tests. The Moodle VLE assessment design module has an option to incorporate confidence-based marking (CBM) into the multiple choice tests. CBM has been used at University College London medical school for formative and summative examinations (Gardner-Medwin, 2006) and the university has developed a website giving access to research publications and authoring tools (www.ucl.ac/lapt).

CBM involves students indicating a degree of certainty for each answer they select. In order to get the full marks for an answer the student must be able to justify that answer and have a high certainty of it being correct. If the certainty is high and the answer wrong, then the student receives a penalty of -6, see Table 4.16. This is justified in that it merits greater penalty than a guessed wrong answer.

Certainty level	C=1	C=2	C=3	No reply
Mark if correct	1	2	3	0
Mark if wrong	0	-2	-6	0

Table 4.16 The confidence-based mark scheme (Gardner-Medwin, 2006)

The aim of this approach is for students to see that to maximise their score, they must be both correct and certain. Hopefully they will spend more time on their answers and in the long term, prepare more thoroughly for the tests. Figure 4.64 shows the information given to students on the BLAST site (having already received an introduction and examples in class). Figure 4.65 shows examples of how the CBM questions are laid out.

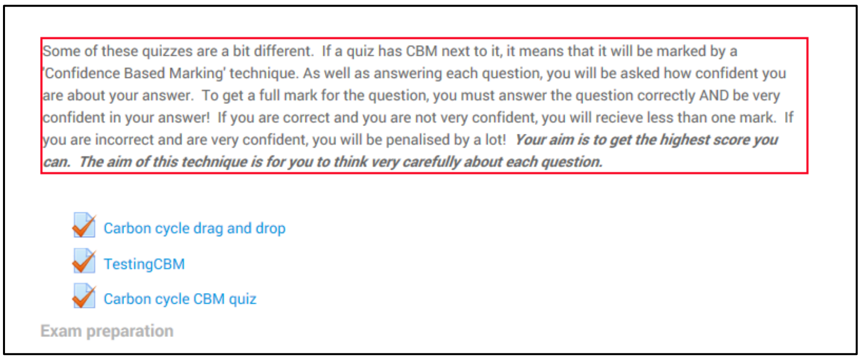


Figure 4.64 Introduction to CBM quiz questions

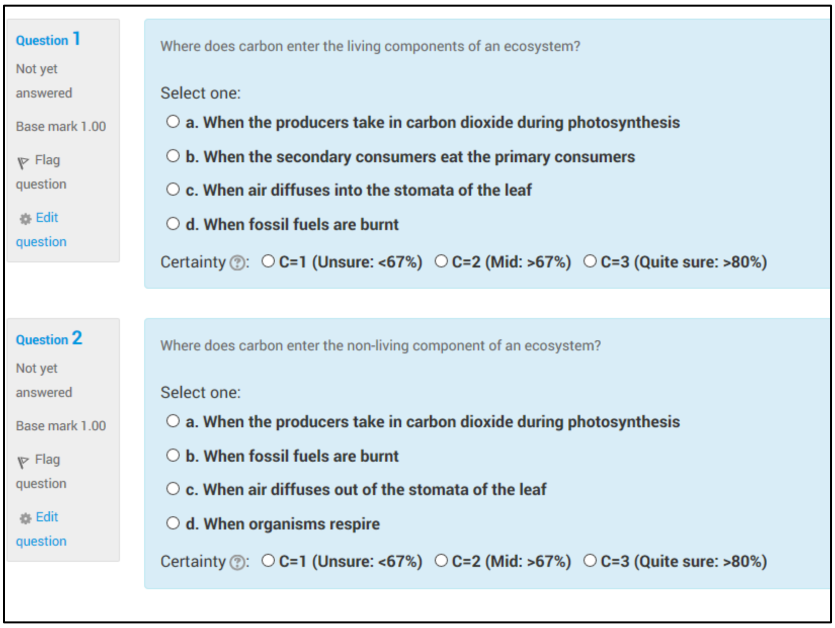


Figure 4.65 Example of CBM quiz questions

The students take to the idea quite quickly and can see the reasoning behind it:

"I take much longer on this type of quiz"

"I can see how it tests whether you really understand a topic"

"I was really shocked when I first got -6!"

The teachers quickly see the benefit and ease of use:

"It only takes a minute to reformat the quiz as a CBM, but it makes the students spend far more time on it!"

There have been some concerns raised about whether this kind of test favours particular personality traits, including gender or ethnic bias (Gardner-Medwin, 2006), in that the system relies on risk taking and motivation to maximise scores. Gardner-Medwin's research finds no evidence for this, indeed in this small study, there seems to be no difference in attitude from the boys or girls. It takes no longer for staff to create the quizzes, although they must use Moodle's own quiz tool to include CBM functionality. It is decided to use this regularly in order to encourage deeper thinking when using quizzes. Nicol (2007a), cites Gardner-Medwin's work as a case study of how using MCQ can support his principles of good assessment practice, in this case, by being forced to reflect on their answers to a greater extent (Principle 2 self assessment and reflection), and increase students' confidence in their knowledge (Principle 5, feedback and motivation).

4.8.3 Review of the third stage

The students responded well to the introduction of CBM assessments, they could see the benefit in the increased reflection time required before answering questions (something they failed to see in the reflective journal). This is now established as an alternative MCQ type in the teams' inventory of assessment activities.

Getting students to work co-operatively or collaboratively has been the subject of many publications, whether for face to face in class or online. Putting students into groups and hoping they will spontaneously discuss issues is as unlikely as creating an online discussion forum and expecting students to contribute useful posts. In these three stages of developing the BLAST learning environment, the teachers have used discussions and group work both in class and online. The teachers have used a variety of techniques to support students working in this way. Principles from Philosophy for Children (Philosophy4Children, 2014), have informed many of the ideas behind structuring class discussions in order to give students confidence in voicing opinions and listening to others. Other techniques have involved different grouping strategies and discussion strategies, for example think-pair-share, a common strategy for encouraging the processing of information before re-presenting it to a larger group (Lyman, 1987). A popular author for staff development and resources is Spencer Kagan, whose resources and 'structures' for effective co-operative student work are evident in many schools, including the project school (Kagan, 2011; Kagan, 1989). Also used in the project school to develop critical thinking and group work are the 'Six Thinking Hats (de Bono, 2009). Elements from these principles and resources have informed the team's approach to planning for online discussions and collaborative activities. Throughout these three iterations, the students have responded well to the structures offered up by the team to encourage the use of the BLAST learning environment. This is evidenced in the example of the model essay task using the wiki, and in the development of the online discussion forums.

While students have responded well to most aspects of the project, the analysis of the Q methodology evaluation (section 5.1), has provided an interesting insight on the attitudes of the students. The team recognise the groups that have been generated by the analysis. Overall, there needs to be more preparation for the activities defined under the social presence setting, the team acknowledges that insufficient work has been done in the years before students enter the sixth form. Future plans involve introducing some of these activities to earlier years in the school.

Chapter 5. Findings of Quantitative Q methodology and MSLQ Surveys

This section will summarise the findings of the quantitative surveys in the project. Further discussion of their relevance to the project will be included in the discussion (section Chapter 6).

5.1 Student evaluation of the course using Q methodology

Q methodology, described previously in section 3.7.6, aims to capture participants' perceptions of a course through the sorting of a set of statements (Q set) linked to the course to be evaluated. The results comprise a sheet of responses from each participant containing their sorted statements on a scale from most disagree (-5), to most agree (+5), the Q sort.

This section will present the results of the analysis of the Q sorts completed by the 19 students in the intervention class. As described in a previous section, the first process in the analysis of Q method data was to enter the Q sort grids into the analysis software PQMethod (Schmolck, 2014). The procedures for analysing the data were taken from the PQMethod manual and helpful step-by-step guidance (Webler et al., 2009). Default settings were used and the 'Qvarimax' option chosen for the rotation of factors. From this analysis, a number of factors were identified that share perspectives on the topic. The analysis produced three factors, see Table 5.1.

Of the 19 participants in class, 6 loaded onto Factor 1, 7 loaded onto Factor 2 and 6 loaded onto Factor 3. One student (St02) was a 'mixed' participant and loaded quite highly onto both Factors 1 and 2.

Each of the three Factors has been shown to share perspectives on the topic of the blended learning re-design of the course. The following sections will describe what those perspectives have in common and how they differ from each other. The descriptions of the factors will be termed narratives and each given a moniker that sums up that perspective. The narratives begin with the table of distinguishing statements, the Q scores and z-scores. In addition, a 'model' Q sort for each moniker is provided in diagrammatic form.

Q Sort	Factor 1	Factor 2	Factor 3
St01	0.5215X	0.0399	0.3159
St02	0.5145	0.5405	0.1748
St03	0.3668	0.6525X	0.3797
St04	0.7317X	0.0639	0.1320
St05	0.6211X	0.2243	0.3316
St06	0.1778	-0.1556	0.5421X
St07	0.0186	0.3286	0.5335X
St08	0.7847X	0.1807	0.1264
St09	0.0935	0.8620X	0.1213
St10	0.0935	0.9737X	0.0306
St11	0.2092	0.9192X	0.1242
St12	0.2534	0.9039X	-0.0667
St13	0.2037	0.9150X	0.7886X
St14	0.1853	0.2006	0.7886X
St15	0.2337	0.0338	0.9427X
St16	0.2067	0.0816	0.8863X
St17	0.3397	0.7027X	0.3568
St18	0.7029X	0.2084	0.0866
St19	0.8441X	0.2245	0.1193
Variance	20%	30%	18%
No. of participants	6	7	6

Table 5.1 Factor Matrix – X refers to Q sorts ‘flagged’ to that factor

5.1.1 Factor 1 – The Pragmatists

The first group identified by the analysis, Factor 1 (Table 5.2) has been termed the Pragmatists. Six (31.6%) out of the 19 students were flagged on Factor 1. The moniker ‘Pragmatist’ has been chosen for this factor because of the nature of the distinguishing statements that make up this group.

These students like the idea of a constructivist pedagogy; working in groups (#45:+4) and experiencing active learning (#28:+4).

> *“It [group work] helps consolidate your knowledge and they might pass on ways for you to remember things” (St05)*

> *“More active lessons are interesting so the content is more memorable” (St04)*

There is an element of seeming contradiction about group work and preferring to work by themselves (#39:+1), although the confusion is cleared up by one student:

"I tend to work better without the distraction of others, but I still rely on others for peer assessment/checking" (St01)

No.	Statements	**Factor 1**	Factor 2	Factor 3
45	I think working in groups is really useful	**+4: 1.88***	+3: 1.08	0: 0.04
28	Classes should be more active rather than teachers telling us things	**+4: 1.56***	0: 0.24	+2: 0.60
15	The technology in school is too restricted and controlled	**+3: 1.02***	0: -0.04	0: 0.12
3	Teachers should just tell us what we need to know	**+3: 0.92***	-4: -1.52	-3: -1.26
6	I can transfer all my skills from social use of techn to learning	**+2: 0.62***	-2: -0.71	-2: -0.70
30	They should let us bring our own laptops etc. into school	**+1: 0.33***	-2: -0.65	-2: -0.64
39	I prefer working by myself	**+1: 0.28***	-5: -1.69	+4: 1.45
44	Blended Learning is probably the best way to organise courses	**0: 0.03**	+4: 1.41	-2: -0.57
8	Teachers should be using Apps like Facebook etc. to help their teaching	**0: 0.02***	-3: -1.24	-5: -1.77
22	I don't like other people seeing my ideas in forums	**0: -0.13***	-3: -1.21	+3: 1.12
29	Moodle makes things more complicated	**0: -0.13**	-5: -1.72	+1: 0.53
12	I don't think forums or discussion boards are much use in learning	**-1: -0.17***	-3: -1.19	+4: 1.60
24	I like having the pattern of class and homework ahead of time to help me organised my work	**-2: -0.59***	+4: 1.46	+3: 1.26
9	Moodle is a good way of organising your work and structuring homework	**-2: -0.67***	+2: 0.77	0: 0.13
16	Students need training to get the best out of using techn for learning	**-3: -0.96**	0: 0.00	0: 0.20
37	I can say things on forums that I might not say in class	**-3: -1.38***	+1: 0.42	-1: -0.36
5	I would like to use all the Moodle tools, but I don't have the right techn or internet access	**-5: -1.63***	-1: -0.51	-1: -0.54

Table 5.2 Distinguishing statements for Factor 1 ($p<0.05$, * indicates significance at $p<0.01$). QSort value:Z-score

They are confident in their use of technology, claiming to be able to transfer their skills from social use of technology to learning (#6:+2). They also think that technology in school is too restricted (#15:+3),

"The school laptops are too slow and many of the useful sites are blocked" (St05)

adding that they think they should be able to bring their own technology into school (#30:+1). These students have access to all the technology they need to use the school's learning platform (#5:-5), and don't consider that they need any training to get the best use of this system (#16:-3).

They are however, sceptical about the school's learning platform Moodle. They don't consider that Moodle is particularly good way of organising work and structuring homework (#9:-2) or that having patterns of class and homework published ahead of time helped them organise their work (#24:-2). Although they do appreciate group work in their classes, they do not like the use of discussion forums for school work (#12:-1)(#37:-3). They do however agree with the other groups that it is essential to have resources online (#4:+5) and Moodle does keep everything in one place (#34:+4). One of the more extreme comments from a member of this group:

> *"Team essays are helpful for getting others' views and a way of understanding, but Moodle gets in the way of work and makes things complicated" (St01)*

In some respects these students have resisted the move towards blended learning. Though not negative about the concept (#44:0), they do represent the traditional passive voice of thinking that teachers should just tell us what we need to know (#3:+3) something that the blended learning design attempted to overcome.

These sceptics are at ease with technology and they like the availability of online resources, but seem to resist the active engagement with blended learning that the use of discussion forums, online assessments and the use of the learning platform as an organiser of their work would involve. The 'model' Qsort for this group is represented by Figure 5.1.

Factor 1 (Pragmatist) 'model' Q sort

-5	-4	-3	-2	-1	0	1	2	3	4	5
#5 I would like to use all the Moodle tools, but I don't have the right techn or internet access	#11 Using the internet hasn't really helped my studies	#14 With a well designed LP, we could work more independently & need fewer lessons	#24 I like having the pattern of class and homework ahead of time to help me organised my work	#2 School use of tech should be more like social networking	#1 Students should take more control of their own learning	#13 More teachers should be using the LP and internet in their subjects	#6 I can transfer all my skills from social use of techn to learning	#3 Teachers should just tell us what we need to know	#28 Classes should be more active rather than teachers telling us things	#4 Having lesson presentations and resources online is essential
#31 I would like to try an online only course	#23 It would be useful to have online modules that we could study at our own pace	#16 Students need training to get the best out of using techn for learning	#9 Moodle is a good way of organising your work and structuring homework	#12 I don't think forums or discussion boards are much use in learning	#7 I wouldn't like school work to take on aspects of social networking	#19 This course is well organised	#10 Technology is not reliable enough for use in teaching and learning	#15 The technology in school is too restricted and controlled	#34 Moodle lets you see everything in one place	#41 The teacher is the most important sources of information for my subjects
	#42 I would like to do more of my work online	#33 I don't think that teaching has changed since my parents went to school	#25 The only technology I see in school is the teachers ppt pres	#18 I am surprised more teachers don't use Moodle	#8 Teachers should be using apps like Facebook etc. to help their teaching	#20 Students know more about technology than their teachers	#17 Sharing ideas in forums helps understand difficult concepts	#32 Communication over the internet is much harder than in person	#45 I think working in groups is really useful	
		#37 I can say things on forums that I might not say in class	#38 It wouldn't make any difference if teachers didn't use technology	#35 I can see loads more ways techn could be used in school	#22 I don't like other people seeing my ideas in forums	#27 In a forum you can build on your own ideas by seeing what others have said	#21 Students want to use techn in their learning	#43 I can see the benefits of creating a piece of work collaboratively		
			#47 Lectures are the best way to get information across to students	#36 We don't get the chance to show our techn skills in school	#26 I expect to use Learning Platforms like Moodle when I get to University	#30 They should let us bring our own laptops etc. into school	#46 Marking sample essays is really useful			
				#40 Peer assessment helps me understand difficult topics	#29 Moodle makes things more complicated	#39 I prefer working by myself				
					#44 Blended Learning is probably the best way to organise courses					

Figure 5.1 Model Qsort for Factor 1 (Pragmatist) students

5.1.2 Factor 2 – The Enthusiasts

Table 5.3 shows the distinguishing statements for Factor 2 or 'The Enthusiasts'. This group is defined by 7 (36.8%) students in the class.

No.	Statements	Factor 1	**Factor 2**	Factor 3
21	Students want to use technology in their learning	+2: 0.78	**+4: 1.56***	+2: 0.73
44	Blended Learning is probably the best way to organise courses	0: 0.03	**+4: 1.41***	-2: -0.57
40	Peer assessment helps me understand difficult topics	-1: -0.41	**+3: 1.24***	-1: -0.48
45	I think working in groups is really useful	+4: 1.88	**+3: 1.08***	0: 0.04
9	Moodle is a good way of organising your work and structuring homework	-2: -0.67	**+2: 0.77**	0: 0.13
23	It would be useful to have online modules that we could study at our own pace	-4: -1.38	**+1: 0.50***	-3: -1.08
37	I can say things on forums that I might not say in class	-3: -1.38	**+1: 0.42***	-1: -0.36
42	I would like to do more of my work online	-4: -1.61	**+1: 0.35***	-5: -1.83
31	I would like to try an online only course	-5: -1.91	**+1: 0.32***	-4: -1.63
32	Communication over the internet is much harder than in person	+3: 1.03	**-1: -0.53***	+3: 1.20
10	Technology is not reliable enough for use in teaching and learning	+2: 0.74	**-2: 0.64***	+1: 0.40
12	I don't think forums or discussion boards are much use in learning	-1: -0.17	**-3: -1.19***	+4: 1.60
22	I don't like other people seeing my ideas in forums	0: -0.13	**-3: -1.21***	+3: 1.12
39	I prefer working by myself	+1: 0.28	**-5: -1.69***	+4: 1.45
29	Moodle makes things more complicated	0: -0.13	**-5: -1.72***	+1: 0.53

Table 5.3 Distinguishing statements for Factor 2 ($p<0.05$, * indicates significance at $p<0.01$). QSort value:Z-score

The second Factor defined by the Qsorts is that termed 'The Enthusiasts'. They are distinguished by their enthusiasm for the use of technology generally and in their willingness to engage with and use the learning platform Moodle.

This group has clearly understood how the re-design of the course into a blended learning environment has linked together their class and home activities. They want to use technology in their learning (#21:+4) and they consider that blended learning is probably the best way to organise courses (#44:+4), the teacher took a great deal of time to explain the concept of blended learning.

"It is nice to see that a teacher is using the learning platform to give us the resources we need" (St03)

"I like having the resources, quizzes and other things online to support what we do in class" (St08)

This group thinks working in groups is really useful (#45:+3), do not really like working on their own (#39:-5) and are quite open to using online discussion boards and forums in their work. They think that forums are useful in learning (#12:-3), they can say things online that they might not say in class (#37:+1) and they do not consider communication to be that much more difficult online than in person (#32:-1), they don't mind other people seeing what they have written online (#22:-3).

"I quite like using the forums, you can take time to think before making a point and you can see the replies all in one place." (St18)

Forums were one of the most difficult activities to get the students to engage with. Many of them could not see the point as they met so often as a class anyway. When asked about their use of forums in their non-school environment, it emerged that few of the class actually engaged in prolonged discussions rather just posting a few comments on Facebook or Twitter.

These students can see the value in the idea of a structured learning platform. They agree that Moodle is a good way of organising the work and structuring homework (#9:+2) and they disagree that Moodle make things more complicated (#29:-5).

The Enthusiasts are also open to develop their online learning experiences. Although they have only had a limited exposure to an online learning experience, this group would like to have the opportunity to have some online modules that they can study at their own pace (#23:+1); would like to do more of their work online (#42:+1) and even try an online only course (#31:+1).

"I like the idea of following a course or part of a course where a lot of the work is online, I would like to have some class work though to make sure I was doing it right" (St03)

This group, comprising about a third of the class, could clearly see the benefits of the learning platform provided and were enthusiastic about its use. However, it would probably take more than a third of the class to create a 'tipping point' that would encourage the 'sceptics' and 'conservatives' to engage more fully. The 'model' Qsort for this group is represented by Figure 5.2.

Factor 2 (Enthusiast) ‘model’ Q sort

-5	-4	-3	-2	-1	0	1	2	3	4	5
#29 Moodle makes things more complicated	#4 Teachers should just tell us what we need to know	#8 Teachers should be using apps like Facebook etc. to help their teaching	#6 I can transfer all my skills from social use of techn to learning	#2 School use of tech should be more like social networking	#1 Students should take more control of their own learning	#1 I am surprised more teachers don’t use Moodle	#9 Moodle is a good way of organising your work and structuring homework	#40 Peer assessment helps me understand difficult topics	#21 Students want to use techn in their learning	#4 Having lesson presentations and resources online is essential
#39 I prefer working by myself	#11 Using the internet hasn’t really helped my studies	#12 I don’t think forums or discussion boards are much use in learning	#10 Technology is not reliable enough for use in teaching and learning	#5 I would like to use all the Moodle tools, but I don’t have the right techn or internet access	#7 I wouldn’t like school work to take on aspects of social networking	#19 This course is well organised	#13 More teachers should be using the LP and internet in their subjects	#43 I can see the benefits of creating a piece of work collaboratively	#24 I like having the pattern of class and homework ahead of time to help me organised my work	#41 The teacher is the most important sources of information for my subjects
	#47 Lectures are the best way to get information across to students	#14 With a well designed LP, we could work more independently & need fewer lessons	#25 The only technology I see in school is the teachers ppt pres	#20 Students know more about technology than their teachers	#15 The technology in school is too restricted and controlled	#23 It would be useful to have online modules that we could study at our own pace	#2 Sharing ideas in forums helps understand difficult concepts	#45 I think working in groups is really useful	#44 Blended Learning is probably the best way to organise courses	
		#22 I don’t like other people seeing my ideas in forums	#30 They should let us bring our own laptops etc. into school	#32 Communication over the internet is much harder than in person	#16 Students need training to get the best out of using techn for learning	#31 I would like to try an online only course	#27 In a forum you can build on your own ideas by seeing what others have said	#46 Marking sample essays is really useful		
			#33 I don’t think that teaching has changed since my parents went to school	#36 We don’t get the chance to show our techn skills in school	#26 I expect to use Learning Platforms like Moodle when I get to University	#37 I can say things on forums that I might not say in class	#34 Moodle lets you see everything in one place			
				#38 It wouldn’t make any difference if teachers didn’t use technology	#28 Classes should be more active rather than teachers telling us things	#42 I would like to do more of my work online				
					#35 I can see loads more ways techn could be used in school					

Figure 5.2 Model Qsort for Factor 2 (The Enthusiast) students

5.1.3 Factor 3 – The Conservatives

The third Factor identified by the Q process, has been named 'The Conservatives', a group distinguished by their almost total lack of enthusiasm for the learning platform and the use of technology in their learning (Table 5.4).

No.	Statements	Factor 1	Factor 2	**Factor 3**
11	Using the internet hasn't really helped my studies	-4: -1.49	-4: -1.59	**+5: 1.60***
12	I don't think forums or discussion boards are much use in learning	-1: -0.17	-3: -1.19	**+4: 1.60***
7	I wouldn't like school work to take on aspects of social networking	0: 0.18	0: 0.07	**+4: 1.54***
39	I prefer working by myself	1: 0.28	-5: -1.69	**+4: 1.45***
22	I don't like other people seeing my ideas in forums	0: -0.13	-3: -1.21	**+3: 1.12***
29	Moodle makes things more complicated	0: -0.13	-5: -1.72	**+1: 0.53**
38	It wouldn't make any difference if teachers didn't use technology	-2: -0.94	-1: -0.42	**+1: 0.43***
9	Moodle is a good way of organising your work and structuring homework	-2: -0.77	+2: 0.77	**0: 0.13**
45	I think working in groups is really useful	+4: 1.88	+3: 1.08	**0: 0.04**
37	I can say things on forums that I might not say in class	-3: -1.38	+1: 0.42	**-1: -0.36***
44	Blended Learning is probably the best way to organise courses	0: 0.03	+4: 1.41	**-2: -0.57**
17	Sharing ideas in forums helps understand difficult concepts	+2: 0.90	+2: 0.88	**-2: -0.77***
2	School use of tech should be more like social networking	-1: -0.48	-1: -0.62	**-3: -1.19**
27	In a forum you can build on your own ideas by seeing what others have said	+1: 0.57	+2: 0.66	**-4: -1.65**

Table 5.4 Distinguishing statements for Factor 3 ($p<0.05$, * indicates significance at $p<0.01$). QSort value:Z-score

This course has been their only experience of a structured use of technology in school and lessons can be learned from how they have perceived the course re-design.

> *"I find the internet a distraction and I can't focus on my work. Also the internet is unreliable. I also prefer paper – the old fashioned way is better" (St06)*

This group of six students felt that using the internet hadn't really helped their studies (#11:+5) and that blended learning was probably not the best way to organise courses (#44:-2).

Although they liked having class resources online (#4:+3), what this group really did not like were the social aspects of online learning. These students felt quite strongly that forums or social networking had little place in learning. They did not think that forums are much use (#12:+4); school work should not take on aspects of social networking (#7:+4)(#2:-3).

"People don't use forums much" (St07)

"Facebook shouldn't be mixed with education" (St07)

"I do not like forums – it is easier to work in groups and verbally discuss than use a forum as more ideas can be expressed" (St06)

"I don't find social networking helpful for work, more of a distraction" (St16)

These 'Conservatives' prefer working by themselves (#39:+4), and think that the use of the learning platform just makes life more complicated (#29:+1). The 'model' Qsort for this group is represented by Figure 5.3.

Factor 3 (Conservative) 'model' Q sort

-5	-4	-3	-2	-1	0	1	2	3	4	5
#8 Teachers should be using apps like Facebook etc. to help their teaching	#14 With a well designed LP, we could work more independently & need fewer lessons	#2 School use of tech should be more like social networking	#6 I can transfer all my skills from social use of techn to learning	#5 I would like to use all the Moodle tools, but I don't have the right techn or internet access	#9 Moodle is a good way of organising your work and structuring homework	#10 Technology is not reliable enough for use in teaching and learning	#1 Students should take more control of their own learning	#4 Having lesson presentations and resources online is essential	#7 I wouldn't like school work to take on aspects of social networking	#11 Using the internet hasn't really helped my studies
#42 I would like to do more of my work online	#27 In a forum you can build on your own ideas by seeing what others have said	#3 Teachers should just tell us what we need to know	#17 Sharing ideas in forums helps understand difficult concepts	#25 The only technology I see in school is the teachers ppt pres	#15 The technology in school is too restricted and controlled	#13 More teachers should be using the LP and internet in their subjects	#21 Students want to use techn in their learning	#3 I don't like other people seeing my ideas in forums	#12 I don't think forums or discussion boards are much use in learning	#41 The teacher is the most important sources of information for my subjects
	#31 I would like to try an online only course	#23 It would be useful to have online modules that we could study at our own pace	#30 They should let us bring our own laptops etc. into school	#35 I can see loads more ways techn could be used in school	#16 Students need training to get the best out of using techn for learning	#19 This course is well organised	#28 Classes should be more active rather than teachers telling us things	#24 I like having the pattern of class and homework ahead of time to help me organised my work	#39 I prefer working by myself	
		#47 Lectures are the best way to get information across to students	#33 I don't think that teaching has changed since my parents went to school	#36 We don't get the chance to show our techn skills in school	#18 I am surprised more teachers don't use Moodle	#29 Moodle makes things more complicated	#34 Moodle lets you see everything in one place	#32 Communication over the internet is much harder than in person		
			#44 Blended Learning is probably the best way to organise courses	#37 I can say things on forums that I might not say in class	#20 Students know more about technology than their teachers	#38 It wouldn't make any difference if teachers didn't use technology	#43 I can see the benefits of creating a piece of work collaboratively			
				#40 Peer assessment helps me understand difficult topics	#26 I expect to use Learning Platforms like Moodle when I get to University	#46 Marking sample essays is really useful				
					#45 I think working in groups is really useful					

Figure 5.3 Model Qsort for Factor 3 (The Conservative) students

5.1.4 Consensus views

Having discussed the statements that have distinguished the three Factors, there are a number of statements upon which all the students agree to a certain extent. Table 5.5 shows those statements that PQMethod defined as not distinguishing between any two factors. Fig 5.4 shows how these are represented on the Qsort grid.

Statement No.	Statement	Score	Student Comments
1	Students should take more control of their own learning	+1	*"Students need to learn independently as they shouldn't rely on the teacher"* (st03)
2	School use of technology should be more like social networking	-2	*"Facebook shouldn't be mixed with education"* (St07)
13	More teachers should be using the LP and internet in their subjects	+1	*"It would be useful if all subjects had their resources on Moodle"* (St09)
14	With a well designed LP, we could work more independently & need fewer lessons	-3	*"I don't like the idea of having fewer lessons"* (St02)
18	I am surprised more teachers don't use Moodle	0	*"I think it would be a lot of work"* (St02)
19	This course is well organised	+1	*"We know what we are doing from lesson to lesson"* (St11)
25	The only technology I see in school is the teachers ppt pres	-2	*"I use the internet for all my lessons, some teachers give you useful links"* (St16)
26	I expect to use Learning Platforms like Moodle when I get to University	0	
33	I don't think that teaching has changed since my parents went to school	-2	*"There are several aspects of teaching that have changed, including the use of technology"* (St05)
34	Moodle lets you see everything in one place	+3	*"It's good to have all Power Points and resources in one place"* (St04) *"I tend to misplace things or forget them, means I can print off extra copies"* (St01)
35	I can see loads more ways technology could be used in school	-1	*"I think we use enough technology already"* (St06)
36	We don't get the chance to show our skills in school	-1	
41	The teacher is the most important sources of information for my subjects	+5	*"We can ask questions when we don't understand and the teacher is able to teach us in a way that helps us learn"* (St03)
43	I can see the benefits of creating a piece of work collaboratively	+ 3	*"Allows us to share ideas, the structure of my essays has improved"* (St05)

Table 5.5 Consensus statements and their mean scores with some student comments

All the participants agreed on the issues shown in Table 5.5. Not surprisingly they regarded their teacher as the most important source of information (#41:+5); they all like the idea of some collaborative work (#43:+3), but really do not want school work to be like social networking (#2:-2).

All the students regarded the idea of online resources and activities replacing contact lessons as a bad idea (#14:-3). The notion of moving towards a more independent web-supported learning environment needs a great deal of careful training and persuasion of students to the benefits if some of the efficiencies of this type of learning are to be realised (Figure 5.4).

There is some general support for more use of the school learning platform, and some acknowledgement of the amount of work that would be involved (#13:+1)(#18:0).

Consensus ‘model’ Q sort

-5	-4	-3	-2	-1	0	1	2	3	4	5
		#14 With a well designed LP, we could work more independently & need fewer lessons	#2 School use of tech should be more like social networking	#35 I can see loads more ways techn could be used in school	#18 I am surprised more teachers don't use Moodle	#1 Students should take more control of their own learning		#34 Moodle lets you see everything in one place		#41 The teacher is the most important sources of information for my subjects
			#25 The only technology I see in school is the teachers ppt pres	#36 We don't get the chance to show our techn skills in school	#26 I expect to use Learning Platforms like Moodle when I get to University	#13 More teachers should be using the LP and internet in their subjects		#43 I can see the benefits of creating a piece of work collaboratively		
			#33 I don't think that teaching has changed since my parents went to school			#19 This course is well organised				

Figure 5.4 Model Qsort for consensus statements

5.2 MSLQ results

The motivational strategies for learning questionnaire (MSLQ), described in section 3.7.5, is a survey commonly used to evaluate the success of programmes that aim to encourage learner self-regulation. The survey comprises a number of subscales that can be chosen to survey students' responses. The questionnaire used in this study can be found in Appendix G.

The data analysis consisted of taking the subscale score for each student, noting that some items were required to be reversed. The mean scores for all students were totalled and a paired t-test applied to find any significant difference between the scores before the intervention and after. An independent t-test was carried out between the intervention class post-intervention and the comparison group. Data presentation and analysis was carried out with Microsoft Excel 2007 and IBM SPSS 21. Effect sizes were created using the 'effect size calculator' (Coe, 2000).

The paired t-test analysis of the scores of the intervention group showed significant differences for all of the subscales (Table 5.6), in all cases, the mean student scores increasing in the post-test survey.

	Mean (StD)				
Scales	*Pre-test*	*Post-test*	*t*	*p*	*d**
Task Value	4.39(.24)	5.34(.41)	9.52	<0.01	2.77
Control of Learning Beliefs	4.14(.33)	5.16(.53)	10.19	<0.01	2.27
Self Efficacy for Learning and Performance	4.20(.16)	4.91(.51)	6.54	<0.01	1.84
Metacognition for Self Regulation	3.71(.17)	4.53(.52)	7.15	<0.01	2.08
Time and Study Environment	4.42(.19)	5.08(.53)	5.25	<0.01	1.63
Effort Regulation	4.19(.29)	5.15(.70)	5.52	<0.01	1.76
Peer Learning	4.15(.34)	5.15(.84)	4.80	<0.01	1.53
Help Seeking	4.41(.32)	5.03(.52)	6.01	<0.01	1.41
*(df=20) * d=standardised effect size*					

Table 5.6. Paired T-test results of the scores of subscales of the MSLQ (N=21)

The comparison group was used in order to limit the influence of the process of 'maturation' of the general school population. Across all courses there would be study skills sessions that would aim to increase the independent learning capability of all students in that school cohort. The results of the test between the post-intervention group and the comparison group (Table 5.7) show that the difference in one of the subscales (TSE) becomes 'not-significant' and in five cases the results are less significant though significant to the 95% (p=<0.05) standard. The overall results are summarised in Figure 5.5.

	Mean (StD)					
Scales	*Comparison Class*	*Post-test Intervention*	*df*	*t*	*p*	*d**
Task Value	4.85(.68)	5.34(.41)	37	2.74	0.009	0.87
Control of Learning Beliefs	4.70(.75)	5.16(.53)	29.9	2.16	0.039	0.70
Self Efficacy for Learning and Performance	4.43(.56)	4.91(.48)	34.9	2.79	0.008	0.91
Metacognition for Self Regulation	4.11(.57)	4.53(.52)	34.8	2.415	0.021	0.76
Time and Study Environment	4.93(.19)	5.08(.53)	35.6	0.875	0.387	0.36
Effort Regulation	4.70(.45)	5.15(.70)	34.5	2.38	0.023	0.74
Peer Learning	3.48(.82)	5.15(.84)	36.2	6.26	<0.01	1.97
Help Seeking	4.45(.79)	5.03(.52)	28.4	2.63	0.014	0.86

**standardised effect size*

Table 5.7 Independent t-test results of post-test and control group of subscales of the MSLQ

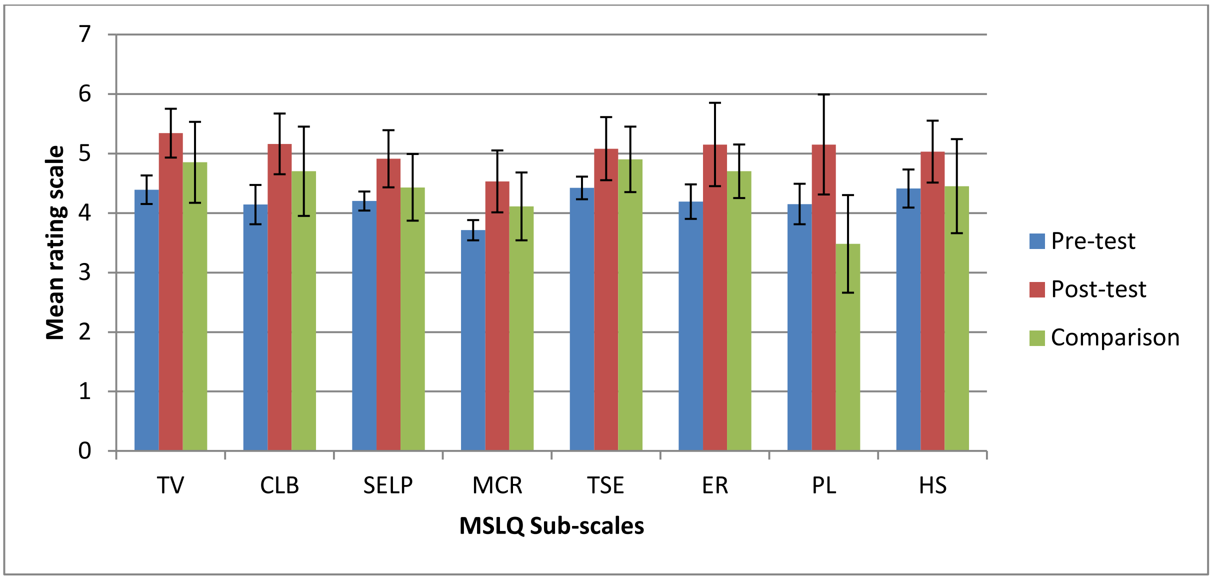


Figure 5.5 Chart to show mean scores for MSLQ subscales, error bars indicate standard deviation

5.2.1 Effect size

In addition to the independent means comparison, a further analysis was carried out. The conventional analysis is to use the ‘statistically significant’ criterion of the results of comparing mean scores (usually where p=<0.05). One of the criticisms of this ‘test’ is that the “dichotomous outcome of a significance test is often inappropriate in drawing inferences from data” (Coe, 2004:84). Coe suggests that more meaningful inferences can be made by using an ‘effect size’ estimate with a confidence interval. The advantage of using effect sizes is that the *size* of the effect is reported. Effect sizes are often combined from a number of different studies, meta-analyses. In the context of approaches to teaching, Hattie’s synthesis of over 800 meta-analyses of research relating to students’ achievement is probably the most well-known (Hattie, 2009).

Hattie's research, while not examining precisely the same criteria as this study, is useful in comparing the general direction of the results (the research that informs the majority of these meta-analyses are the results of random-controlled trials (RCTs) in the USA). Effect sizes are sometimes referred to as small (*d=0.2*), medium (*d=0.5*) or large (*d=0.8*), Hattie (ibid), suggests *d=0.2, 0.4* and *0.6* respectively for judging educational outcomes. On educational innovations and effect sizes, Hattie notes that "effects follow a normal distribution...; almost anything works, .. one only needs a pulse and we can improve achievement..; set the bar at *d=0.4*, this average summarizes the typical effect of all possible influences in education and should be used as the benchmark to judge effects in education" (ibid:16). Hattie refers to this *d=0.4* figure as the hinge point, a standard for noticing real change and places all of his meta-analyses of effect sizes along this continuum, relative to this figure, although other factors including, cost, ease of implementation etc. may alter this view.

Coe (2004), offers certain guidelines when using effect sizes to report on research findings, among them; standardised effect sizes with confidence intervals should be included, these should be shown graphically; interpretation of the significance of an effect should include a regard to issues including feasibility and policy.

A note should also be made about the nature of innovations. Innovations in education raise the agenda of teaching and learning and may capture the enthusiasm of teachers and students, sometimes termed the 'Hawthorne effect'. However, Hattie (2009:12) points out that;

> "when teachers introduce innovation there can be a heightened attention to what is making a difference and what is not, and it is this attention to what is not working that can make the difference – feedback to the teacher about the effects of their actions!"

The effects sizes between the intervention group and the comparison groups are summarised in Table 3.4 and shown graphically in Figure 5.6 and Figure 5.7. All of the effect sizes except TSE, meet Hattie's *d=0.4* hinge point and would seem to show support for the intervention raising the means of the variables measured.

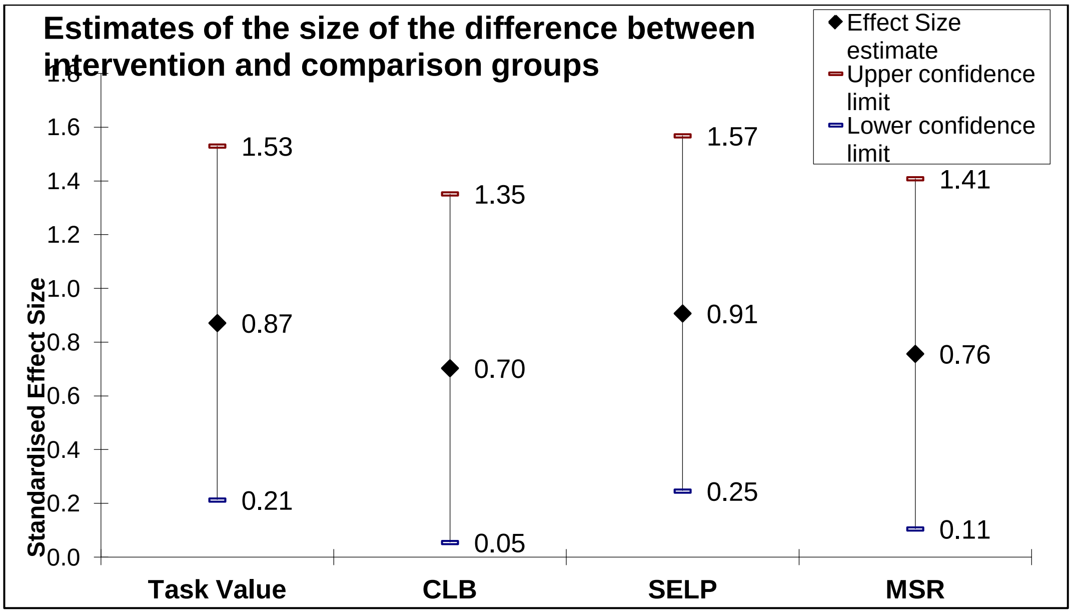


Figure 5.6 Effect sizes for MSLQ subscales TV, CLB, SELP, MSR

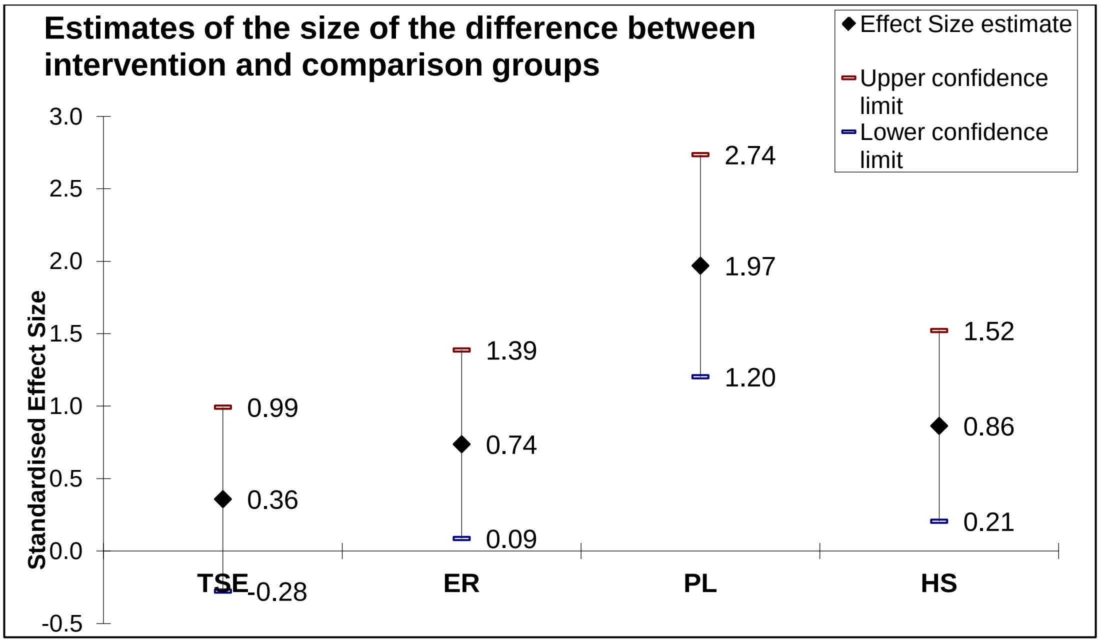


Figure 5.7 Effect sizes for MSLQ subscales TSE, ER, PL, HS

5.2.2 Task value

Pintrich (1991) describes the task value component as how interesting, how important and how useful the tasks are in a course. 'High task value should lead to more involvement in one's learning' (ibid:15). The results for individual questions in this subscale are shown in Table 5.8. Although the subscale as a whole showed significant improvement between the pre- and post- surveys (*d=0.87*), two of the individual questions (items 17 and 26) were not significant. These related to interest and liking of the course content. This may be because a number of students, although keen to achieve, are taking this particular course to make up the number of grades required for higher education entry. Discussions with the students have indicated that some students are applying to study different subjects at higher education. Certainly, evidence from the teachers supports the view that students now seem more focussed and determined to succeed in this course, so although interest may have not improved, importance and utility have.

		Mean (StD)			
Item	Task value subscale	*Pre-test*	*Post-test*	*t*	*p*
4	I think I will be able to use what I learn in this course in other courses	3.42(.50)	5.14(.91)	6.85	<0.01
10	It is important to for me to learn the course material in this class	4.95(.66)	6.19(.67)	5.43	<0.01
17	I am very interested in the content area of this course	4.71(.71)	4.80(1.16)	0.295	0.771
23	I think the course material in this class is useful for me to learn	4.42(.67)	5.61(.49)	5.87	<0.01
26	I like the subject matter of this course	4.33(.57)	4.71(1.38)	1.22	0.237
27	Understanding the subject matter of this course is very important to me	4.52(.67)	5.57(.92)	3.99	0.001
	(df=20)				

Table 5.8 t-test results of Task Value items (N=21)

5.2.3 Control of learning beliefs

This subscale refers to the beliefs students have about how much their efforts to learn will result in positive outcomes (Pintrich et al., 1991). The assumption here is if students feel they can control their academic performance they are more likely to do what is needed strategically to effect the desired changes. This also reflects the ideas that Dweck (1999) put forward about whether students regard their intelligence to be fixed or changeable. Dweck found 'a clear and significant relation between the students' theories of intelligence and their goal choices' *(*ibid: 21). The results here in Table 5.9 (*d=0.7*) show that these students have clearly taken on the responsibility for their own learning, rather than take on a 'fixed intelligence' approach blaming some inherent lack of ability as a reason for poor performance.

		Mean (StD)			
Item	Control of Learning Beliefs subscale	*Pre-test*	*Post-test*	*t*	*p*
2	If I study in appropriate ways, then I will be able to learn the material in this course	4.33(.65)	5.42(.92)	4.80	<0.01
9	It is my own fault if I don't learn the material in this course	4.19(.60)	4.95(.97)	4.20	<0.01
18	If I try hard enough, then I will understand the course material	4.38(.66)	5.90(.76)	8.00	<0.01
25	If I don't understand the course material, it is because I didn't try hard enough.	3.66(.92)	4.38(.92)	2.75	0.012
	(df=20)				

Table 5.9 t-test results of Control of Learning Beliefs items (N=21)

The results for this subscale show that as the course has progressed, students have increasingly taken on responsibility for their own learning. This is supported by comments from the students and the teachers that they have developed in this way. The fact that the intervention group has shown significantly better results than the comparison group strongly suggests that the activities in the course have influenced students' beliefs.

5.2.4 Self-efficacy for learning and performance subscale

This subscale assesses two components; expectancy for success and self-efficacy. 'Self-efficacy is a self-appraisal of one's ability to master a task.... includes judgements about one's ability to accomplish a task as well as one's confidence in one's skills to perform that task' (Pintrich et al., 1991: 13). Overall this subscale had an effect size of *d=0.91*. In all questions bar one (item 5), students showed significant improvement in their confidence and abilities (Table 5.10). The one factor that did not show any difference was the item that asked if they believed they would receive an excellent grade in this course. Having completed the survey, students reported that they thought that an 'excellent' grade meant an A grade. Students in the class are made very aware of their target grades based on past examination performance at GCSE and current performance levels. These students are realistic and if they did not have a grade 'A' as a target grade, would not have responded positively to this question. The wording of the question may reflect an American concept of 'excellent', in the grade-focussed UK high-stakes assessment environment; few well adjusted students would want to claim to be able to achieve a grade 'A', unless targeted for that grade, showing excellent self-efficacy.

		Mean (StD)			
Item	Self-Efficacy for Learning and Performance subscale	*Pre-test*	*Post-test*	*t*	*p*
5	I believe I will receive an excellent grade in this class	3.76(.62)	4.00(.94)	0.96	0.348
6	I'm certain I can understand the most difficult material presented in the readings in this class	3.85(.65)	4.76(.94)	3.80	0.001
12	I'm confident I can understand the basic concepts taught in this course.	4.61(.58)	5.80(.60)	8.07	<0.01
15	I'm confident I can understand the most complex materials presented by the teacher in this course	4.38(.49)	5.00(.92)	3.52	0.002
20	I'm confident I can do an excellent job on the assignments and tests in this course	4.14(.47)	4.71(.64)	3.87	0.001
21	I expect to do well in this course	4.09(.76)	4.90(.76)	3.068	0.006
29	I'm certain I can master the skills being taught in this course	4.09(.53)	4.80(.87)	4.17	<0.01
31	Considering the difficulty of this course, the teacher, and my skills, I think I will do well	4.66(.57)	5.33(.85)	2.55	0.019
	(df=20)				

Table 5.10 t-test results of Self-Efficacy for Learning and Performance subscale items (N=21)

This subscale showed significant differences between the intervention group and the control group. Much of the course redesign focussed on formative assessment, and activities such as self- and peer- assessment might explain the confidence that students in the intervention group had about their working habits and knowledge about their own performance.

5.2.5 Metacognitive self-regulation

According to Pintrich (Pintrich and Zusho, 2002; Pintrich et al., 1991), metacognition in the MSLQ focuses on the control and self-regulation aspects of metacognition. These include planning, monitoring and regulating student activities. All of the items except item 33 produced a significant difference between the pre- and post-scores at least at the 95% level (Table 5.11). There was also a 95% significant difference between the intervention group and the comparison group for this subscale and an effect size of *d=0.76*.

		Mean (StD)			
Item	Metacognitive Self-Regulation	*Pre-test*	*Post-test*	*t*	*p*
33	During class time I often miss important points because I'm thinking of other things (R)	3.42(.67)	4.00(1.54)	1.40	0.174
36	When reading for this course, I make up questions to help focus my reading	2.85(.57)	3.61(1.59)	2.16	0.042
41	When I become confused about something I'm reading for this class, I go back and try and figure it out.	3.90(.76)	5.57(.81)	7.51	<0.01
44	If course materials are difficult to understand, I change the way I read the material	3.76(.70)	4.57(1.16)	2.76	0.011
54	Before I study new course material thoroughly, I often skim it to see how it is organised	3.57(.67)	4.14(1.15)	2.09	0.049
55	I ask myself questions to make sure I understand the material I have been studying in class	3.04(.97)	3.85(1.06)	2.31	0.031
56	I try to change the way I study in order to fit the course requirements and instructor's teaching style	3.61(.80)	4.57(1.56)	2.25	0.036
57	I often find that I have been reading for class but don't know what it was about (R)	3.52(.67)	4.09(1.22)	2.16	0.042
61	I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying	3.85(.65)	4.57(.74)	3.42	0.003
76	When studying for this course I try to determine which concepts I don't understand well	4.14(.65)	5.00(.83)	3.87	0.001
78	When I study for this class, I set goals for myself in order to direct my activities in each study period	4.04(.66)	4.76(1.26)	2.75	0.012
79	If I get confused taking notes in class, I make sure I sort it out afterwards	4.76(.78)	5.71(.78)	4.26	<0.01
	(df=20) (R)- Reversed survey statement				

Table 5.11 t-test results of Metacognitive Self-Regulation subscale items (N=21)

The results above align well with the strategies employed in the course redesign. Considerable effort has been employed to include involving the students in the purpose of the learning sequences and activities. Planning and task analysis are important features of a number of the activities included in the learning environment. Monitoring and self-regulation are at the heart of the learning designs developed in this study.

5.2.6 Time and study environment

Time management and the control of students' learning environments play a large role in ensuring student success. The results from the survey (Table 5.12) show that while there was significant development in this subscale over the period of the course, this was not significantly better than the comparison group and showed the lowest effect size *d=0.36*. The course activities were aimed to improve this aspect of independent learning, however student maturity, motivation and training in other courses may be responsible for these figures.

		Mean (StD)			
Item	Time and Study Environment	*Pre-test*	*Post-test*	*t*	*p*
35	I usually study in a place where I can concentrate on my course work	4.61(.74)	5.33(.79)	3.62	0.002
43	I make good use of my study time	4.04(.66)	4.61(.86)	2.33	0.030
52	I find it hard to stick to a study schedule (R)	2.90(.70)	3.76(.94)	3.54	0.002
65	I have a regular place set aside for studying	4.00(.63)	4.80(1.59)	2.33	0.030
70	I make sure I keep up with the weekly readings and assignments	4.71(.78)	5.38(1.07)	3.34	0.003
73	I attend class regularly	6.57(.50)	6.66(.58)	0.29	0.771
77	I often find that I don't spend very much time on this course because of other activities (R)	4.61(.66)	5.14(1.19)	1.59	0.126
80	I rarely find time to review my notes or readings before a test (R)	3.95(.66)	4.95(1.24)	3.32	0.003
	(df=20) (R)- Reversed survey statement				

Table 5.12 t-test results of Time and Study Environment subscale items (N=21)

Two of the items show no significant development, item 73 most likely because of the high score on attendance in a school environment, and item 77, again because of an already fairly high mean and the pressure of work in a busy student timetable; a factor mentioned in student interviews.

5.2.7 Effort regulation

Pintrich (1991), describes this subscale as the ability of students to 'control their effort and attention in the face of distractions and uninteresting tasks ...effort management is important to academic success because it not only signifies goal commitment, but also regulates the continued use of learning strategies' (ibid:27).

The Effort Regulation subscale as a whole showed significant improvement ($t(20)=5.56$, $p<0.01$)) from the pre- to the post-results (Table 5.13). There is also a significant difference between the intervention and comparison group ($t(34.8)=2.38$, $p<0.05$)) and an effect size of *d=0.74*, showing that there is a strong likelihood that the course redesign helped students develop their effort management, commitment and learning strategies. The one item (37) that showed no significant difference demonstrates that students can still be relied upon to display typical student characteristics despite ingenious learning interventions.

		Mean (StD)			
Item	Effort Regulation	*Pre-test*	*Post-test*	*t*	*p*
37	I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do (R)	3.90(.70)	4.52(1.43)	1.77	0.091
48	I work hard to do well in this class even if I don't like what we are doing	4.52(.67)	5.28(.78)	3.20	0.004
60	When course materials are difficult, I give up or only study the easy parts. (R)	4.52(.60)	5.38(.74)	3.69	0.001
74	Even when course materials are dull and uninteresting, I manage to keep working until I finish.	3.80(.67)	5.42(.67)	8.05	<0.01
	(df=20) (R)- Reversed survey statement				

Table 5.13 t-test results of Effort Regulation subscale items (N=21)

5.2.8 Peer learning

One of the main objectives of the learning designs developed over the course of this study has been in the development of formative assessments techniques. These have been shown to enable students to become more familiar with task and assessment objectives and marking schemes and raise student achievement (Nicol, 2009; Nicol, 2007b). Students in this study have been involved in numerous activities involving group work, pair work, self and peer-assessment. The results of this are demonstrated in the remaining two subscales in the MSLQ, Peer Learning and Help Seeking. The development of Peer Learning (Table 5.14) was significant ($t(20)=4.80$, $p<.01$)) as was the difference between the intervention and the comparison group ($t(36.2)=6.26$, $p<.01$)) with an effect size of $d=1.97$.

		Mean (StD)			
Item	Peer Learning	*Pre-test*	*Post-test*	*t*	*p*
34	When studying for this course, I often try to explain the material to a classmate or friend	4.52(.51)	5.42(.97)	3.28	0.004
45	I try to work with other students from this class to complete the course assignments	4.52(.60)	5.47(.78)	4.48	<0.01
50	When studying for this course, I often set aside time to discuss the course material with a group of students from the class.	3.42(.74)	4.57(.74)	3.17	0.005
	(df=20)				

Table 5.14 t-test results of Peer Learning subscale items (N=21)

5.2.9 Help seeking

The Help Seeking subscale reinforces the value of students managing the support of others, including teachers and other students. Students' development of Help Seeking was significant (t(20)=6.01, p<.01)) (Table 5.15) as was the difference between the intervention and the comparison group (t(28.4)=2.63, p<.05)) with an effect size of *d=0.86*.

		Mean (StD)			
Item	Help Seeking	*Pre-test*	*Post-test*	*t*	*p*
40	Even if I have trouble learning the material in this class, I try to do the work on my own, without help from anyone(R)	3.71(.64)	3.52(1.24)	-0.72	0.479
58	I ask the teachers to clarify concepts I don't understand well	4.57(.59)	5.23(.94)	3.16	0.005
68	When I can't understand the material in this course, I ask another student in this class for help	4.76(.62)	5.90(.43)	8.00	<0.01
75	I try to identify students in this class whom I can ask for help if necessary	4.61(.58)	5.47(1.03)	3.17	0.005
	(df=20) (R)- Reversed survey statement				

Table 5.15 t-test results of Help Seeking subscale items (N=21)

The one item that stands out here is the reversed item 40. From discussions with the students, the statement was somewhat misunderstood. Students responded to the reversed statement with a high score being positive in terms of commitment and self-reliance, as opposed to a negative score in the context of help seeking. The high means in the other items, however easily counteracted this item.

5.2.10 Limitations

However significant the results of this application of the MSLQ survey, caution must be applied to any resulting conclusions or generalisations made. The sample size, limited by the nature of the case study, was small. While an attempt to account for student maturation over the period of the taught course was included in the form of a comparison class in the post-test survey, so many factors influence students' learning that it would be naive to single out the impact of specific activities. Also when comparing the results of this study with others, particularly the effect size meta-studies, it should be noted that the outcomes of this survey are not students' achievements or results, but changes to attitudes and perceptions of themselves, their motivations and attitudes. However, the strength of the results taken as a whole and the high effect sizes, do suggest that the attitudes and independent learning skills of the intervention group have improved over the course, supporting previous studies that self-regulatory strategies delivered by technologically enhanced learning environments improve students' motivation and learning strategies.

Chapter 6. Discussion

Learning design or design for learning, as discussed earlier, is an emerging field of educational research and practice (Mor et al., 2015). It aims to be ‘creative and deliberate’ in the planning of effective and shareable outcomes. Learning design has become associated with the collaboration of teachers and designers using available literature and previous research to create practical solutions to pedagogical problems. Thus, in this study, learning design is aligned with the research process termed Education Design Research. This is an approach that involves the collaboration between practitioners and researchers in the creation of an innovation, informed by previous studies, that is tested iteratively to produce suggested principles for other practitioners to guide their designs. The BLAST project is an example of the creation of an innovation using a learning design approach to undertake an EDR study.

There is a broad consensus concerning the three main outputs of design-research. The obvious practical output of such research is the intervention itself, in this project, the BLAST learning environment. Secondly, theoretical understandings advanced through the process are termed design principles or intervention theory; these are presented as heuristic statements about purpose, context and activities. The third output is the opportunities for reflection by the participants on teaching and learning that the research enables.

This section summarises and contextualises the main findings of this study. The chapter begins with a discussion of the results of the two quantitative data collection instruments, the MSLQ survey and the Q methodology student evaluation of the BLAST learning environment and the activities it contained. This part also answers the second research question:

Research Question 2: Do students learning from a blended learning re-design improve SRL as measured by the motivational strategies learning questionnaire (MSLQ)?

This is followed by an evaluation of the programme using Fullan and Donnelly’s (2013) index and consideration of the factors influencing the take-up of technology within the case study. The importance to the study of the underlying Conversational Framework and Community of Inquiry is then considered together with the use of the tools to aid the design and representation of the learning sequences. An evaluation of the research approach taken is then discussed, linking to the third research question:

Research question 3:

How effective is the chosen collaborative educational design-research approach in investigating an authentic educational challenge in a living educational context?

The second main outcome of the study, the design principles which effectively provide the responses to the first research question follows:

Research Question 1: What are the characteristics of:

a) blended learning activities that can develop independent learning behaviours in sixth form students?
b) a TELE that will promote student engagement in the new course?
c) an educational context that encourages the effective use of educational technology?

The third element, considering the professional development of the participants, is discussed next. The chapter concludes with a discussion of the issues raised by elements in the study within the wider context of education policy and change and suggests themes for further relevant research.

Research into educational technology has a chequered past (see Chapter 2). Often research studies concentrate on the ‘state of the art’ technologies and their potential for enhancing learning. Selwyn (2010), argues that this research should move away from a ‘means-end’ approach about how to employ the presumed potential of technology and instead focus on the “socially contested and ‘socially shaped’ nature of technology” (ibid:66). He suggests that the academic study of the use of technology should concentrate in how digital technologies are *actually* being used ‘in the swamp’ or real educational contexts. This is such a study, about “what happens when a digital technology meets an educational setting” (Selwyn, 2011c:177).

While this study has attempted to draw on theories of learning to help design technological environments where ‘enhanced’ learning might take place, it has also involved the study of the context in which the intervention has been developed. A number of writers including Selwyn (2010; 2011c) have criticised the technological determinism of many research studies, that assume that by merely identifying deficiencies of the participants, the inevitable march of technological progress will occur. There *is* a sense of technological determinism in the first two research questions in this project; the underlying assumptions that a course re-design along blended learning lines will enhance the opportunities for independent learning. There is also an element of using the study to explore the barriers and challenges of introducing a technological innovation. However, this study has attempted to place this intervention in the context of the social, political and economic environment, through discussions of the developments and trends surrounding education change and its relation to technology.

This discussion will argue that for any meaningful e-learning to take place, students' skills, behaviours and attitudes need to become more aligned to the demands of new modes of learning. These attributes have been conflated into the concept of independent or self-regulated learning in this study. The BLAST project aimed to integrate strategies of self-regulation into the design of the learning environment. Through numerous data collection methods, the development of these behaviours and attitudes have shown that for those aspects of the project that were under the control of the research team, the strategies have largely met their objectives.

There is no doubt that having experienced the course re-design, the participating students changed their views about their own learning, as defined by the MSLQ. The sub-scales of the MSLQ chosen for this study reflected the main motivational and value beliefs that related to their course of study. In all of the subsections (with the exception of time and study environment (TSE)), the intervention group's scores significantly improved over the period of the project when compared with the non-intervention group. The MSLQ survey and its questions did not specifically refer to the e-learning features of the course. However, the strategies employed in the design of the sequences seemed to support their progressive structure, see Table 3.7 for the alignment of design strategies and MSLQ sub-scales.

Throughout the re-design, the team focussed on aligning the activities in the learning design with the underlying Conversational Framework and aspects of the Community of Inquiry emphasising the roles of teacher and social presence, as well as existing design principles of good practice. These ensured that students were given opportunities to develop those behaviours and attitudes measures by the MSLQ instrument. However, the means from the student scores hide differences in the perception of the course re-design as shown in the three factors identified by the Q analysis (section 5.1).

In the analysis of the MSLQ instrument (section 5.2), the ‘task value’, ‘control of learning beliefs’ and ‘self efficacy for learning’ subscales, clearly define those attributes required for effective study. Students showed more involvement in their own learning, and appreciation of the resource materials available; they accepted responsibility for their own performance and recognised that it is their own efforts that improve outcomes; they also showed increased awareness and confidence in their performance. These results aligned with the learning designs that emphasised shared teacher and student goals, explained the benefits of the activities provided and the use of a variety of models and opportunities to engage with the expectations of the examination. In terms of the Conversational Framework, this involved the development of the TCC, PCC, and TPMC elements (Figure 2.9).

The ‘meta-cognitive self regulation’, ‘time and study environment’ and ‘effort regulation’ subscales showed students had a greater awareness of the importance of planning and organising their work, study skills and greater attention to their learning strategies. The teaching and learning strategies in the course that supported these developments included a great deal of scaffolding and study support, for example the use of graphical organisers, text messaging, and the use of pre-lesson quizzes. There was also an emphasis on student participation and task variety. All these activities supported the learning cycles of TCC, PCC and TPMC.

Social presence, incorporating the ‘peer learning and ‘help-seeking’ subscale scores showed that the group work and collaborative activities designed into the course had been effective. This was accomplished through increased class and online peer work, including peer and self-assessment. The use of discussion forums and collaborative work in class and online ensured that all the learning cycles in the Conversational Framework had been encountered a number of times, TCC, PCC, MPMC and PMC.

The results of the MSLQ survey showed a general improvement in all areas defined in this study as ‘independent learning’. However, as alluded to earlier, the student evaluations from the Q methodology and interview responses, while largely appreciative of the course re-design showed mixed feedback as far as the use of technology was concerned. As Fullan states: “Technology is not a panacea. Not all technology is good for pedagogy. And great pedagogy will exist without technology” (2013:78). The participating students’ responses were categorised in three factors or groups, given the monikers ‘Pragmatists’, ‘Enthusiasts’ and ‘Conservatives’ in this study on the basis of their willingness to embrace the features of e-learning (section 5.1). In this analysis approximately a third of the students did not seem to want to engage with the BLAST project learning environment and the social and participatory activities it provided.

Much of the variation between the groups seemed to be based on notions of their roles as students and the central role of the teacher. In the discussion in previous sections (2.6 and 2.7), the myth of the digital native and the power of experience and *habitus* for students reveal that digital literacy and new experiences may take a long time to embed and for students to be convinced to embrace new challenges. There is no data in this study to compare the background or other characteristics of the students' group in order to attempt to explain why some students found themselves in the 'Enthusiasts' and some in the 'Conservative' camp. In the consensus statements, the central role of the teacher (#41:+5) was the top scoring statement, and the view that students should take more control of their learning (#1:+1), and generally liked working collaboratively (#43:+3) were also conspicuous. It was statements that focussed on the technology that divided the students.

The 'Conservatives' liked traditional didactic teaching; being told what to do by the teacher; working on their own without the Internet and certainly without any social networking. They saw their role as quite passive and this is likely to reflect their experience of learning in the previous twelve years of schooling as well as the influences from teachers and their parents and family. They felt insecure when confronted with the challenges of the learning platform, especially in regard to aspects of social presence. The 'Enthusiasts' and 'Pragmatists', for whatever reasons were more open to the challenges and demands of the blended learning format. They saw their roles as being more pro-active in the learning process and could see the benefit that the new learning environment offered. Perhaps it is a sign of the project's success that two thirds of the participating students, in the first attempt at a new mode of learning are so supportive and positive about the experience and the use of technology.

6.1 The Intervention, BLAST learning environment

One of main outcomes of this type of research approach is the product of the intervention, in this case the BLAST learning environment, "these interventions, inputs into educational environments that are fine tuned through empirical testing, constitute the main practical contribution of educational design research. This is because they are designed for actual use.” (McKenney and Reeves, 2012:19). The BLAST learning environment created in this study consists of a number of learning objects, resources and activities, structured for use by students within a virtual learning environment.

The design and structure of BLAST was informed by a number of ideas from the research team as well as research and design principles emanating from previous studies. This discussion will return to some of those sources to help provide criteria with which to evaluate the learning environment.

6.1.1 Design of BLAST

The actual design and layout of the learning environment was influenced by a number of helpful literature sources (see section 2.2). In particular, Quality Matters, a quality assurance organisation that offers guidance and extensive literature reviews of current educational research into the use of technologically enhanced learning environments (Quality Matters, 2012) was used by the team as a first source of help for design and layout before pedagogical structures were embedded, although to evaluate fully through the programme, institutions need to be registered.

Table 6.1 summarises an informal assessment of how the BLAST learning environment might have scored using the QM criteria. In a registered official moderation, a course would be expected to score at least 85/100 points, including all standard subsections of 3 points. The BLAST project might have achieved this standard, although the assessment did not consider all aspects in moderation detail. The project team found the QM rubric helpful as scaffolding for the design and layout of the learning environment. It gave a comprehensive checklist as well as an extensive literature review justifying components. A number of studies found that using the QM rubric together with an underlying pedagogical theory was linked to improved outcomes (Shattuck, 2013; Shattuck, 2012; Swan et al., 2012). It has been noted that many of the QM related research studies had used a single-year time frame, not really allowing sufficient time for changes to bed in or staff and students to come to terms with the new demands of course-redesign. This was the case with BLAST project; any changes would need a number of cycles to become embedded into normal modes of delivery.

Quality Matters Summary Criteria	Reflected in BLAST Over the 3 iterations	Score
1. Course overview and Introduction	Clear relationship between the face-to-face elements of the course with the online elements, a graphical representation will be on the project site.	12/15
2. Learning Objectives	Include explicit learning objectives based on the taxonomy circles, (Atkinson, 2013), aligning objectives, activities and assessments.	13/15
3. Assessment and Measurement	A variety of assessments will be included in course, both online (MCQ, short answer questions etc.) and offline. Clear criteria will be available to students as will model answers and opportunities for self and peer assessments.	12/14
4. Instructional materials	Teaching materials will be varied and appropriate, including the class text book, Internet links to appropriate resources, further reading selected to develop the topic as well as video resources.	13/15
5. Learner Interaction and engagement	The design of the course is aimed at being attractive and easy to navigate, with a consistent layout. The activities will be varied, from individual tasks and MCQ, to group discussions and collaborative work. Clear guidelines will be given.	10/11
6. Course Technology	The technology and software required for students is designed to be easily and freely available. All resources and activities will be available through an Internet browser. Display of resources will be available on the browser without recourse to proprietary software.	14/16
7. Learner and Instructor support	Technical support and advice will be available in school and online through a forum to report difficulties.	6/7
8. Accessibility	The face-to-face, online and all course components are accessible to all students. Before the course goes online the students in the project course will all have access to appropriate technology to access the online components at home.	5/7
	Total score of informal assessment	85/100

Table 6.1 Evaluation of BLAST using QM criteria (Quality Matters, 2012)

6.2 Future development of BLAST

Throughout the three iterations of the project, the use of the learning environment has become more sophisticated as teachers and students have learned to use the various applications. Future use of the BLAST learning environment would involve the development of a number of aspects not yet utilised.

As teachers and students become more familiar with operating under a blended learning environment, there is the possibility of reducing teacher contact with classes in order to exploit the new found ‘independence’ of the students and to make more efficient use of the teachers’ time. This would be dependent on the teachers’ time saved in subsequent years from the initial investment in the creation of a stable learning environment. The LDSE design tool does have a function that attempts to calculate the relationship between student numbers and the teacher preparation hours required for each different TLA. This was not used in this study, and the figures would need to be established for this phase of education.

One feature of the BLAST environment was that it was not designed as a context specific learning environment. The design of sequences and the use of the Conversational Framework meant that it would be applicable to most subjects taught at this level. One of the first steps in the diffusion of the principles of the learning environment would be to other subject areas within the school, through the presentation of models of blended learning pedagogy from the BLAST experience.

6.3 Evaluation against Fullan and Donnelly's Index

Fullan (2013), in his slim volume *Stratosphere*, analysing the requirements for the successful transformation of education, identified three forces which, in his view need to come together for a solution to the crisis in (United States) education. These components comprise technology, pedagogy and change knowledge, without all three elements, meaningful change is unlikely. These components, shown in Figure 6.1, form part of the evaluation of this project. The ideas in *Stratosphere* were further developed into an index for the evaluation of technologically enhanced educational programmes.

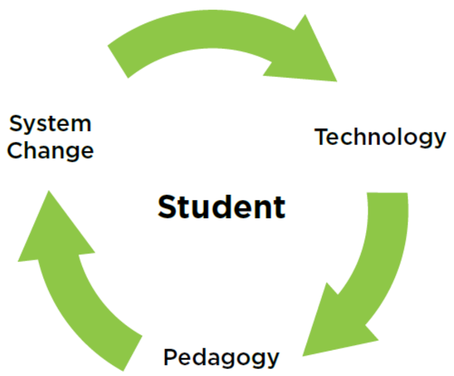


Figure 6.1 The components of Stratosphere (2013:15)

In *Alive in the Swamp*, Fullan and Donnelly (2013), remarked that in digital educational innovations, "the field is currently characterised by either weak or undeveloped pedagogy, or strong technology and pedagogy confined to a small number of schools; that is, the best examples tend to be small-scale exceptions that are not representative of the main body of schools" (ibid:11). As outlined in section 2.3.1, Fullan and Donnelly created an index by which programmes could be evaluated under three main headings; pedagogy, system change and technology, each of these components is then further broken down into three subcomponents, which can be scored on a four-point scale to give colour coded results as shown in Figure 6.2. This evaluation will be termed the 'Index' throughout the section.

Green: Good - likely to succeed and produce transformative outcomes (4)

Amber Green: Mixed – some aspects are solid, a few aspects are lacking full potential (3)

Amber Red: Problematic – requires substantial attention, some portions are gaps and need improvement (2)

Red: Off track – unlikely to succeed (1)

Figure 6.2 Key to colour code of Fullan and Donnelly's index (2013)

The categories and subcategories are evaluated against a number of demanding underlying questions, and although this system is qualitative, numerical scores (1 – 4), are given to firm up the judgements. In this section, the BLAST programme will be evaluated according to the descriptors detailed in the Index (Appendix B).

6.3.1 Pedagogy

The BLAST intervention study concentrated on developing new pedagogical practices within the course re-design for blended learning. During the planning and design of the course, the design team aimed to provide explicit and shared learning outcomes with the students, consistent with elements of teaching presence. The learning outcomes included the scientific content and some of the learning processes expected within the activities. The BLAST project could not meet the 'green' criteria in this sub-category because of a lack of clear quantifiable outcomes that could be tracked and monitored in real time, this element was scored an 'amber-green'. These features were not designed into the BLAST project, which in this version is still a 'prototype'. These features as well as quantifying the impact of the intervention on national indicators with associated benchmarks were beyond the scope of this study.

In addition to assessing the learning outcomes, the pedagogy itself is challenged in the Index. In this sub-category the BLAST programme has been scored 'green'. One of the main emphases of the project was to design the course with the learning and teaching underpinned by current research. It is in the nature of experimental interventions that not all of the designs and activities are successful. In this study, the underpinning of the learning designs and activities were as far as possible informed by current research found in the literature and shared by the researcher with the practitioners in the team. Fullan and Donnelly reject the notion of the role of a teacher as a ‘guide on the side’ as “poor pedagogy” (ibid:11), they cite Hattie’s definition of a ‘teacher as activator’ or change agent where the student teacher relationship is reciprocal, feedback is a high priority and metacognition is in built into the design process. This also reflects the importance of teacher presence in the Community of Inquiry (Fullan and Donnelly, 2013; Garrison, 2011; Hattie, 2009). These aspects were at the heart of the BLAST study. This sub-criterion has according been scored ‘green’.

The final criterion of this section is that of the quality of the assessment platform. The Index expects a sophisticated assessment system to be in place, which is adaptive and produces a great deal of useful data for planning ‘actionable outputs’. While the BLAST intervention included planned formative assessment activities, assessments based on shared criteria and models, little data was produced from the learning environment, partly because of a failure in the inter-operability of the systems used, or in the range of technology available to the programme. For these reasons this area has been scored ‘amber-red’ (Figure 6.3).

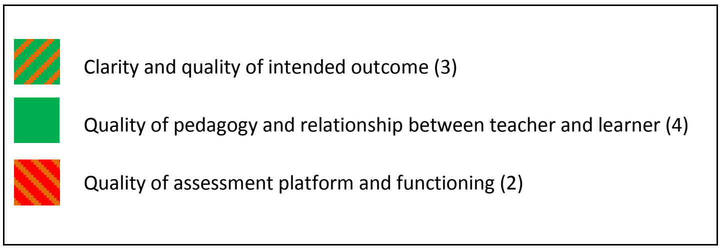


Figure 6.3 BLAST score for Pedagogy criteria

6.3.2 System change

This category aims to assess how ‘transformational’ the innovation is in terms of becoming a sustainable effective change in the system. Fullan and Donnelly reflect that “strategy and product design gets you 10 percent of the way and the remaining 90 per cent is implementation” (2013:17). The BLAST study does not score well in this section. The study was initiated by the researcher and two subject teachers in a secondary school. It was not part of any school innovation plan and the project received little acknowledgement from senior staff. In an ironic way, the lack of interest by the institution allowed the researcher unrestricted access to the classrooms and teachers in the project. The school environment was not a culture of innovation and risk taking;

most of the senior staff's energy was expended on getting from one inspection to the next, with staff looking over their shoulders and keeping dubious records for evidence of 'progress' and 'achievement'. As a result, the only real implementation support came from the IT department technician who had installed the open source learning platform on which BLAST was built as a response to the poor local authority VLE. There was little training for staff; some single sessions by the technician on the basic operation of the platform were offered, but any development of new pedagogy for using the platform was not part of the training plan of the school. As far as the BLAST project was concerned, the researcher undertook the training role in a just-in-time approach and acted as a mentor for the teachers. In terms of hardware and software, there was no investment. The platform was hosted on a spare server and all of the software was either open source or freeware (see Appendix J), nor was there any financial support for purchasing 'content' to support the syllabus beyond the physical textbooks that each student was allocated. In terms of value for money, the next sub-category, it could be said that this innovation cost very little and that for the cohort of students on the course, the benefits were positive. This is a long way from one of the 'green' criteria that states "the innovation should .. be able to produce twice the learning outcome for half the cost of the previous methods" (ibid: 19). One of the few ways that money can be saved in schools is by reducing the input of teachers by cutting contact time, a feature of most blended learning plans. This had been discussed by the team, but it was not part of the senior management planning agenda.

The last sub-category is that of whole system change potential. Again, from this small case study, potential can only be inferred. To score 'green', an innovation will "scale virally to schools within the system"; ...."clusters of schools learn from each other"; ... "little central management is necessary to ensure innovation is embedded and maintained" (ibid: 33). None of these is likely in the culture surrounding the case study school.

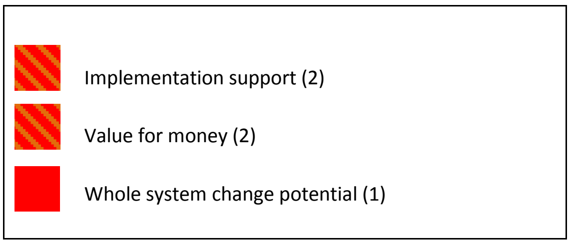


Figure 6.4 BLAST score for System Change criteria

Cuts in budgets have removed local authority advisors and network meetings between schools are a thing of the past, with schools becoming more isolated from each other. This sub-section would have to score ‘red’ (Figure 6.4).

6.3.3 Technology

The first sub-category of this section refers to the quality of the user experience and model design. The BLAST platform was designed to be presented in Moodle, an open source virtual learning environment. While not as ‘flashy’ as some commercial offerings, the platform is continuously being updated and improved by the online community. The technology supported all the required activities, from resource reading to resource uploading, social discussion opportunities and collaborative creative work. During the intervention there were frequent opportunities for students and teachers to feedback aspects of the design and navigation interface as well as the format of some of the assessments and forums. While the Index suggests that the best innovations might include ‘gamification’ elements and a fully integrated data collection system, these were not required. This element is scored an ‘amber-green’, as there is still potential to develop these aspects.

Ease of adaptation is the second part of this section. This involves how well the technology is connected and whether real-time adaptation of the programme to the learner is possible. In the study, not all of the potential of the software was utilised, many more sophisticated modules and options could have been chosen and would be developed in future developments. During the study there were periods of time when the platform was ‘down’ and unavailable to students. This was, in most cases, the result of the ‘in house’ hosting and precarious nature of the hardware. In addition, while the Moodle platform has begun to offer ‘Apps’ that function on other devices than personal computers, this study did not explore the possibility of students’ accessing BLAST from tablet computers or smartphones. Again this could be a further area of development. This sub-section also scores ‘amber-green’.

The last area in the technology category is ‘comprehensiveness and integration’. This means the integration of the innovation into all aspects of the institution and the school itself. There was little integration with the rest of the school or other subjects, although some of the students reported some evidence or other teachers beginning to use the platform. The course was designed to be the ‘one-stop-shop’ for students, was accessible ‘24/7’ and where possible assessment was integrated with the content. The

BLAST platform used resources created within the school as well as some commercial products that were integrated into the learning environment, but these were mainly used for extension materials. On a whole school basis this area would score red as the technology has been included ad hoc into courses and teachers are using it their own way with no direction from the school leadership (Figure 6.5).

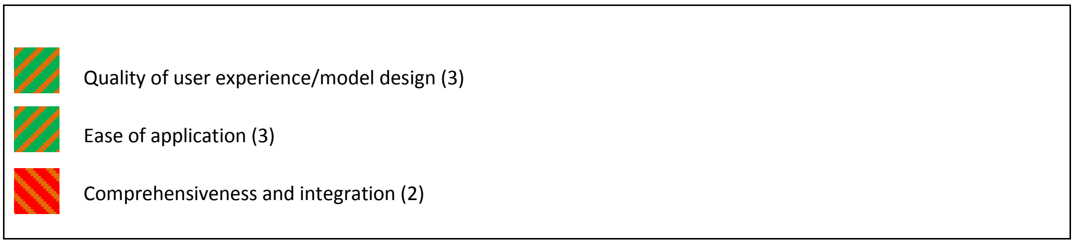


Figure 6.5 BLAST score for Technology criteria

6.3.4 *Summary*

Having added up all the scores, the final score for BLAST is 22/36 or 'amber-red', meaning the innovation is 'problematic' as far as a transformational programme is concerned, see Figure 6.6.

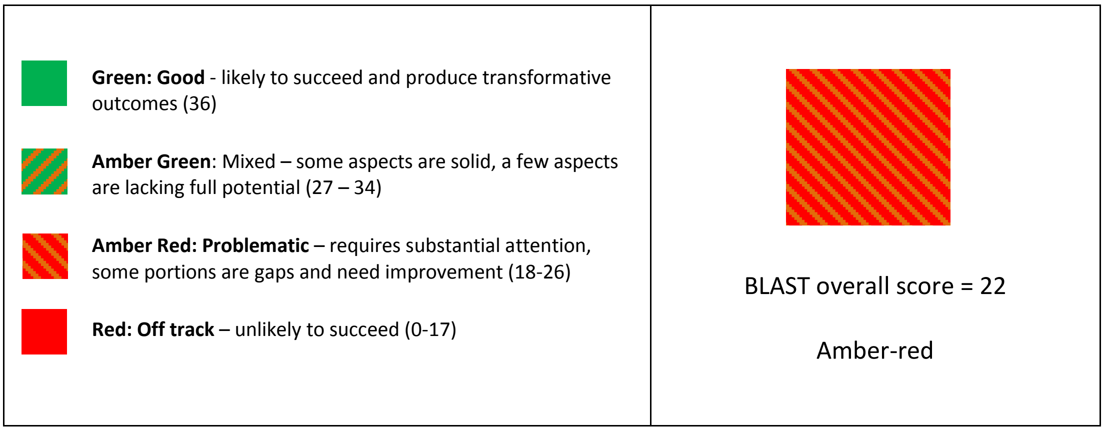


Figure 6.6 BLAST overall score from the Index.

Having applied the Index to a number of innovations, Fallon and Donnelly looked for common strengths and weaknesses in the field. Their conclusions reported that the categories 'pedagogy' and 'implementation and system change' were the most challenging issues across innovations, "..they are the weakest part of the triangle of technology, pedagogy and system support" (Fullan and Donnelly, 2013: 23). They observed that considerable work still needs to be done to develop the meaning of 'the new pedagogy' in terms of:

- Clarifying the learning goals, especially related to 'deep learning'

- Being precise about the pedagogy that will deepen learning in relation to these goals
- Seeing how technology may accelerate the learning
- Using assessment of the learning to inform improvements and to provide evidence of efficacy

  (ibid:23)

The BLAST learning environment shared a number of the characteristics of other innovations studied by Fullan and Donnelly. As described above, the 'System Change' section was found to be very weak. This aligns with the conclusion of Li and Choi (2013) discussed in section 2.7 on the importance of *social capital* for the successful implementation and sustainability of an innovation. Although the *social capital* instrument was not formally part of the study, observations, interviews and conversations with members of the school created a view of the school that would have scored very low on '*social capital*' as defined in the paper, especially in the scales that related to teachers' perceived *social capital* in the school. An extract from the scales is shown in Table 6.2.

Scale	Statement
socap1	I can communicate freely with the principal about school matters My opinions can be conveyed to the school management effectively The school goals are reflected in the school plans I have a sense of belonging to my school The principal trusts me with school matters Teachers in our school manifest trust and team spirit Teachers in our school are willing to experiment with new ideas in classroom practice The principal encourages me to experiment with new IT practices
socap2	I participate in sharing lessons for exchanging experiences of using IT to enhance teaching and learning with teachers from other schools My school organizes sharing sessions for exchanging experiences of using IT in education with educators from tertiary institutions I participate in sharing sessions for exchanging experiences of using IT in education with educators from tertiary institutions My school organizes sharing sessions for exchanging experiences of using IT in education with teachers from other schools I collaborate with colleagues to develop curriculum resources for using IT in teaching and learning Colleagues in my school share experiences of using IT in education

Table 6.2 A selection of statements from 'social capital' survey instrument (Li and Choi, 2013:6)

Teachers, through their comments and responses to questions in some of the interviews refer directly to some of the items in the scales shown in Table 6.2.

Some comments made by staff members are relevant to socap1:

> *"The head doesn't seem interested in IT here – at least he leaves me alone to get on with this project"*

> *"I think the leadership team are just desperate to satisfy the inspectors – we don't seem to discuss anything else"*
>
> *"The lesson observation regime and preparation for inspection made everyone nervous"*
>
> *"Even for a small school, there is not much general sharing of school plans and goals"*

Comments relevant to socap2:

> *"There is no planned schedule of platform training, sometimes Kevin gets a short slot"*
>
> *"Since the loss of the science consultant, we don't have any meetings with other schools"*
>
> *"There are no links here with local universities"*

In the absence of a wider school policy and leadership on the use of technology, teachers in the project school have been left to their own devices. For the individual teacher, the motivation involves what can benefit their everyday practice with what is available. All existing structures in the school support the status quo, all innovation has to be sought out, researched and developed by individuals or departments as the attention of the leadership is elsewhere. While the lack of appropriate training is a factor, most relevant here is consistent with the risk-averse culture of the current staff, most of whom do not perceive the value of using technology in their teaching (see section 2.7). On a deeper issue, there is the 'natural conservatism' of a number of teachers (including the leadership), who teach how they have been taught, supporting the powerful idea of 'folk-pedagogy' among teachers, parents and students. Indeed the findings of the Q methodology student evaluation largely support this and deny the existence of a class of 'digital natives' just waiting to be freed from the constraints of traditional teachers. Looking back to Belland's (2009) analysis (section 2.7), it is not surprising that the first experience of a significant change in the teaching approach should unsettle some of the students. These new experiences will be resisted because they challenge the views of the expected process of education already present in their *habitus*. While Belland suggests that extended training can challenge this in the teachers, students too may be challenged by being exposed to new forms of teaching (including the use of technology), from earlier in their studies.

The comments emphasise the focus of the school on removing the threat of poor inspection judgements, and how this can colour attitudes to other developments. The atmosphere within school, although friendly was of vulnerability and isolation from other schools. This isolation has been emphasised by the loss of the local authority secondary consultants who, in the past had organised regular meetings between schools. In such an environment, the BLAST project though carrying on beyond the end of the research study is inevitably vulnerable, and it is quite possible that with staff changes, the BLAST learning environment in this context could wither and die, albeit probable that staff would take their new knowledge and experience with them.

In concluding the discussion of the findings into the initial use of the Index, Fullan and Donnelly contrast the two major modes of transmission of innovation; school-based innovations and technology-enabled innovations (see section 2.3.2), the findings will now be considered in the light of these.

School-based innovations include the total re-think of the educational environment. The whole structure of the school-day, the curriculum, the role of teachers and technology has been re-designed from scratch. Examples of these are to be found in some charter school chains in the USA, including Rocketship and Carpe Diem schools where schools can control every aspect of the institution, including employment contracts, building design and finance. Fullan and Donnelly "have yet to come across a strong example of a technology related school-based innovation that has scaled beyond an initial pilot with much success" (ibid: 25). These schools have certainly proved to be transformative but have not been without their critics.

Technology-enabled innovations, which in this taxonomy would include the BLAST innovation, include programmes usually based on Internet courses. They commonly come packaged in learning platforms with adaptive learning paths, resources and assessment management software. While these can be 'scalable', in that there is no theoretical limit to the numbers of students who could enrol of these programmes, there is no mechanism here for them to become embedded in the school system itself. Teachers are able to choose and apply 'solutions' that suit them, but tend to be added to existing types of institution.

6.4 Using the theoretical frameworks for design and evaluation

The introduction of new modes of teaching and learning in the re-design of the course required a foundational, underlying framework to support the various activities and sequences that would make up the new blended learning course. The frameworks chosen were Nicol and Macfarlane-Dick's (2006) interpretation of independent learning through formative assessment, Laurillard's Conversational Framework (CF) and Garrison's Community of Inquiry (CoI). Laurillard's book *Teaching as Design Science* (2012), firmly places this in the tradition of learning design, the 'creative and deliberate' planning and implementation of a teaching/learning product. This framework (discussed in more detail in section 2.9), describes the teaching and learning process through a number of learning cycles. Some other studies have found the Framework 'difficult', 'complicated' (Heinze et al., 2007), "fails to address the issues of social interaction and assessment" (Heinze, 2008:267). Most of these issues seem to arise from attempting to follow the framework in too literal a way. Criticisms of the CF for relying on teachers and students to participate in discussions and undertake homework assignments would seem to be denying the central ideas of teacher and social presence in CoI in designing appropriate activities with suitable induction, (although this project shared with other studies the lack of student reflection (Heinze et al., 2007), this cannot be attributed to the CF, more to the unfamiliarity of the process). The project team found that having the CF, CoI and the LDSE to contextualise the activities helped to link the huge range of possible functions in the VLE with the learning cycles (*see Figure 2.11 Mapping Moodle activities to Conversational Framework adapted from Laurillard and Ljubojevic (2009:19)*). The team did not follow the 'twelve steps' of the CF process, but used the guidance and terminology of the framework to help design teaching sequences that employed suitable online and face to face activities. The CF and CoI presences also helped to analyse which parts of the learning cycles were being addressed. Without this central framework, there was a danger that the application of e-learning activities might have become a random selection of technology applications. The design of the sequences was also aided by the linked LDSE support tool that categorised the teaching and learning activities (TLAs) in a way that was easy to apply to the CF.

It is possible that the course re-design could have been accomplished without the use of technology, yet still following the Conversational Framework. However, the BLAST project has shown that the appropriate use of technology does enhance the teaching and learning experience, throughout the learning cycles (Figure 2.9), for examples of this see Table 6.3.

Conversational Framework Cycle	Cycles enhanced by technology
Teacher Communication Cycle	Resources, teachers' presentations etc. available online – giving students greater access to the teachers' concepts, extension links as well as feedback from MCQ etc.
Peer Communication Cycle	Peers can access each others' concepts through discussion forums, and can elicit feedback from posts and responses in a more reflective fashion than in-class discussions.
Teacher Practice Modelling Cycle	Students receive intrinsic feedback from models and marking schemes put online by the teacher and extrinsic feedback from the teacher by online marking and feedback from tasks on the virtual learning environment.
Peer Modelling Cycle	Students are motivated to contribute to collaborative online products, e.g. wikis, the students are able to modulate their practice by discussion about the final shared output.

Table 6.3 Learning cycles enhanced by the use of technology

While the CF was followed quite explicitly throughout the project, the underlying concepts of 'presences' originating from the CoI were ever present, informing the main themes of learning design (teacher presence), enabling and encouraging students to communicate and work collaboratively (social presence), and in the development of thoughtful sequences (cognitive presence).

6.4.1 Learning design support environments

During the course of the BLAST project, it became clear that planning a scheme of work involving both class-based and online elements into an integrated blended learning environment required more explicit and detailed planning than traditional lesson plans.

The learning design community has produced a huge variety of tools to assist teachers and designers in planning teaching episodes, perhaps a measure of the immaturity of the emerging field (Persico and Pozzi, 2015).

Two design support tools were used in this study, both aimed at planning and representing learning designs for the purpose of sharing and analysing the designs. The LDSE, closely linked to the Conversational Framework was used to create and edit learning designs based on the taxonomy of activities defined. The team found this classification helpful and used the TLAs to build teaching/learning sequences. The actual process of using the LDSE tool was left to the researcher after team discussions. Representations of the sequences on paper, and in the form required by the school's policy on lesson planning, were provided by the teachers. However, the analysis of the resulting distribution of learning types through the pie chart supported discussions of emphasis and resulted in editing the sequences if the team felt the distribution was inappropriate for the context. The team did not take long to learn and use the language and terminology of the TLAs to inform their planning. The version of the LDSE tool used was rather cumbersome. It was then in the prototype stage and another version is now available in an online configuration, which may be more ‘user-friendly’. The team felt that the tool achieved its main aims; to help structure the activities of teaching into sharable patterns; to support the process of design as well as contributing a ‘product’; and to create a visual representation useful for sharing and analysis.

The other tool used, CompendiumLD, was also designed to assist in the creation of learning sequences and their analysis. In the case of the BLAST project, the tool was only used for the representation of the learning sequences as ‘swimlines’ or maps. The value of the tool was in its simple GUI (graphical user interface), which made it easy to use and an appropriate range of editable icons and ‘stencils’. The resulting design could be saved, edited and exported for sharing or publication. In the BLAST project, these representations were used extensively to communicate the ‘big-picture’ of teaching and learning sequences to the students (for example see Figure 4.55). They showed the different learning environments and associated activities clearly and were regarded as a valuable aid in involving the students in the design of new modes of teaching and learning. They also provided valuable ‘photo-elicitation’ prompts for stimulating group interview discussions.

6.5 A reflection on the research approach (EDR)

The aim of this section is to reflect on the use of educational design research in this project. The third Research question, ‘*How effective is the chosen collaborative educational design-research approach in investigating an authentic educational challenge in a living educational context?’* is considered in this section. One of the fundamental assumptions of this approach is that “cognition is not a thing located within the individual thinker but is a process that is distributed across the knower, the environment in which it occurs, and the activity in which the learner participates” (Barab and Squire, 2004:1), in other words, the *context matters*. The approach involves moving beyond observing the context and the behaviour of the actors, but being part of a team that systematically engineers educational interventions that aim to “improve and generate evidence-based claims about learning” (ibid:2).

The research approach is not yet mature and is subject to a number of challenges to its validity and reliability (see section 3.6.5). During this reflection, some of these challenges will be addressed.

The conduct of the research project follows the general processes advocated by the principle commentators on design research (McKenney and Reeves, 2012; van den Akker et al., 2006; Bannan-Ritland, 2003; Brown, 1992). The research approach has been adapted to fit in with practical issues in the project school context. The structure of the subject specification, the school curriculum and timetable and staffing did not allow for the repeat iterations of short semester studies common in papers from higher education in the USA, that make up a large number of EDR projects.

The BLAST research project was conducted over a period of two years, following a cohort of students studying a pre-university biology course. While the course units themselves were not repeated during the project, the notion of 'iterations' still applied to the progression and refinement of the activities within the course. These included aspects of learning design, the understanding and use of the underlying theories, the representation of learning design, the design and layout of the learning environment, social presence and assessment and feedback.

The initial phase of this research approach, where the problem is identified and explored included both teachers and the researcher, an essential characteristic of the EDR approach. Initial worries over what constituted 'independent learning' as a rather nebulous and ill-defined concept were satisfied by literature research and comfort in the fact that the issue was a common concern across education stages and countries. One of the specific concerns of the team was the lack of time spent on tasks away from the classrooms. This led directly to the idea to produce a technologically enhanced learning environment (TELE) to support the teaching and learning of the course. This in itself generated further research into this aspect of the intervention and the beginnings of draft design principles.

One of the important developments in the second phase, where initial prototypes and design ideas began to emerge, was the selection of underlying theories to inform the structure of the intervention and the consideration of existing design principles from previous research (Herrington and Reeves, 2011). From the literature review on the development of the design of learning environment, Laurillard's Conversational Framework (2002) and Garrison's Community of Inquiry (2011), seemed to the team to complement each other and the intentions to create a blended learning re-design of the biology course. Both theories or frameworks emphasised the essential role of the teacher as the learning designer and the interaction of the teachers and students as partners in the ‘conversation’. This commitment to the ‘learning design’ approach to curriculum development led to the inclusion of learning design tools to support and represent the planned activities.

The representation of Laurillard’s Conversational Framework through the design tool the Learning Design Support Environment (LDSE) became a key element in the process of creating the BLAST learning environment. Although somewhat cumbersome in the version used in the project, the classification of teaching and learning styles, the ability to sequence and edit activities and analyse the resulting patterns meant that there were visual and informative prompts to selecting TLAs (teaching and learning activities), which were clearly related to the Conversational Framework.

The selection of draft design principles to guide the creation of the initial BLAST designs came from extensive literature searches. The most relevant in terms of theme (independent learning) and educational age group came from a variety of studies into the difficulties of transition from school to higher education (Mostert and Snowball, 2012; Barnard-Brak et al., 2010; Mitchell and Forer, 2010; Moore and Gilmartin, 2010; Nicol, 2009; Nicol and Milligan, 2006a) among others. The team felt that many of the ideas could be transferred to the transition from the heavily teacher directed Key Stage 4 curriculum to the more demanding sixth form structures. The team relied heavily on Nicol’s interpretation of independent learning or SRL (self-regulated learning), that has elements of formative assessment at the heart of the process. This was consistent with much of the literature on SRL from Zimmerman (2001), Black and Wiliam (2009) and Pintrich (2000). Nicol’s principles formed the basis of the design principles for the project. These were refined and adapted to the project school context.

The resulting intervention has been written up in the form of a narrative, a ‘thick description’ of the ideas, discussions and decisions surrounding the design of the intervention (largely left as a black-box in many programme evaluation studies). One of the challenges in producing such narratives is firstly in the selection of elements, secondly, the representation of the complexities of the processes and lastly giving relevance to other situations. In this study the narrative has been informed by ideas from Mor (2011), which together with the resulting design principles (this section) provide a more complete picture than traditional research approaches.

The elaboration and development of design principles and the strategies for their success can be described as theory building (Meijer et al., 2009; van den Akker et al., 2006), since their formulation is theory driven.

The multi- and mixed-methods research techniques employed during the project came from both qualitative and quantitative traditions. The choice of the variety of methods sought to supply the required validity and reliability (or trustworthiness and credibility (Barab and Squire, 2004)) to the study. The project's balance of quantitative measures of the MSLQ survey and the Q methodology analysis, gives some formal representation of the impact of the intervention and the attitudes of the students. Other methods, such as the interviews with staff and students, as well as observations of classes, although not always formally transcribed and evaluated, form part of the triangulation of the context of the intervention that is intended to add to its credibility as a 'true' reflection of the events. It is also incumbent on the researcher to acknowledge that any claims to knowledge are based on researcher influenced interventions and as such may be limited where this influence is lacking (ibid).

The involvement of the researcher in EDR is an essential element of the approach. It is also a challenge. The role of the researcher in this project was as a co-designer of the learning environment, a mentor to the staff concerning new literature, the research approach and design issues, as well as training the team in the use of the learning environment itself. Inevitably the researcher brought a set of values and attitudes to the project. However, the other participants also brought theirs and the resultant project is a result of negotiation and research into the evidence before the team.

The potential of role conflict is a key challenge to this kind of research and is highlighted in all of the major commentaries e.g. (Plomp, 2009; Herrington et al., 2007; McKenney et al., 2006). The main issues have been discussed in section 3.6.4. One of the main challenges has been described as 'access to the team' and 'establishing authority'. These were mitigated by the previous relationship of the researcher with one of the participant teachers, and the fact that the researcher was not a 'cultural stranger' in the milieu of this educational environment. He understood the relationships, tensions and structures present in the culture of a school of this nature and did not find difficulties in establishing respect for his contributions and ideas. The relationship with the students took a little longer to establish as they did initially resent the invasion of a stranger into the classes and were defensive and protective of their teachers in interviews. There was little conflict in the alignment of the research project with the priorities of the teaching team. The research team had negotiated that the teaching of the students and their preparation for their examinations would always be a priority and if parts of the learning designs became unsustainable (for example with the attempt to develop reflective journals with students), they would be discontinued. Summaries of the BLAST project's progress was shared between the team and although there were discussions over priorities, timings and designs, there was no conflict or disagreements of a serious nature.

For any research approach that deviates from the traditional 'scientific-based' paradigm, consideration of rigour is at the forefront of its justification (see section 3.6.5), indeed the tenets of rigour, relevance and collaboration are seen as the foundation for design research work (McKenney et al., 2006). In this study, the notions of relevance and collaboration (the purpose and alignment of the research with the aims of the participating teachers) have been made clear.

In terms of validity, a number of authors have suggested generic criteria for the evaluation of high quality interventions, involving the formulation of a number of different validities, e.g. content validity, consistency, practicality and effectiveness (Plomp, 2009), or Reeves (2011) summarised in Table 3.4. The table has been updated here, see Table 6.4:

Validity	Developing Pedagogical Patterns/Sequences (this study)	Evaluation of these in the BLAST project
Face	Does the overall design of the learning environment encourage students to engage with the curriculum and activities?	On the whole students engaged and participated in the whole range of activities
Content	Does the sequence align with the examination specification and depth of study?	This was a priority and alignment was always at the heart of the designs
Learning	To what extent does the sequence provide a range of activities that support the learning and assessment objectives?	Both learning objectives and activity objectives were aligned in the designs with a range of assessment types
Curriculum	Do the sequences align with other curriculum components, e.g. high stakes examinations, school requirements etc?	See content above
Predictive	Can the structure/design of the sequences transfer to other courses in the institution or to other institutions?	The designs have been made available to other courses in the institution, but are still at a prototype stage.

Table 6.4 Evaluation of the validities in the project

Further aspects of 'trustworthiness' relate to the types of data collection involved in the study. Triangulation is important in enhancing the reliability and internal validity of the study, the premise being that weaknesses in any single data source can be counterbalance by the strength of another (McKenney et al., 2006). This study employed multiple and mixed methods of data collection, both qualitative and quantitative. There was consistency in the findings and analysis, for example from the Q methodology evaluation of students' views about e-learning and the teachers' perceptions of the same groups of students; the results of the MSLQ survey, and the evaluations of the students themselves and their teachers about the development of independent learning behaviours over the course of the study.

One of the criticisms of this type of research is that most of the studies that appear in the research literature (journal articles or theses), never seemed to complete the design processes modelled by the eminent writers, only showing evidence of potential (see section 3.4.1). This project has been no different. Challenges of time, resources and the deadlines of thesis submission are common factors in design-based research (Herrington et al., 2007), this study has not been able to move onto the latter stages of the models of the process: maturing intervention and spread (McKenney and Reeves, 2012); evaluation: broader impact (Bannon, 2009).

Previous studies (Ormel et al., 2012)(see section 3.4.1), were found to have been limited in their sources of knowledge to inform the design of interventions. This study aimed to use all three of the identified sources; literature, empirical data and practical data from the experiences of the participants (see Table 3.3). All of these sources have been included in the summary of design principles in the next section.

There is no doubt that this research approach has yielded knowledge and outcomes not available through some of the alternative methodologies. Much in-school research carried out by participants for higher degrees uses action research, which although dealing with real-world issues and aiming at improving practice, is not usually collaborative and does not involve the generation of design principles (Plomp, 2009). It is these last factors that make the approach so appropriate for school-based research. It would not have been possible or appropriate to contrive control classes being exposed to different models of teaching; or to find causal factors in accounting for achievement difference. The approach is well supported with emerging models of practice and guidelines on research processes.

The BLAST project has yielded the three outcomes described in the literature referred to above, the intervention (described previously), the generic design principles and the professional development of all of the participants; these will be discussed in the next sections.

6.6 Design principles

Design principles are heuristic in nature (employing a practical methodology not guaranteed to be optimal or perfect, but sufficient for the immediate purpose). They are generic guidelines for teachers or learning designers using these design principles that can be useful in further work in the same area, having considered the contextual limitations of any suggested course of action. “The heuristic principles are meant to support designers in their tasks, but cannot guarantee success – they are intended to assist (in other projects) in selecting and applying the most appropriate (substantive and procedural) knowledge for specific design and development tasks” (Plomp, 2009:21). Design principles in this study, comprise strategic components that are expected to give rise to pedagogic effects, based on theoretical research, empirical experiences and practical considerations (Prins and Pilot, 2009). The design principles for this study have been grouped into the following areas and will be expanded below; learning design and layout; assessment and feedback; access to and creation of resources; developing social presence; coping with technological issues and student induction, training and on-going support. The link between design science and design principles is made clear by Laurillard:

> “A design science uses and contributes to theoretical science, but it builds design principles rather than theories, and the heuristics of practice rather than explanations .. it uses what has gone before as a platform or inspiration for what it creates. Teaching is more like a design science because it uses what is known about teaching to attain the goal of student learning, and uses the implementation of its designs to keep improving them”. (Laurillard, 2012:1)

The construction of design principles is a mixture of the consideration of the learning theories that underlie the intervention, as well as existing principles from the literature that have been applied and perhaps revised, together with suggestions from practitioners as a result of experience. The structure and phrasing of the design principles has been informed by suggestions from van den Akker (1999). He suggests that a stem is used e.g. (*condition x may best be facilitated by learning environments that*:) that will keep principles specific and lead on to verbs that are related to action or activity in the learning situation (*e.g. allow, provide opportunities for, promote, enable, support etc.*).

6.6.1 Learning design and layout

Having established that much of this study is concerned with following the ideas of teaching as a design science, the project has concentrated on the design of activities and sequences of activities that enable students to fulfil their potential. Despite a central theme of the study being about independent learning, the whole enterprise depends on effective teaching. Learning design is the deliberate creation of teaching schemes of work and activities, in this case informed by Laurillard's Conversational Framework. In addition, many of the terms and concepts derive from the Community of Inquiry. In the development of the design principles in this section, the notion of teaching presence is essential in the learning design process. Both the Conversational Framework and Community of Inquiry emphasise this vital component of designing learning to develop independent learning.

Student engagement, participation and attitudes to independent learning will be encouraged and facilitated by the design of a learning environment that:

Strategy components for learning design and layout
• Establishes clear learning objectives and goals • Establishes clear performance models • Communicates clear sequences of learning activities • Is informed by a consistent theory of teaching and learning • Provides clear design and navigation throughout the online website

Expected to result in

Pedagogic effects
• Students understanding the purpose of learning activities • Students getting to know what good performance looks like • A shared understanding of the 'big picture' of the structure and activities within a topic, through graphical organisers • Students' metacognitive understanding becoming more sophisticated • Increased student willingness to access the online environment and participate in activities

Based on

Theory from literature: Learning design: Laurillard (2012), Conole (2013), Garrison (2011), Hattie (2009; 2014), Nicol (2006; 2009) TELE design: Quality Matters (2012), Walmsley (2011) Empirical evidence: Student/staff evaluations showed using underlying theories (CF and CoI) helped contextualise the application of technology activities. Practical experience/considerations: It was found that providing students with maps of the oncoming sequence of activities helped them plan for in class and online activities.

Table 6.5 Design Principles for learning design and layout

It is a shame that a number of commentators publish unhelpful articles describing such aims as 'quack theories', 'myths and 'chimera' (Weston, 2014). The principles behind the quest for designing activities to encourage independent learning have come from a variety of sources. For example Goatman and Medway (2011), describe how the design of active learning in the business studies context is time consuming and difficult, but a necessary counter to the habits of some, to whom Weston may have been referring, who have used poorly planned tasks to send students away to work on their own, commonly known across staffrooms as Fo-Fo projects (f*** off and find out). Like many others, Goatman and Medway base their ideas on the principles of Chickering and Gamson (1987).

As part of the design of the programme of study, the BLAST learning environment has also been created to hold and display the resources and activities. If students are to be engaged with the learning process and access the blended learning opportunities, then the learning environment must be accessible and easy to navigate in order to retrieve and contribute content and participate in online activities.

The design principles are summarised in Table 6.5.

6.6.2 Assessment and feedback

In the quest to develop students as independent learners, much of the supporting literature agrees on the central place of assessment and feedback. In this study, the work of Nicol and Macfarlane-Dick (2006) and their development of principles of good feedback in order to facilitate self-regulation has been fundamental in the design of assessment and feedback opportunities.

Although designed for higher education, Nicol is well known for his work concerning the transformation of first year students' experiences (2009a; 2009). In particular, the development of thoughtful applications of the use of multiple choice quizzes; the more complex confidence-based marking; issues of cognitive load that have been addressed through the use of pre-lecture quizzes (Seery and Donnelly, 2011), have shown how the use of simple technology in the VLE can engage and test the students. It is the central role of teacher presence and the learning designs that can take a simple multiple choice quiz and change it from a potential trivial activity to one that involves sound feedback practice and deeper knowledge of concepts. The design principles are summarised in Table 6.6.

Student engagement, participation and attitudes to independent learning will be encouraged and facilitated by assessment and feedback procedures that:

Strategy components for assessment and feedback
• Provide numerous opportunities for formative assessment, including MCQ • Provide opportunities for students to create their own MCQ in groups • Provide feedback to students that is timely and formative • Give students the opportunity for assessing model assignments using authentic rubrics • Give students the opportunity to assess each others' work through self – and peer-assessment activities • Experiment with different types of computer marked assessment e.g. CBM

Expected to result in

Pedagogic effects
• Improved student achievement • Students deeper understanding of core concepts • Students being motivated to act on feedback comments • Students gaining a clear understanding of the examiners' expectations of good quality work • Students understanding of examination rubrics becomes deeper with their application to peers' work • Students spending more time reflecting on the questions and answers

Based on

Theoretical notions: Nicol, D and Macfarlane-Dick (2006), Kirkwood (2013), Black and Wiliam (2007; 2009), Seery and Donnelly (2011), Hattie (2009) etc. Empirical experiences: Student/teacher evaluations Practical experiences: Students responded well to creating their own MCQ, CBM questions increased reflective time spent on questions, problems with interoperability with SCORM and browsers.

Table 6.6 Design Principles for assessment and feedback

6.6.3 Access to, and creation of, resources

It is almost a cliché in discussing e-learning that one of the main drivers has been the shift from Web 1.0 to Web 2.0. This shift is illustrated by the evolution from passive information provision to active user engagement and information creation. However, as this study has shown, there is still a need for the Web 1.0 repository of information and as a result, the need to provide access to that information in appropriate and simple ways. In the case of this study, it has meant agreeing on consistent file formats for display on the web and in the use of presentation software. Students have been encouraged to contribute their own work to the BLAST learning environment, for example posting in discussion forums, attaching images to forums, glossaries and wikis, as well as uploading posters, presentations and essays for peer review. In order to enable students easily to create and upload resources, it is recommended that mundane issues of file formats, image sizes etc. are agreed between staff and students in order to avoid frustrations and disengagement. The design principles are summarised in Table 6.7.

Student engagement, participation and attitudes to independent learning will be encouraged and facilitated by learning environments that:

Strategy components for access to and creation of resources

- Provide resources in formats that are freely and easily available
- Do not require numerous software installations to read resources
- Allow the uploading of lesson resources in a timely and clearly identified fashion
- Enable students to create and upload their own resources to the learning environment
- Provide links to Internet sites for basic and further study

Expected to result in

Pedagogic effects

- Students being able to access resources easily without recourse to costly software
- Students accessing resources when they become available
- Motivation and engagement in publishing their own work for scrutiny
- Students exploring topics in greater detail

Based on

Theoretical notions: Modelling work: Laurillard (2012), Nicol (2009)
Empirical/practical experiences: Students responded well to easily navigable website. Students had problems before access software was standardised. Students used Internet links for further study.

Table 6.7 Design Principles for access to and creation of resources

6.6.4 Developing Social Presence

According to Garrison (2011:23), "Social presence is the ability of participants to identify with a group, communicate purposefully in a trusting environment". This involves both co-operative and collaborative work in class, and asynchronous communication online and is one of the central aspects of the Community of Inquiry. Laurillard's Conversational Framework emphasises the teacher communication cycle (TCC) and the peer communication cycle (PCC) as vital elements in the learning cycles. Whereas teachers are largely familiar with organising students in a class environment, designing and maintaining discussion boards, collaborative opportunities using wikis etc. is more challenging. This is also the case for students who in this study as elsewhere do not always see the benefit of these activities, especially where they can meet in the traditional classroom.

These opportunities for discussion and collaboration, as well as allowing greater time for reflection, also help to integrate home and school activities into the blended mix, where before students may have seen homework as an optional and not very important extra. As with many of the ideas set out here, effective use of these techniques takes time and students need to be progressively exposed to the activities through induction, scaffolding and modelling (Salmon, 2011). The design principles are summarised in Table 6.8.

Student engagement, participation and attitudes to independent learning will be encouraged and facilitated by the provision of communication applications that:

Strategy components for developing social presence
• Encourage students to develop their own avatars to personalise their online presence • Provide students with training and expectations of behaviour in online communications • Provide opportunities for students to communicate online via teacher moderated forums • Enable teachers to post model contributions to establish quality of posts • Enable teachers to consider the use of grades in forum contribution using clear rubrics of performance criteria • Provide opportunities for students to collaborate in creating essays, presentations etc. E.g. using wikis

Expected to result in

Pedagogic effects
• Students becoming motivated to personal their online identities • Consistent and sympathetic online 'etiquette' • Reflective discussion forum posts • Higher quality posts and responses in discussion forums • More frequent and higher quality posts • Students discussing, comparing and modelling work for each other and negotiating the final output

Based on

Theoretical notions: Garrison (2011), Laurillard (2012), Salmon (2011) Empirical/practical experiences: Students responded well to well organised and moderated discussions, but required significant induction and persuasion initially to participate.

Table 6.8 Design Principles developing social presence

6.6.5 Coping with technological issues

Overall the students and staff reported mostly satisfactory responses to the technology. There was some frustration in the early part of the project though reliability issues and the occasional break down in service. As the BLAST site was browser based, it was available on all platforms and operating systems. The Moodle VLE software proved reliable and was kept up-to-date by the technical support department. One of the most disappointing aspects of the prototype BLAST environment was the failure of the software to keep the 'mark book' up-to-date with the students' attempts at the SCORM quizzes, thus preventing the routine monitoring of the MCQ quizzes that the students had become used to. This was basically due to incompatibility between more recent versions of Microsoft Internet Explorer and the SCORM standards. The students found it difficult to change the default browser on their home computers. To an extent this was solved by the use of the Moodle based assessment module, rather than third party applications, but this reduced considerably the variety and choice of assessment format for the students.

The design principles are summarised in Table 6.9.

Student engagement, participation and attitudes to independent learning will be encouraged and facilitated by access to technology that:

Strategy components for coping with technological issues
• Does not depend on expensive proprietary software • Works across a variety of operating systems and hardware • Is compliant with interoperability standards e.g. SCORM • Is reliable and robust • Is well maintained and supported by technical staff • Has reliable Internet hosting

Expected to result in

Pedagogic effects
• Students being able to access the online activities and resources without restrictions. • Successful monitoring of progress through the VLE 'mark book' • Greater trust in the system

Based on

Empirical/practical experience: Most of the frustrations of the research team were from the occasional unreliability of the technology. Once the standardised software was installed and the connections became more reliable, the only issue was the failure of the SCROM assessments to operate within the browser environment.

Table 6.9 Design Principles for technology issues

6.6.6 Student induction, training and on-going support

Much of the work on the transitional difficulties that students encounter in the first year of higher education has centred on the lack of preparedness for more advanced and independent study. Similar features have been found in this study on the transition to sixth form work. One of the aims of the learning designs and representations of blended learning sequences has been to disabuse students of the notion that independent learning is 'homework', an additional and sometimes unnecessary part of their studies, rather than an integrated feature (Murtagh, 2010). This is not something that can be sprung upon students, as evidenced in all the studies referred to earlier on the concerns about the first-year university experience. Clearly students need to be exposed to these expectations in a progressive and supportive manner from earlier in their school careers. The design principles in this section refer to two main issues; digital literacy and critical reflective thinking. The issues relating to the lack of digital literacy among the majority of students, who in contrast to the notions of the digital native, present as poorly prepared for studying in a blended learning environment as evidenced in this study and has been discussed in section 2.6. Both students and teachers need to be helped to develop the digital literacy to harness the benefits of the new technologies (Conole, 2013).

Student engagement, participation and attitudes to independent learning will be encouraged and facilitated by undergoing training that:

Strategy components for student induction, training and on-going support
Technical training in basic digital literacy Critical and reflective thinking training: • Provides opportunities and support for the development of reflective activities • Provides training in searching critically for information • Develops skills of peer and self assessment • Encourages the use of reflection, by providing models and scaffolding

Expected to result in

Pedagogic effects
Technical training: • Enables students to create materials suitable for uploading • Ensures students can install, use and adapt the software applications on their personal computers • Enables students to understand and handle different file types • Ensures that students can use appropriate graphics in their work • Enables students to easily upload and download materials from the website • Students feeling more confident and comfortable in creating resources for uploading that are of an appropriate size and format etc. • Students being able and confident in articulating reflections on their own and others' performance in order to develop critical capacity

Based on

Theory from literature: Conole (2013), Parkes (2015), Nicol (2006, 2007), Salmon (2011), O'Connell and Dyment (2011) Empirical evidence/Practical experience of researchers/designers: Student resistance to new modes of learning as evidenced in the Q methodology evaluation, as well as reluctance by some students to engage in social networks surrounding the learning.

Table 6.10 Design Principles for student induction and training

In order to get the most out of participating in a blended learning course such as the BLAST project, students also need to be prepared for the demands that come with this type of study; the time expectations of the course; reading and writing new sorts of material; working together to produce collaborative outputs and to think critically and reflectively about their own and others' work. Again, many of these have been shown to be issues of transition to higher education (Parkes et al., 2015), but could also be seen as a feature of the transition from highly structured teaching to the open nature of blended learning in any educational phase. In addition to the progressive development of these skills, there will always be a need to remind students, through induction to new courses and activities. The design principles are summarised in Table 6.10.

6.7 Professional development of participants

After the actual product of the intervention and the design principles derived from the design-research process, the third main output is the professional development of the participants. The fact that this collaborative research process increases the chance that interventions of this kind will be successful and sustainable has been emphasised by many of the established writers on this approach e.g. Plomp (2009) and McKenney and Reeves (2012).

The teachers involved in the BLAST project were probably similar to many other mid-career teachers, in that their connection with educational research ended with their PGCE, apart from occasional articles in the professional press like the Times Educational Supplement or some references to fashionable educational 'gurus' on INSET days, supporting Hargreaves' contention (1996) about the gulf between the teaching and research community.

The process of being a participant in a research project meant that the teachers were exposed to more of the academic literature. This was mediated by the researcher who made available copies or summaries of the most relevant material. Since the expansion of the use of technology in education, there have been attempts to provide a theoretical foundation to professional knowledge surrounding the issue. The Technological Pedagogical and Content Knowledge (TPACK), was designed to describe the different domains in the professional development of teachers (Koehler and Mishra, 2009), and described in section 4.3.3. The approach emphasises the integration of the knowledge domains in the model.

The teachers in the study were experienced specialist teachers of biology and the content knowledge of the subject at this level. They were also experienced in the practice of teaching science through a variety of methods; their pedagogical knowledge and pedagogical content knowledge was well developed. What needed professional development for the effective design and management of the intervention was the integration of this existing knowledge with the technological opportunities offered by the BLAST learning environment.

Training opportunities for teachers have been very poor in this area. The only real training opportunities available for the participating teachers have been occasional after-school sessions from the ICT technician, Kevin, on demonstrations of the technical side of the Moodle VLE available in the school. Since the loss of much of the local authority advisory team, department training involving local schools has ceased.

During the BLAST research project, the researcher took on the role of inducting the other participants into relevant aspects of the pedagogical implications of using a technologically enhanced learning environment. This involved a number of aspects:

- Advising the team on the most appropriate models/theories for the project
- Liaising with the ICT technician for the installation and configuration of the project software
- Demonstration of the use of the software
- Providing summaries of literature concerning ‘why’ and ‘when’ as well as ‘how’ to use the software applications

After the initial decision to adopt the Conversational Framework and Community of Inquiry as the underlying learning models, further professional development took a ‘just-in-time’ approach. This involved short, sometime spontaneous interventions at the time of confusion or during a project meeting over a learning design. This is in contrast to a ‘just-in-case’ approach where a lot of training is delivered in a programme that may cover all eventualities. Some of these interventions could not really be termed training sessions, most were informal needs-based advice or demonstration.

Some of the teachers’ comments here demonstrate how they felt about the challenges of teaching with technology:

> *“It’s not Kevin’s fault, he does his best, but he is not a teacher” (Jenny)*
>
> *“We use the Internet all the time, but I did struggle with some of the intricacies of Moodle and the quiz options” (Jenny)*
>
> *I think it is important to able to practice the activities as soon as it has been demonstrated – it really focussed the mind” (Lauren)*
>
> *“It’s not so much the technology; it’s the why and when to use things like forums, quizzes and so on” (Lauren)*
>
> *“I think it important to slot these activities into the underlying theory of learning” (Jenny)*

Much of the technology was fairly simple to use and set up. For example a discussion forum or wiki in Moodle only requires a few clicks and it is online, ready for posts and contributions. Similarly MCQ could be easily setup once the various configuration options were understood. Where the TPACK framework became relevant was in the purpose and application of these tools. The teachers felt that the TLAs available in the LDSE tool meant that these activities were put in the context of the learning cycles and supported the overall teaching sequences rather than being just stand alone activities. The team spent a great deal of time discussing when to use these activities, as well as how to manage and maintain discussion forums. This was aided by summaries of articles provided by the researcher and in sharing these transparently with the students to add to their metacognitive development.

By the end of the project, the teachers were confident in the 'why', 'when' as well as 'how' to use many of the features of the virtual learning environment and indeed have become sources of advice to other members of staff.

6.8 After BLAST . . . . . .

Undertaking the BLAST project has revealed a number of important matters that relate back to some of the issues and arguments developed in earlier sections of this study.

The first issue is that teachers, with support, can develop a successful scheme of work using an underlying theoretical framework that elicits many of the desired changes in student behaviour. Secondly, teachers can enhance the teaching and learning experience through the development of a virtual learning environment. Thirdly, collaborative design-based research can be an effective way of prototyping and developing innovations that can lead to successful outcomes and produce principles for others. Lastly, during the process, the professional development of the participants has involved a connection between the teachers and the research literature that would otherwise not have been made.

The first outcome illustrates that an innovation can be developed and implemented on a small scale. The limitations of this study become apparent when the 'sustainability' validity or the scaleability element of the design-research process is examined. The discussion has shown previously that using Fullan and Donnelly's Index, the BLAST project falls down on one of the elements of their essential factors for a successful innovation – system change; lacking system support, leadership and collaboration between the whole school and other institutions. In terms of EDR, it is unlikely that the prototype will be developed beyond a few interested teachers or departments in the school. In its present form and in its present context, it is unlikely that the BLAST project will survive any major staff changes in the participating department, thus illustrating its vulnerability.

The BLAST project was extremely successful when dealing with factors under the control of the research team; the scheme of work, interpreting the content and assessment criteria from the examination board, the design and implementation of the BLAST learning environment i.e. the pedagogical issues. It is those factors that were not under the control of the team that have left it vulnerable:

- The form of the final assessment regime
- The content of the syllabus
- Some aspects of the technology and its management
- The school timetable and staffing
- Resources and finance to support the project
- Leadership, management and institutional support
- Political, economic and ideological context of education policy

The profile of the school itself remains the same and some of the challenges that face the project school have been mentioned earlier and include:

- The small (and declining) size of the school
- Variable results from inspections
- Constant pressure from imminent inspections
- Limited curriculum offer to students
- Difficulties in recruiting staff
- Limited experience of staff in some specialist areas
- Leakage of students to other schools (including at sixth form level)

These are the very issues that some claim have the potential to be ‘solved’, by the introduction of planned ‘disruptive’ technological innovations (Christensen et al., 2013; Picciano et al., 2012).

In early 2010, while BECTA still informed educational planning in the UK, and ‘Building Schools for the Future’ were re-imagining schools for the next century, with ideas about a new curriculum with new assessment models, there was an optimism about a future of an open technology operating within a prosperous knowledge based economy (Facer and Sandford, 2010). In their summary of the Beyond Current Horizons report (Beyond Current Horizons, 2010) that drew on a wide range of evidence from field of policy and practice, Facer and Sandford describe some of the principles that led to the development of the scenarios for the future. They make the point that scenarios can best be formulated in terms of ‘probable, possible or preferable futures’, thus illustrating their subjective and value laden nature. Recent trends in the direction of educational policy (see section 2.3 and 2.4) reflect the values of wider changes in society and would seem to be less optimistic, reflecting the responses to financial insecurity. These include a continuing trend towards economic inequality, fewer employment opportunities for those not highly qualified and mobile, public services increasingly implemented by private agencies, with an increased diversity of provision of educational institutions and further de-regulation of curriculum requirements, employment laws and training. It is the government’s intention that all secondary schools will become independent of local authority support and turn into academies. This is very similar to the economic and political environment that enabled the development of the blended learning schools in the USA described in section 2.3.

In terms of the project school and the development of the use of the learning platform and e-learning, there are a number of possible strategies available in order to use the potential of e-learning to address some of the issues that confront the school. The ‘probable’ outcome is of very little change until forced by some crisis initiated by external agencies, e.g. an unsatisfactory inspection. This would instigate a complete reform of the school’s structure.

Many of these issues have been discussed earlier in relation to the motivations in the USA regarding developments in blended learning (section 2.3). The BLAST project as an example of Fullan and Donnelly’s (2013) classification, could be a model that might be expanded or added to in a number of ways as in Florida where some schools have created their own ‘virtual curricula’ to support some of these issues (Chingos and Schwerdt, 2014). This possibility of change is possible at the three scales in this context, the individual teachers, the subject department and the school. Some of the possible strategies and issues are shown in Table 6.11. The scales represented in Table 6.11 are not independent of each other or from the influence of policy from government.

Scale	Potential strategy	Issues
Individual	Develop individual learning environment and activities to support lessons and online tasks	Regarded as eccentric member of staff, isolated from the rest of the school, ultimately unsustainable. Could be successful in the short term for some students.
Department	Develop department-wide learning environment	Consistent design and approach, collaborative planning, evaluation and feedback, staff development opportunities
School	Encourage all departments to engage with e-learning Design or purchase learning packages for specialist or minority subjects Join academy chain	Consistent design and approach, collaborative planning, evaluation and feedback, staff development opportunities. Reduce 'leakage', wider curriculum offer, create innovative culture. Gain support, resources and expertise. Lose local control.

Table 6.11 Potential strategies for action at individual, department and school level

In his analysis of the sustainability of educational change, Andy Hargreaves (2002), remarks that the differential approach to school improvement advocated by government policies ".. offers freedom to change to the affluent and fear of failure to the rest. Successful test scores in affluent areas get schools 'earned autonomy', but there is no freedom to manoeuvre in schools at the bottom where standardized solutions and heavy-handed intervention repeatedly fail or enjoy only temporary success" (ibid:206).

In developing the e-learning environment to support existing courses (as in the BLAST project) and offering online courses to students who are at the present not having their curriculum needs met, the school could address some of those issues of leakage and lack of specialist staff.

In the first instance, the school could 'buy in' courses from a growing list of suppliers, before developing in-school course design skills to create their own. These commercial packages could be supported by in-school mentoring to avoid some of the drawbacks of entirely online courses. Although the reaction of the participating students to the idea of online modules was only regarded as a positive possibility by the 'Enthusiastic' group, the other positive responses about blended learning could be supported by introducing students to these ideas at an earlier stage in the school.

Another way the school might develop would be to establish a new reputation for innovative teaching methods. While schools with a legacy of poor inspection reports find it supremely difficult to change local opinion, it may be possible, as Hargreaves implies, to ".. redefine the mythical spaces of the *imaginary* geographies of schools ... Making improvements means inventing new myths" (2002:196): in this case possibly as an e-learning pioneer school.

Ultimately the school might choose (or be forced) to join an academy chain, which would probably entail overall curriculum reform and the possibility of a 'school-based' scenario in terms of e-learning adoption, which would, despite the input of resources and expertise, deny the individual teachers control of their work.

6.9 Further research

The BLAST project was a wide ranging project, involving many learning activities both in class and online. One of the drawbacks of such a wide-ranging project is the lack of in-depth research into individual activities. Further research is required to develop strategies of induction and implementation of a number of these, especially in relation to secondary age students. Firstly, developing ways to encourage reflective writing, perhaps in the form of journals or blogs in order to complement other self-regulating behaviours shown in this study are required. Secondly, developments in online assessment procedures would be useful in order to move beyond the MCQ formats described in this study and therefore assess different areas of knowledge and skills. Thirdly, this study did not address issues of wider access to the learning platform though mobile 'smart phones' or tablets. This also involves the under utilisation of the interoperability potential of learning platform technology. This is the issue that would finally give credence to the notion of 'transformation', where the responses of students are analysed and used to 'personalise' the structure of future tasks. This area of 'data analytics', while the main driver of the scope (and profits) of applications like Google, has yet to be seen in effective and widespread use in education, apart from self-reported successes from sources such as Rocketship.

In terms of methodology, one of the limitations referred to previously has been the incomplete nature of research projects like BLAST. Studies are too often undertaken as part of the beginnings of projects, where the wider dissemination is left unknown. Therefore more longitudinal studies would be useful to the research approach. This might also include situations where there has been a move towards design for more online access with less classroom contact in real-school settings.

6.10 Conclusion

This educational design-research study was instigated to attempt to address the challenge of passive students who did not display skills of ‘independent learning’. In a study concentrating entirely on school education, Meyer described independent learning as comprising two elements, internal and external to the learners (2010). The external factors include “a strong relationship between teachers and pupils and the establishment of an ‘enabling environment’ in which ICT has a part to play” (ibid:2). In this study the ‘enabling environment’ was the BLAST learning environment. As discussed earlier, ICT is important in that it provides tools for students to take more responsibility for their own learning. The internal elements are the attitudes, skills and behaviours that students need to acquire in order to respond successfully to online learning environments and become more independent learners. This study has shown how important the design and structure of the learning experience is, in promoting these changes in the students. It has also shown that change will be slow and there will be resistance from some students.

The intervention involved the re-design of a pre-university biology course using an open source virtual learning environment, based on the principles of learning design and underpinned by the Conversational Framework and the Community of Inquiry. The course was designed as blended teaching/learning involving class based activities as well as online activities that would be done either individually or in student groups. The intervention followed a class of biology students from their entry into the course until its completion. The majority of the students went on to higher education. The intervention and research outcomes have raised awareness in the school of the potential of the use of technologically enhanced learning environments, a resource that was not widely used before the start of the intervention.

The intervention and accompanying research gave rise to a number of characteristics that have informed the design of this intervention and could potentially aid others designing their own TELEs, in similar contexts. The study included findings that suggest that these design principles are effective in developing independent learning and student engagement in the context of a small comprehensive school.

One of the original features of this study has been its scope and context. While this study did not involve ‘state of the art’ technology, the introduction of some technological features to the design and delivery of an A level course, was in fact unusual at this time. There have been many studies (Higgins et al., 2012; Passey and Higgins, 2011; Jewitt et al., 2010) showing how schools in the UK have not so far utilised much of the available technology to enhance learning. The researcher and teachers involved in the project were not aware of any similar blended learning designed courses in schools in any of the neighbouring education authorities. Local authority teacher network meetings have been discontinued since the removal of advisory staff in 2011, making it more difficult to cascade and share innovations. There has been some interest from other individual teachers since the study has become known.

The development of the BLAST learning environment and the design principles emanating from it, provide a framework to guide other practitioners in designing their own learning environments. The design principles provide both substantive and procedural knowledge (Plomp, 2009) from which other colleagues can select to develop designs in their own contexts.

The legacy of failure of education reform and innovation has become more than repeated events; “In the minds and memories of teachers, the failure of change becomes a cumulative phenomenon” (Hargreaves, 2002:190). “Change over time in education is a predictable failure ... a serial killer of initiative and enthusiasm over the duration of teachers’ careers” (ibid:190).

Educational research in schools needs models of success to encourage teachers to take risks and develop new modes of teaching and learning. This original study showed how a course re-design based on extensive literature reviews was conducted in a real-world ‘messy’ environment of a school over the course of two years. The research approach chosen involved a collaborative, iterative co-design involving both researcher and practitioners. The account has been documented through a design narrative exposing the discussions, successes and failures inherent in any intervention. During the course of the development of the BLAST environment, a number of setbacks, technological problems school inspections all contrived to derail the project. The nature of the research design and the collaborative features of practitioners and researcher working together as a research team meant that most of these hurdles were overcome.

A further original contribution of this study has been in the use of design representation tools and educational design-research approach, which have not been commonly used in the context of a secondary school examination course. While action research is a fairly common approach for practitioners conducting research in their own institutions, this research approach takes action research one step further, including the development of design principles to offer guidelines to other colleagues. The approach also provides a context and structure for researchers and practitioners to work together producing research from real world contexts.

The project also illustrates another aspect of working in the 'swamp'. Even though the pedagogy and technology of the innovation were effective in terms of the research project, in terms of sustainability, wider areas of context not under the influence of the research team were more likely to influence further developments.

Appendix A Ethics

Consent form Page 1/2

Blended Learning and Sixth-form Teaching

Consent form for all students and staff taking part in the research project exploring the impact of units of work that 'blend' online work with class work to support students' learning.

I confirm that I have read (or had read and explained to me) the information sheet relating to the research study and give my consent to take part in the research project:

I understand that interviews may be recorded

I understand that taking part in this research study is voluntary and that I can withdraw from the research project at any time.

Please print name……………………………………………………………………

Signed……………………………………………………………………………

Date………………………………………………………………………………

Parents' information sheet Page 2/2

Blended Learning and Sixth-form Teaching

Parents' information sheet

Background

A researcher from Newcastle University will be working with school staff to investigate the impact of using the school's VLE with sixth form students. The aim of the research is to explore the impact of units of work that 'blend' online work and class work to support students' learning.

What will the research project do and who will be involved?

The research project will look at the experiences and expectations of:

- Sixth form students
- Teachers
- Other school staff.

How will we do it?

The researcher will have regular meetings with teaching staff to plan units or work and evaluate their success.

Students: The researcher

- will collect views about learning and teaching by talking to students in groups and asking them to complete a questionnaire.
- will visit lessons and talk to students

Staff:
The researcher will work with staff in creating sequences of activities using the schools' VLE. This will involve regular meetings with teaching staff and students discussing various activities and providing any necessary CPD in the use of the VLE tools and activities.

How will the research data be used?

Data collected from staff and students will be treated as confidential within the research project. Nobody but the research team will see or hear records of what staff and students have said. Individuals will not be named in written documents or in the titles of photographs. Any data used in interim or final reports will be anonymised.

If your concerns are not addressed to your satisfaction you may withdraw your child from the research project.

If you are content for your child to be involved in this project, you do not need to do anything.

If you want to know more about the project, or have any questions, please contact Roger Handyside: R.Handyside@ncl.ac.uk, Tel:

Appendix B Fullan and Donnelly's Index

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Index criteria – Pedagogy (1/3)

Clarity and quality of learning outcome goals

Definition	What green looks like	What red looks like
• How clearly are the learning outcomes of the innovation defined? • Are the learning outcomes explicit and defined for the school, the student, the parents and school system? • Is the clarity of outcome shared by student, teacher, parent, school and school system?	Each activity, overall lesson and broader course has clear, quantified outcomes. The innovation is able to demonstrate strong benefits for customers and/or students. The learning outcomes are communicated effectively within the school and to parents, teachers and students. Trajectories are produced for key outcomes. Where possible, modelling is used to quantify the impact on key national indicators of student attainment. The student and the teacher are both clear about the success criteria in relation to their learning outcomes. (Best practice in Ontario).	Exercises and modules do not have specific outcomes identified. Outcomes identified lack specificity. There is insufficient linkage to key leading indicators and a lack of clear trajectories. School staff are unaware of the impact of the innovation and the benefits to students. There is no tracking or monitoring system to ensure learning is taking place and adaptations are made.

Index criteria – Pedagogy (2/3)

Pedagogy

Definition	What green looks like	What red looks like
• How refined is the pedagogical underpinning? Does the pedagogy reflect the latest global research, including the emphasis on constructivism and real-world examples? • Do students learn through enquiry? • Is there a mechanism to ensure the pedagogy is updated? • How is the teacher's role defined? Is the role reflective of a 'teacher as activator' relationship? Can teachers effectively manage all the students? • How is the student engaged? Is there a student-teacher partnership? Does the model include an emphasis on the necessary psychological and intellectual processes?	Pedagogy reflects the most advanced and proven techniques to date. The theory of learning is stated explicitly in both the technology, model design and training of teachers. The model includes a view of the teacher as a change agent. Problems and questions are placed in real-world contexts and the emphasis is on intellectual risk-taking and trial -and-error problem solving. There is a healthy partnership between the student and teacher. The teacher's role is defined as activator of learning and centred on the learner. Teachers are open to alternatives, seek evidence and are adaptable when new evidence is raised. Students are engaged through enquiry, learning is personalised and directed at unlocking the passion of the learner. Students feel supported by the teacher. Learners are supported psychologically and teachers are trained to focus on the personal experience of the individual student and to help uncover values and motivations.	Pedagogy lacks innovation and current thinking and is often the traditional rote method of 'tell and test' or 'experience and evoke'. Theory of learning is difficult to detect and incoherent. Pedagogy is not consistent across technology, teachers and school model. There is a tension between the student and teacher based on misaligned incentives and teaching style. Teachers are set on teaching using a method that works for them and is without evidence base. Students are taught to. Curriculum and school design are imposed. Students feel unsupported by school or teacher.

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Index criteria – Pedagogy (3/3)

Quality of assesment platform

Definition	What green looks like	What red looks like
• What is the quality of the built-in assessment systems? Is it adaptive? Does it include an optimal amount of detail? • Is it clear how the outcomes will be measured? • How does the teacher use the assessment system to motivate and activate the learner? • How does the student use the assessment system to monitor and motivate his or her own learning?	The assessment system is completely adaptive, interactive and integrated seamlessly into the innovation. In some best cases, the student does not realise they are being assessed. Both formative and summative assessments are in place. Assessment shows every stakeholder an optimal level of detail (students, teachers and parents). Assessments measure student activity and behaviour, not just outputs. The assessment system is integral to learner engagement and their sense of engagement. The teacher uses the assessment system to motivate the learner, helping them feel small daily accomplishments while also appropriately targeting areas for further refinement.	Measurement of success is unclear or non-existent. The assessment system is not robust and, in some circumstances, misleading. Teachers use the assessment system as a simplistic way of grading students and do not integrate the results into student learning. Students do not have access to the results and are unable to monitor progress. The system focuses only on rigid outputs and teachers teach to the test.

Index criteria – System change (1/3)

Implementation support

Definition	What green looks like	What red looks like
• What is the nature of the implementation support provided? • What support is provided to ensure the technology functions (all parts including software, hardware, maintenance, electricity and connectivity)? • How long is the implementation support or servicing in place for? • Is the support based on a culture of learning, risk-taking and learning from mistakes? • Does the innovation include teacher training and professional development? Are teacher development goals explicit? Is there appropriate follow-up and mentoring?	The innovation service/ product team provides full implementation support that acts in constant partnership and dialogue with the school system. Technology support is timely and effective on all aspects. The innovation includes professional development to ensure the change is embedded in the teaching force. The innovation sees teachers as vital change agents and integral to the success of the innovation. Professional development focuses on the teacher learning to know the impact he or she has on every student; to provide feedback that assists students to progress; and to master the motivation of students. Teachers understand that the training is a necessary investment in their career development and success. Professional development is constantly monitored and added on an as-needed basis. Focus is on capacity building through rapid learning cycles, fast feedback, continual reflection and good coaching.	The innovation is dropped into the school and implementation is up to the school system to figure out. There is no technology support, or the support is lacking timeliness and reliability. There is limited to no professional development for teachers. Teachers are unsure of their goals. Students and teachers do not understand the model and have no forum to ask questions. There are too many programmes and innovations being implemented at once.

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Index criteria – System change (2/3)

Value for money		
Definition	**What green looks like**	**What red looks like**
• Are there overall school cost savings realised by the innovation? • Is the product of sufficient value, demonstrated by learning outcomes, to justify change? • How expensive is the product or design change itself? • Are there hidden costs such as infrastructure upgrades? • Does the product accelerate learning?	From a school perspective, the innovation produces twice the learning outcome for half the cost, or more, of previous methods. The school and learner are significantly better off with the innovation and would actively choose to allocate scarce resources towards its purchase.	The innovation adds excess cost to the learner and the school. The value in learning is not demonstrable and it is difficult to tell how the learner will be positively impacted by the innovation. The end consumer of the innovation would not allocate resources to purchase the innovation. There are hidden implementation and upgrade costs.

Index criteria – System change (3/3)

Whole system change potential		
Definition	**What green looks like**	**What red looks like**
• Does this innovation have the ability to scale system-wide? • How does the innovation implement in the whole system? Is there a plan for scale based on world-leading change knowledge? • Will clusters of schools learn from each other? Are developments developed and scaled in laterally? • Is capacity building a central component of the strategy? • Are teachers and schools learning together?	The innovation scales virally to schools throughout the system. Little central management is necessary to ensure innovation is embedded and maintained. Clusters of schools learn from each other and continue to build and improve with the innovative product/service. New developments in the innovative product/service are made collectively and the learning is done collaboratively. The innovation implementation team has a robust understanding of 'simplexcity' and sticks to its priorities as it strives for scale.	The innovation is difficult to scale throughout the system. Burdensome management systems are necessary to maintain, scale and embed the innovation. Innovation is directed entirely top down; schools are directed how to learn new developments. Feedback from other schools is not considered or used. The district and school system is overburdened with too many priorities and distracted away from core goals.

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Index criteria – Technology (1/3)

Quality of user experience and model design		
Definition	**What green looks like**	**What red looks like**
• How is the technology for the user? Is it easy to use and intuitive? Is it irresistibly engaging and elegantly efficient? • Does the technology incorporate latest design principles for user experience?	The technology is irresistibly engaging for the learner. The interface is well-designed using the most current formatting and based on data-analysis of learner needs and effectiveness. The learner has little difficulty learning different functions as the tools are intuitive and questions are answered in an easily navigable help section. Digital tools are participatory, engaging, co-creative and collaborative. The innovation contains gameification elements that capture a sense of engagement and maintain student's interest (linked to assessment system).	The technology lacks engagement for the learner. The user experience feels heavily dated and there are frequent stop points, downloads and interruptions. The learner and user cannot find the applications and tools easily. The modules feel clunky and not fully integrated.

Index criteria – Technology (2/3)

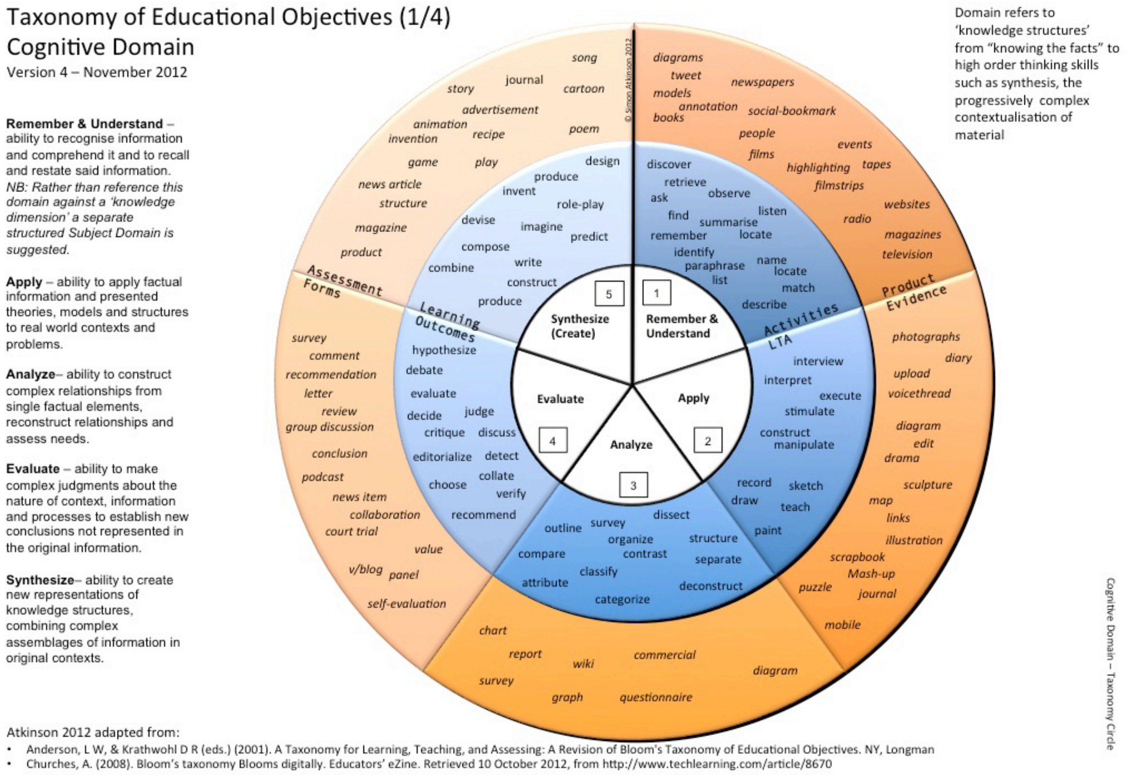
Ease of adaptation		
Definition	**What green looks like**	**What red looks like**
• Is the technology adaptable? Is it highly connective? • Can the technology be accessed on any device? Can it be accessed any time?	The technology is highly connected to the Internet, allowing for real time adaptation of the programme to the learner and access to the resources of the Internet when appropriate. Technology is easily assessable from any device; users only need to enter security information once; and information is stored on the cloud for 24/7 access.	The technology is disconnected from the Internet and is unable to be adapted in real time. There is little to no communication between devices, terminals, users. Access to resources is limited to that immediately within the programme.

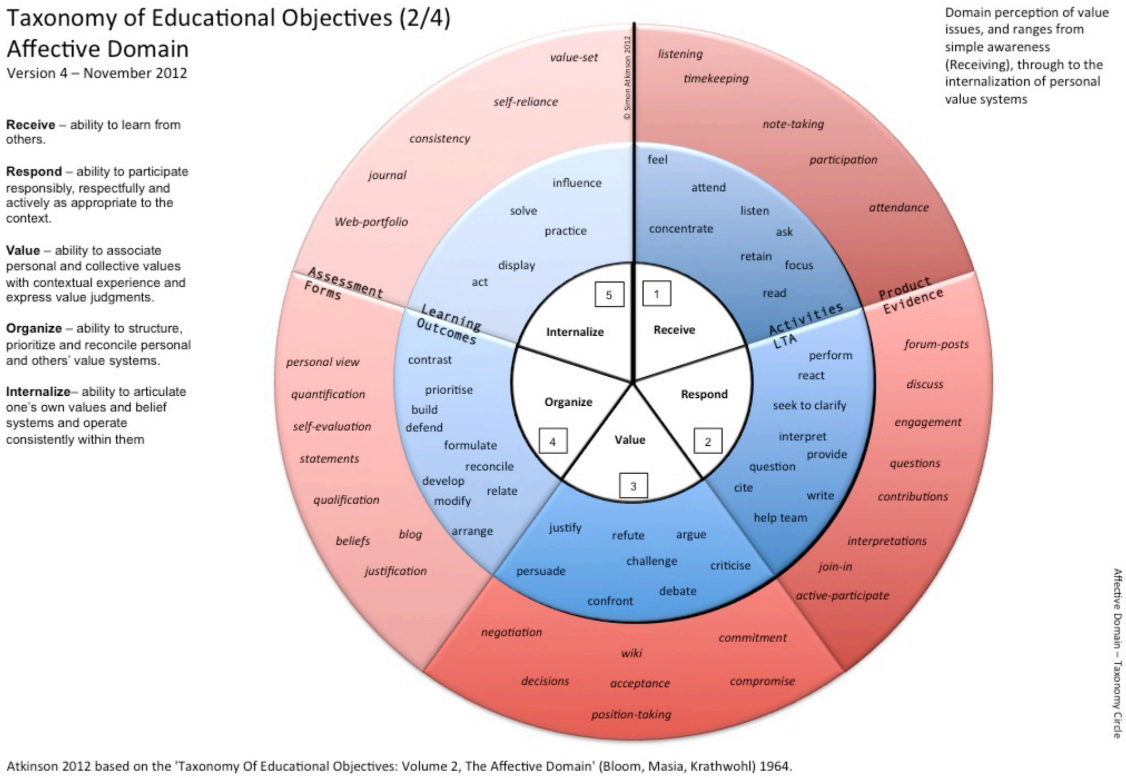
Index criteria – Technology (3/3)

Comprehensiveness and integration		
Definition	**What green looks like**	**What red looks like**
• It the technology integrated and seamless? • Is the content comprehensive? • Is the assessment system integrated into the pedagogy and curriculum? • Is 24/7 access and learning enabled?	All elements of the technology, pedagogy and system change knowledge are integrated. Teachers feel very confident that they can integrate the technology into the classroom and understand how it functions. The innovation is technologically ubiquitous and every learner has equal access and opportunity. The technology is embedded in the school day and enables teacher interactions with the students. The technology contains a comprehensive set of materials and supporting learning mechanisms e.g., assessment. The assessment platform is seamlessly integrated into the technology and any content and curricula are personalised based on student performance.	The elements of technology and pedagogy do not complement each other and there is often friction. Users must frequently log into separate systems and terminals that do not interact. The technology is crudely added into the school day and teachers all adapt to the technology in their own way. The content and assessment is split separately and is often unaligned.

Appendix C Taxonomy Circles

Cognitive & Affective Domains Page 1/2





Taxonomy of Educational Objectives (3/4)
Psychomotor Domain
Version 4 – November 2012

Domain refers to progressively complex manual or physical skills

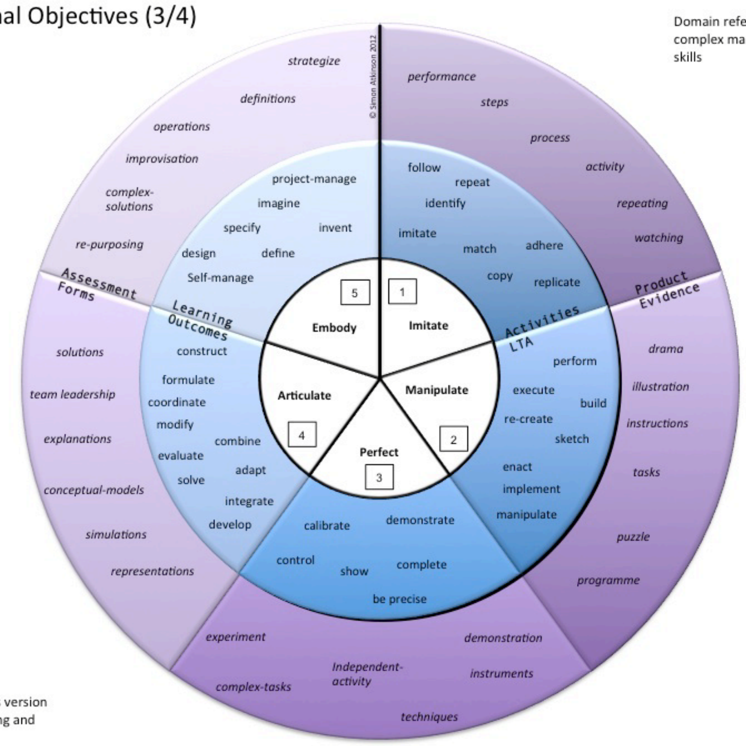
Imitate – ability to copy, replicate the actions of others following observations.

Manipulate – ability to repeat or reproduce actions to prescribed standard from memory or instructions.

Perfect– ability to perform actions with expertise and without interventions and the ability to demonstrate and explain actions to others.

Articulate – ability to adapt existing psychomotor skills in a non-standard way, in different contexts, using alternative tools and instruments to satisfy need.

Embody– ability to perform actions in an automatic, intuitive or unconscious way appropriate to the context.



Atkinson 2012 - derived from RH Dave's version of the Psychomotor Domain ('Developing and Writing Behavioral Objectives', 1970)

Taxonomy of Educational Objectives (4/4)
Knowledge Domain
Version 2 - November 2012

This Knowledge Domain is a reinterpretation of the Knowledge Dimension intended to identify the field or subject structure of knowledge rather than its operation. *Addition of Contextual knowledge.

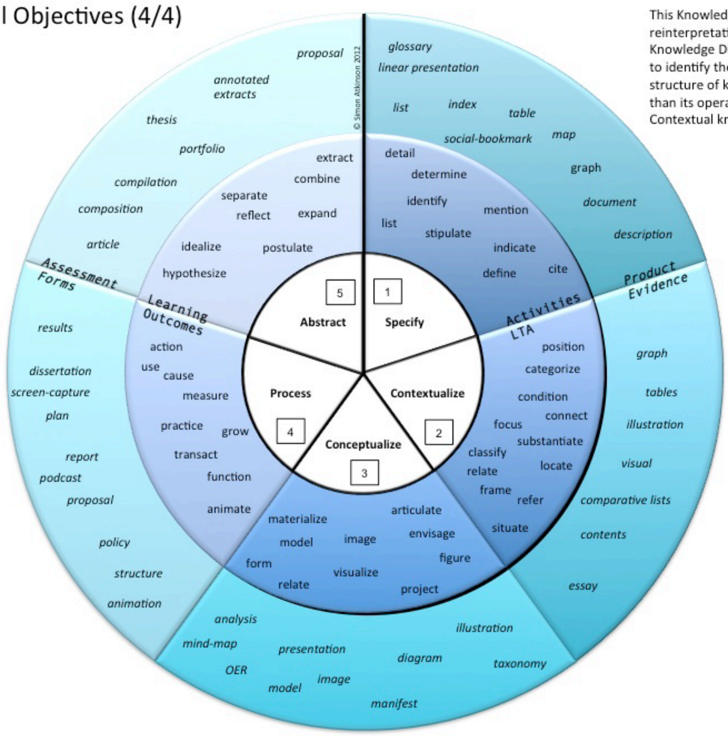
Specify – ability to locate, identity and recognise factual knowledge, dates, terminology, artefacts (audio and visual) required of a given discipline domain.

Contextualize* – ability to place specific knowledge within appropriate discipline relationships, classifications, taxonomies and categorizations.

Conceptualize – ability to articulate relationships between knowledge contexts and to work with models, visualizations, theories and structures that relate between contexts or within contexts.

Process – ability to utilize subject or discipline language and actions to specify, contextualise and conceptualize existing and new knowledge.

Abstract – ability to recognise and process abstract, unseen or unspecified knowledge, and articulate knowledge origination, including meta-cognition.



*Atkinson 2012 adapted from
Anderson, L W, & Krathwohl D R (eds.) (2001). A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. NY, Longman
Bower, M; Hedberg J G & Kuswar A (2010): A framework for Web 2.0 learning design, Educational Media International, 47:3, 177-198

Appendix D Scheme of assessment for GCE Biology

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4 Scheme of Assessment

4.1 Aims

AS and A level courses based on this specification should encourage candidates to:

a) develop their interest in and enthusiasm for the subject, including developing an interest in further study and careers in the subject

b) appreciate how society makes decisions about scientific issues and how the sciences contribute to the success of the economy and society

c) develop and demonstrate a deeper appreciation of the skills, knowledge and understanding of *How Science Works*

d) develop essential knowledge and understanding of different areas of the subject and how they relate to each other.

4.2 Assessment Objectives (AOs)

The Assessment Objectives are common to AS and A level. The assessment units will assess the following assessment objectives in the context of the content and skills set out in Section 3 (Subject Content).

AO1: Knowledge and understanding of science and of *How Science Works*

Candidates should be able to

a) recognise, recall and show understanding of scientific knowledge

b) select, organise and communicate relevant information in a variety of forms.

AO2: Application of knowledge and understanding of science and of *How Science Works*

Candidates should be able to

a) analyse and evaluate scientific knowledge and processes

b) apply scientific knowledge and processes to unfamiliar situations including those related to issues

c) assess the validity, reliability and credibility of scientific information.

AO3: *How Science Works*

Candidates should be able to

a) demonstrate and describe ethical, safe and skilful practical techniques and processes, selecting appropriate qualitative and quantitative methods

b) make, record and communicate reliable and valid observations and measurements with appropriate precision and accuracy

c) analyse, interpret, explain and evaluate the methodology, results and impact of their own and others' experimental and investigative activities in a variety of ways.

Quality of Written Communication (QWC)

In GCE specifications which require candidates to produce written material in English, candidates must:

- ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary where appropriate.

In this specification, QWC will be assessed in Unit 1 and Unit 2 at AS, and Unit 4 and Unit 5 at A2. Where relevant, the mark schemes for questions contain specific statements about QWC. These statements are marked "Q" in the mark scheme and relate to the clear expression of concepts (e.g. the active site of an enzyme has a complementary shape to that of its substrate, but not the same shape), correct subject-specific terminology and correct spelling where there are close alternatives to biological terms (e.g. glucose, glycogen and glucagon), as appropriate. The mark scheme for the essay in Unit 5 is divided into three sets of skills: subject content; breadth of selected material; relevance of selected material; QWC. Specific descriptors are used for allocating the marks for QWC in these essays.

4.5 Synoptic Assessment and Stretch and Challenge

The definition of synoptic assessment in the context of science is as follows.

Synoptic assessment requires candidates to make and use connections within and between different areas of the subject at AS and A2: for example, by

- applying knowledge and understanding of more than one area to a particular situation or context
- using knowledge and understanding of principles and concepts in planning experimental and investigative work and in the analysis and evaluation of data
- bringing together scientific knowledge and understanding from different areas of the subject and applying them.

Synoptic assessment in Biology is assessed in the A2 units by two types of question: structured questions carrying 15 marks and an essay question carrying 25 marks. The structured question on Unit 4 develops a *How Science Works* context and requires candidates to use subject matter and skills from Unit 4 and the AS specification. The structured question in Unit 5 tests data handling skills and requires candidates to apply knowledge, understanding and skills from the AS and A2 specification. In the essay in Unit 5, candidates are required to use knowledge and understanding from across all units.

The requirement that Stretch and Challenge is included at A2 will be met in the externally assessed units by the following

- using a variety of stems in questions to avoid a formulaic approach through the use of such words as: evaluate.
- avoiding assessments being too atomistic, connections between areas of content being used where possible and appropriate
- having some requirement for extended writing
- using a range of question types to address different skills, i.e. not just short answer/structured questions
- asking candidates to bring to bear knowledge and the other prescribed skills in answering questions rather than simply demonstrating a range of content coverage.

The requirement that Stretch and Challenge is included at A2 is met in the long, structured questions in Units 4 and 5 which are designed with an incline of difficulty such that the later sub-questions will offer a genuine challenge to the most able candidates. Differentiation by outcome will be used. The mark descriptors for the essay in Unit 5 include marks that will be gained only by those candidates who have included material beyond that expected of a good A Level candidate. This technique has been successful in rewarding the most able candidates.

Appendix E Student instructions for the Q method survey

Page 1/2

Name: ....

INSTRUCTIONS FOR THE SURVEY

These instructions will guide you through the survey step by step. Please read each step to the end before you start carrying it out.

1. Take the deck of cards and the score sheet and go and sit at a table. Lay down the score sheet in front of you. All 47 cards in the deck contain a statement about teaching and learning. We will ask you to rank-order these statements from your own point of view. Our question to you is: "To what extent do you agree with the following statements". The numbers on the cards (from 1 to 47) have been assigned to the cards randomly and are only relevant for the administration of your response.

This study is about teaching and learning preferences.

2. Read the 47 statements carefully and split them up into three piles: a pile for statements you tend to disagree with, a pile for cards you tend to agree with, and a pile for cards you neither agree nor disagree with, or that are not relevant or applicable to you. Please use the three boxes "AGREE", "NEUTRAL OR NOT RELEVANT" and "DISAGREE" at the bottom left of the score sheet.

Just to be clear, we are interested in your point of view. Therefore, there are no right or wrong answers.

3. When you have finished laying down the cards in the three boxes on the score sheet, count the number of cards in each pile and write down this number in the corresponding box. Please check whether the numbers you entered in the three boxes add up to 47.
4. Take the cards from the "AGREE" pile and read them again. Select the two statements you most agree with and place them in the two last boxes on the right of the score sheet, below the "+5" (it does no matter which one goes on top or below).
5. Next, from the remaining cards in the deck, select the three statements you most agree with and place them in the three boxes below the "+4". Follow this procedure for all cards from the "AGREE" pile.
6. Now take the cards from the "DISAGREE" pile and read them again. Just like before, select the two statements you most disagree with and place them in the two last boxes on the left of the score sheet, below the "-5". Follow this procedure for all cards from the "DISAGREE" pile.
7. Finally, take the remaining cards and read them again. Arrange the cards in the remaining open boxes of the score sheet.
8. When you have placed all cards on the score sheet, please go over your distribution once more and shift cards if you want to.

9. Please explain why you agree most with the two statements you have placed below the "+5".

Card number:

Card number:

10. Please explain why you disagree most with the two statements you have placed below the "-5".

Card number:

Card number:

11. When you are finished, please write down the number of the cards in the boxes you placed them on.

Thank you for completing this survey

Appendix F Q-Methodology statements and card numbers

Themes, statements and card numbers for Qsort

Individual	Social	Pedagogical	Design	Technology
Students should take more control of their own learning 1	School use of tech should be more like social networking 2	Teachers should just tell us what we need to know 3	Having lesson presentations and resources online is essential 4	I would like to use all the Moodle tools, but I don't have the right techn or internet access 5
I can transfer all my skills from social use of techn to learning 6	I wouldn't like school work to take on aspects of social networking 7	Teachers should be using apps like Facebook etc. to help their teaching 8	Moodle is a good way of organising your work and structuring homework 9	Technology is not reliable enough for use in teaching and learning 10
Using the internet hasn't really helped my studies 11	I don't think forums or discussion boards are much use in learning 12	More teachers should be using the LP and internet in their subjects 13	With a well designed LP, we could work more independently & need fewer lessons 14	The technology in school is too restricted and controlled 15
Students need training to get the best out of using techn for learning 16	Sharing ideas in forums helps understand difficult concepts 17	I am surprised more teachers don't use Moodle 18	This course is well organised 19	Students know more about technology than their teachers 20
Students want to use techn in their learning 21	I don't like other people seeing my ideas in forums 22	It would be useful to have online modules that we could study at our own pace 23	I like having the pattern of class and homework ahead of time to help me organised my work 24	The only technology I see in school is the teachers ppt pres 25
I expect to use Learning Platforms like Moodle when I get to University 26	In a forum you can build on your own ideas by seeing what others have said 27	Classes should be more active rather than teachers telling us things 28	Moodle makes things more complicated 29	They should let us bring our own laptops etc. into school 30
I would like to try an online only course 31	Communication over the internet is much harder than in person 32	I don't think that teaching has changed since my parents went to school 33	Moodle lets you see everything in one place 34	I can see loads more ways techn could be used in school 35
We don't get the chance to show our techn skills in school 36	I can say things on forums that I might not say in class 37	It wouldn't make any difference if teachers didn't use technology 38		
I prefer working by myself 39	Peer assessment helps me understand difficult topics 40	The teacher is the most important sources of information for my subjects 41		

I would like to do more of my work online 42	I can see the benefits of creating a piece of work collaboratively 43	Blended Learning is probably the best way to organise courses 44		
	I think working in groups is really useful 45	Marking sample essays is really useful 46		
		Lectures are the best way to get information across to students 47		

Appendix G MSLQ survey questions

Page 1/2

Name: ....

The following questions ask about aspects of your attitudes to learning. **There are no right or wrong answers.** Use the scale to answer the questions. If you think the statement is very true of you circle 7, if a statement is not at all true of you, circle 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you.

		Not at all true of me						Very true of me
2	If I study in appropriate ways, then I will be able to learn the material in this course	1	2	3	4	5	6	7
4	I think I will be able to use what I learn in this course in other courses	1	2	3	4	5	6	7
5	I believe I will receive an excellent grade in this course	1	2	3	4	5	6	7
6	I'm certain I can understand the most difficult material presented in the readings for this course	1	2	3	4	5	6	7
9	It is my own fault if I don't learn the material in this course	1	2	3	4	5	6	7
10	It is important for me to learn the course materials in this class	1	2	3	4	5	6	7
12	I'm confident I can learn the basic concepts taught in this course	1	2	3	4	5	6	7
15	I'm confident I can understand the most complex material presented in this course	1	2	3	4	5	6	7
17	I am very interested in the content area of this course	1	2	3	4	5	6	7
18	If I try hard enough, then I will understand the course material	1	2	3	4	5	6	7
20	I'm confident I can do an excellent job on the assignments and tests in this course	1	2	3	4	5	6	7
21	I expect to do well in this class	1	2	3	4	5	6	7
23	I think the course material in this class is useful for me to learn	1	2	3	4	5	6	7
25	If I don't understand the course material, it is because I didn't try hard enough	1	2	3	4	5	6	7
26	I like the subject matter if this course	1	2	3	4	5	6	7
27	Understanding the subject matter of this course is very important to me	1	2	3	4	5	6	7
29	I'm certain I can master the skills being taught in this class	1	2	3	4	5	6	7
31	Considering the difficulty of this course, the teacher and my skills, I think I will do well	1	2	3	4	5	6	7
33	During class time I often miss important points because I'm thinking of other things	1	2	3	4	5	6	7
34	When studying for this course, I often try to explain the material to a classmate	1	2	3	4	5	6	7
35	I usually study in a place where I can concentrate on my work	1	2	3	4	5	6	7
36	When reading for this course, I make up questions to help focus my reading	1	2	3	4	5	6	7
37	I often feel so lazy or bored when I study that I quit before I finish what I had planned to do	1	2	3	4	5	6	7
40	Even if I have trouble learning the material, I try to do the work on my own, without help from anyone	1	2	3	4	5	6	7

MSLQ Survey questions page 2/2

		Not at all true of me						Very true of me
41	When I become confused about something I'm reading, I go back and try to figure it out	1	2	3	4	5	6	7
43	I make good use of my study time	1	2	3	4	5	6	7
44	If course readings are difficult to understand, I change the way I read the material	1	2	3	4	5	6	7
45	I try to work with other students to complete assignments	1	2	3	4	5	6	7
48	I work hard to do well in class even if I don't like what we are doing	1	2	3	4	5	6	7
50	When studying, I often set aside time to discuss material with a group of students from the class	1	2	3	4	5	6	7
52	I find it hard to stick to a study schedule	1	2	3	4	5	6	7
54	Before I study new course material thoroughly, I often skim it to see how it is organised	1	2	3	4	5	6	7
55	I ask myself questions to make sure I understand the material I have been studying in class	1	2	3	4	5	6	7
56	I try to change the way I study in order to fit the course requirements and the teacher's style	1	2	3	4	5	6	7
57	I often find that I have been reading for this class but I don't know what it was all about	1	2	3	4	5	6	7
58	I ask the teacher to clarify concepts I don't understand well	1	2	3	4	5	6	7
60	When coursework is difficult, I give up or only study the easy parts	1	2	3	4	5	6	7
61	I try to think through a topic and decide what I am supposed to learn from it rather than just reading it	1	2	3	4	5	6	7
65	I have a regular place set for studying	1	2	3	4	5	6	7
68	When I can't understand the material in this course, I ask another student for help	1	2	3	4	5	6	7
70	I make sure that I keep up with the weekly readings and assignments	1	2	3	4	5	6	7
73	I attend this class regularly	1	2	3	4	5	6	7
74	Even when course materials are dull and uninteresting, I manage to keep working until I finish	1	2	3	4	5	6	7
75	I try to identify students whom I can ask for help	1	2	3	4	5	6	7
76	When studying for this course I try to determine which concepts I don't understand well	1	2	3	4	5	6	7
77	I often find that I don't spend very much time on this course because of other activities	1	2	3	4	5	6	7
78	When I study, I set goals for myself in order to direct my activities in each study period	1	2	3	4	5	6	7
79	If I get confused taking notes in class, I make sure I sort it out afterwards	1	2	3	4	5	6	7
80	I rarely find time to review my notes or readings before a test	1	2	3	4	5	6	7

Appendix H Student use of technology survey

Page 1/2

Student Technology Survey **Name** ....

Information will be kept confidential

Please complete this brief survey about your use of technology.

1. What technology do you have access to? Tick as many as apply – comment if you want to add an explanation etc.

Type of technology	Tick	Comment
Reasonable access to the internet at home		
Standard mobile phone		
'Smart' mobile phone (internet, apps etc.)		
Access own PC or laptop at home		
Access shared PC or laptop at home		
Games on PC or console		
Personal music player		
Video/audio editing capability		
Music creation capability		
Other.		

2. How would you rate your own competence at using technology?

Level of competence	Tick
Extremely competent – I am quite a geek! I use and understand most forms of technology and can adapt them to my own preference. People come to me to help them.	
Very competent – I can do everything I need to. I sometimes change the preferences and setting on programs, I can install and configure software, e.g. alternative browsers.	
Quite competent – I can do most everyday things. I don't do things like change settings unless someone is there to help me.	
Not very competent – I can do the basics, but I struggle with anything a bit complicated	

Student use of technology survey Page 2/2

3. How often do you think you do the following?

Technology based activities	**Never** I have never done this	**Yearly** I have only done this once this year	**Monthly** I do this occasionally	**Weekly** I do this quite often	**Daily** I do this every day
Mobile phone use – using mobile for calls and texts					
‘Smart’ phone use – using mobile phone to take and send images, videos, listen to music, access the internet, send and receive emails					
Using social networking sites, e.g. Twitter, Facebook, Instagram etc, posting on forums etc.					
Publishing – using blogs, uploading photographs, videos to the ‘net etc.					
Games – using PC, phone or games console to play computer games					
Routine web use – looking up information on the internet, sending and receiving emails					
Creating/using media – using technology to create/manipulate images, sound or video					

Thank you for completing this survey. Roger Handyside

Appendix I Summary of common TLAs

(Laurillard et al., 2011) TLA Page 1/5

Summary of common Teaching and Learning Activities (TLA) for use in the LDSE design/analysis tool.

LDSE – Learning Design Support Environment

Each TLA comes pre-programmed with properties of cognitive activities; Acquisition, Discussion, Inquiry, Practice, Production. (Note that the analysis is an indication only of the *likely* distribution of students' time across these forms of activity. It is not a prediction of the exact proportions)

Tutor Supported Class Many of these TLAs could also be defined as Tutor supported Group Work depending on size of groups	
Tutor Presentation	A TLA type for an activity in a face-to-face class where students listen to and/or watch a presentation which is either given directly by the teacher or through some technological medium (e.g. a DVD). Although the students may, optionally, take notes during this time, the emphasis is on the transmission of knowledge. **Typical keywords for this activity and its constituents:** **Tutor/lecturer:** Present, Tell, Describe, Explain, Read out, Show, Demonstrate **Student:** Listen, Watch, Observe, Take notes If you are designing a lecture in which your presentation is broken with other activities (e.g. brainstorming, discussions, voting), then your session will consist of this TLA type alternating with other TLA types: e.g. *Small-group discussion, Resource-based group activity or Formative activity.* Note that activities that involve **reading** are classed as **resource-based**: e.g. *Resource-based individual activity or TEL resource-based individual activity.*
Tutor-guided class discussion	A TLA type that denotes face-to-face discussion involving the whole class. The teacher takes an active part by asking questions, providing feedback, ensuring each student has their say and keeping the discussion on topic. **Typical keywords for this activity and its constituents:** Discuss, Debate, Critique, Evaluate, Negotiate
Resource based group activity	A TLA type in which students work in a small group (typically, 2-5) to conduct an inquiry into a topic that has been set by, or agreed with, the tutor, and using pre-existing non-digital resources e.g. textbook, exam papers etc. (i.e. not generated by the tutor). In tutor-supported sessions, the tutor is available to provide support and advice.
Group practical activity	A TLA type in which students work in a small group (typically, 2-5) on a practical activity using physical tools in the real

	world. In tutor-supported sessions, the tutor is available to provide support and advice. **Typical keywords for this activity and its constituents:** Carry out an investigation/experiment Design/create something Do a role play Do a written/practical exercise
Individual practical activity	A TLA type in which students work individually on a practical activity using physical tools in the real world. In tutor-supported sessions, the tutor is available to provide support and advice. **Typical keywords for this activity and its constituents:** Carry out an investigation/experiment Design/create something Do a written/practical exercise
Formative activity	A TLA type in a tutor-supported class, where students carry out a short activity intended to elicit the current stage of their knowledge/conceptions, or to break up a tutor presentation with some form of interaction. On the basis of students' performance, the teacher can adapt the next segment of the class to address any problems that emerge. **Typical keywords for this activity and its constituents:** **Tutor/lecturer:** Take a vote/poll/show of hands/snapshot survey, Q&A **Student:** Express opinion/view/knowledge/conception, Vote
Student presentation(s)	A TLA type in which students present (or perform) their work in a face-to-face class. **Typical keywords for this activity and its constituents:** Present, Produce, Perform **Session types in which this activity is found:** Tutor-supported class Tutor-supported group **Tools and resources that support this activity:** The students might consider supporting a presentation with the following tools and/or resources: Presentation tool Podcast, Vodcast Digital audio, Digital video
Small-group discussion	A TLA type that denotes face-to-face discussion where a large class is subdivided into groups of 2-5 students for this activity. The teacher takes an active part by moving around the groups to ask questions, provide feedback, ensure each student has their say and keep the discussion on topic. **Typical keywords for this activity and its constituents:** Discuss, Debate, Critique, Evaluate, Negotiate
Resource-based individual activity	A TLA type in which students work individually to conduct an

	inquiry into a topic that has been set by, or agreed with, the tutor, and using pre-existing non-digital resources (i.e. not generated by the tutor). In tutor-supported sessions, the tutor is available to provide support and advice.
Online tutor-guided class discussion (asynchronous) (Forum)	A TLA type that denotes online discussion involving the whole class, but in which students and tutor may be online at different times. The teacher takes an active part by asking questions, providing feedback, ensuring each student has their say and keeping the discussion on topic. **Typical keywords for this activity and its constituents:** Discuss, Debate, Critique, Evaluate, Negotiate
Tutor supported individual work	
Individual tuition, Supervision	A TLA type that denotes an activity in which the student meets the tutor one-to-one. This meeting may be to provide, for example, additional coaching, feedback on a formative assignment, formative feedback on a summative assignment that the student is preparing etc. Typical keywords for this activity and its constituents: Tutor/lecturer: Supervise, Coach, Explain, Mentor, Critique, Counsel, Give support, Give feedback Student: Listen, Ask, Reflect, Justify
Independent Group Work (where teacher is not available/no contact time)	
Online student-only group discussion (asynchronous)	A TLA type that denotes discussion in an online environment involving smaller groups of students (typically, 2-10), in which students may be online at different times. The teacher takes no part in the discussion, although they may set the topic of discussion in advance. **Typical keywords for this activity and its constituents:** Discuss, Debate, Critique, Evaluate, Negotiate
Independent Individual Work (where teacher is not available/no contact time)	
Reflective Journal	Students write a weekly reflective journal – based on idea of teaching metacognition to improve student learning. Initial questions: 1. How did I prepare for my classes this week? 2. What have I done to follow up the lessons 3. What issues are still causing confusion? What have I done about this? 4. What homework tasks have I completed this week? 5. What Moodle activities have I completed 6. Have I used all the readings and activities?
Resource-based individual activity	A TLA type in which students work individually to conduct an inquiry into a topic that has been set by, or agreed with, the tutor, and using pre-existing non-digital resources (i.e. not generated by the tutor). In tutor-supported sessions, the

	tutor is available to provide support and advice. **Typical keywords for this activity and its constituents:** Research, Gather information, Read, Conduct an inquiry Inquiry-based learning (IBL), Problem-based learning (PBL), Case-based learning (CBL), Resource-based learning Do a TEL written/practical exercise
TEL resource-based individual activity	A TLA type in which students work individually to conduct an inquiry into a topic that has been set by, or agreed with, the tutor, and using pre-existing digital resources (i.e. not generated by the tutor). In tutor-supported sessions, the tutor is available to provide support and advice. **Typical keywords for this activity and its constituents:** Research, Gather information, Read, Conduct an inquiry Inquiry-based learning (IBL), Problem-based learning (PBL), Case-based learning (CBL), Resource-based learning
Adaptive digital individual activity, experiment/investigation **TEL**	A TLA type in which students work individually, interacting with digital tools that respond to their input: for example, a simulation, virtual experiment, data analysis tool or intelligent tutoring system. In tutor-supported sessions, the (human) tutor is available to provide support and advice. **Typical keywords for this activity and its constituents:** Conduct an experiment or investigation Build/run a model, Run a simulation Conduct a virtual experiment Learn through playing an online (multiplayer) game Design and run a computer program An interactive and adaptive program or digital tool can offer a highly supportive learning experience for students. This is because the computer can respond immediately to their input. If the tutor is working either in the classroom, or online with the students, it is possible to guide their use of a digital resource in the same way as they do with a textbook.
TEL-based formative assignment, Computer-assessed formative assignment , Quiz	A TLA type that denotes a piece of work that does not contribute to the summative assessment of the module or course, and is marked (assessed) by the computer. Typical examples are multiple-choice quizzes (MCQs). **Typical keywords for this activity and its constituents:** Take a quiz/test, Write a short essay The LDSE classes formative assignments as teaching-learning activities (TLAs) because their primary purpose is learning rather than testing. Computer-assessed assignments have the advantage that the student can take them at any time and receive instant feedback. Moreover, the teacher's contact time (i.e. the time needed to mark the assignment) is zero.

Summative Assessment	
Summative assessment	The session type which you use to define the activity (or activities) that the students will do in the summative assessment of the module. The teacher is present only in the sense that they are marking the assessed work. The summative assessment may take a number of forms: e.g. an exam, a written assignment, a presentation or a performance. The default number of students is 1, although you can change this if the assessment is one that students prepare, and for which they are marked, as a group. If the assessment is an assignment on which students work over an extended period and they receive formative feedback (e.g. comments on drafts of a paper), define those feedback activities separately as Individual tuition (or its online counterpart) in a session of the type Tutor-supported individual work. If the assessment is a report of an independent project carried out over an extended period, define the project as a session of the type Independent group work/Individual group work and the report as the summative assessment.

Appendix J Details of VLE and software used in the study

Page 1 of 2

The MOODLE VLE

One of the key features of Moodle is the way in which the activities can be customised so that students can gradually take on more control of their contributions to the VLE – an essential feature of true Web 2.0 applications. There are numerous ways for students to contribute research, opinions and media in response to assignments set by teachers.

One of the features that is essential to the BLAST project is the opportunity for progression in both sophistication in staff skills and student experience as shown in the figure below. The design of the course will need to reflect the inexperience of the staff and students in using online resources and activities, through a progression from passive retrieval of resources to more active collaborative activities.

Possible progression for a teacher:

1. Putting up the handouts (Resources, SCORM)
2. Providing a passive Forum (unfacilitated)
3. Using Quizzes and Assignments (less management)
4. Using the Wiki, Glossary and Database tools (interactive content)
5. Facilitate discussions in Forums, asking questions, guiding
6. Combining activities into sequences, where results feed later activities
7. Introducing external activities and games (internet resources)
8. Using the Survey module to study and reflect on course activity
9. Using peer-review modules like Workshop, giving students more control over grading and even structuring the course in some ways
10. Conducting active research on oneself, sharing ideas in a community of peers

Possible progression using Moodle (Moodle, 2013:7)

Moodle, a name derived from an acronym for Modular Object-Oriented Dynamic Learning Environment was originally published in 2002, by Martin Dougiamas as part of a PhD project (Dougiamas and Taylor, 2003). Since then he has led the development of the Open Source software that is free to download and install, under GNU licence, and provides forums for support (moodle.org). In 2013 Moodle was reported to be the market leader in the world rankings for LMS, with 68,000 sites and 60 million users in 218 countries (Lambda Solutions, 2013). One of the reasons why Moodle is so popular around the world in schools and universities is the wide ranging variety of support sites, blogs and forums devoted to the program as well as the ability for teachers to backup their courses and restore them intact to another installation of Moodle in another institution.

Software applications used in the Intervention

The table below summarises the software applications used in the intervention. One of the priorities was to use applications that were Open Source or freely available in the public domain. Some of the applications needed licences that were held at the time by the researcher.

Software	Function	Licence
Moodle	VLE Software with core modules and additional modules available for download	Open source GNU http://moodle.org
iSpring Free	Plugin for Microsoft PowerPoint to allow generation of Flash 'popup' slideshows	Freeware http://www.ispringsolutions.com/ispring-free
Fuse Creator	SCORM compatible quiz generator	Licence held by researcher http://store.point2educate.com/fuse-creator.html
Hotpotatoes	SCORM compatible quiz generator	Freeware http://hotpot.uvic.ca/
Content generator	SCORM compatible quiz generator	Licence held by researcher http://www.contentgenerator.net/
LDSE (Learning design support environment)	Support tool for designing and sharing learning designs	Demonstration prototype https://sites.google.com/a/lkl.ac.uk/ldse/
CompendiumLD	Software tool for designing and sharing learning activities	GNU Lesser General Public licence http://compendiumld.open.ac.uk/
CutePDF	Converts documents to PDF format	Freeware http://www.cutepdf.com/

Software used in the BLAST project learning environment

References

Akkerman, S., Bronkhorst, L. and Zitter, I. (2011) 'The complexity of educational design research', *Quality & Quantity,* Online First 5th July 2011, pp. 1-19.

Akyol, Z. and Garrison, D. R. (2011) 'Understanding cognitive presence in an online and blended community of inquiry: Assessing outcomes and processes for deep approaches to learning', *British Journal of Educational Technology,* 42, (2), pp. 233-250.

Amiel, T. and Reeves, T. (2008) 'Design-Based Research and Educational Technology: Rethinking Technology and the Research Agenda', *Educational Technology & Society*, 11, (4), pp. 29-40.

Anderson, T., Rourke, L., Garrison, D. and Archer, W. (2001) 'Assessing Teaching Presence in a Computer Conferencing Context', *Journal of Asynchronous Learning Networks,* 5, (2), pp. 1-17.

Anderson, T. and Shattuck, J. (2012) 'Design-Based Research: A Decade of Progress in Education Research?', *Educational Researcher,* 41, (1), pp. 16-25.

Annand, D. (2011) 'Social Presence within the Community of Inquiry Framework', *The International Review of Research in Open and Distance Learning*, 12, (5), pp. 41-56.

Arbaugh, J. B., Cleveland-Innes, M., Diaz, S. R., Garrison, D. R., Ice, P., Richardson, J. C. and Swan, K. P. (2008) 'Developing a community of inquiry instrument: Testing a measure of the Community of Inquiry framework using a multi-institutional sample', *The Internet and Higher Education*, 11, (3-4), pp. 133-136.

Armellini, A. and Aiyegbayo, O. (2010) 'Learning design and assessment with e-tivities', *British Journal of Educational Technology,* 41, (6), pp. 922-935.

Artino, A. R. (2005) *A Review of the Motivated Strategies for Learning Questionnaire*. Available at: http://eric.ed.gov/?id=ED499083 (Accessed: February 2014).

Atkinson, S. (2013) *Taxonomy Circles: Visualizing the possibilities of intended learning outcomes.* London: BBP University College.

Ball, S. J. (2003) 'The teacher's soul and the terrors of performativity', *Journal of Education Policy*, 18, (2), pp. 215-228.

Bannan-Ritland, B. (2003) 'The Role of Design in Research: The Integrative Learning Design Framework', *Educational Researcher,* 32, (1), pp. 21-24.

Bannan, B. (2009) 'The Integrative Learning Design Framework: An Illustrated Example from the Domain of Instructional Technology', in Plomp, T. and Nieveen, N.(eds) *An Introduction to Educational Design Research.* Enschede: SLO, pp. 53-72.

Barab, S. and Squire, K. (2004) 'Design-Based Research: Putting a Stake in the Ground', *Journal of the Learning Sciences*, 13, (1), pp. 1-14.

Barab, S. A., Baek, E., Schatz, S., Scheckler, R. and Moore, J. (2008) 'Illuminating the braids of change in a web-supported community: A design experiment by another name', in Kelly, A. E., Lesh, R. A. and Back, J.(eds) *Handbook of design research methods in education: Innovations in science, technology, engineering, and mathematics learning and teaching.* New York: Routledge, pp. 321-353.

Barnard-Brak, L., Lan, W. Y. and Paton, V. O. (2011) 'Measuring and Profiling Self-Regulated Learning in the Online Environment', in *Fostering Self-Regulated Learning through ICT.* IGI Global, pp. 27-38.

Barnard-Brak, L., Paton, V. O. and Lan, W. Y. (2010) 'Self-regulation across time of first-generation online learners', *Alt-J*, 18, (1), pp. 61-70.

Bassey, M. (1999) *Case study research in educational settings.* Buckingham: Open University Press.

BBC (2014) *Ofsted marking down traditional teaching*. Available at: http://www.bbc.co.uk/news/education-28365652 (Accessed: July 2014).

Beckman, K., Bennett, S. and Lockyer, L. (2014) 'Understanding students' use and value of technology for learning', *Learning, Media and Technology*, 39, (3), pp. 346-367.

BECTA. (2003) *A review of the research literature on the use of managed learning systems and virtual learning environments in education, and a consideration of the implications for schools in the United Kingdom.* Coventry: BECTA.

BECTA. (2006) *Learning platform functional requirements.* Coventry: BECTA.

BECTA. (2008) *Harnessing technology review 2008: The role of technology and its impact on education.* Coventry: BECTA.

BECTA. (2009b) *Harnessing technology review 2009: The role of technology in education and skills.* Coventry: BECTA.

BECTA (2010) *Learning Platform: Steps to adoption*. Available at: http://www.school-portal.co.uk/GroupDownloadFile.asp?GroupId=162371&ResourceID=3160439 (Accessed: July 2011).

Belland, B. R. (2009) 'Using the theory of habitus to move beyond the study of barriers to technology integration', *Computers & Education*, 52, (2), pp. 353-364.

Benedictus, L. (2013) 'The nudge unit - has it worked so far?', *The Guardian*, 2 May 2013.

Bennett, S. and Maton, K. (2010) 'Beyond the ‘digital natives’ debate: Towards a more nuanced understanding of students' technology experiences', *Journal of Computer Assisted Learning*, 26, (5), pp. 321-331.

Bergmann, J. and Sams, A. (2012) *Flip your Classroom: Reach Every Student in Every Classs Every Day.* Washington, DC: ISTE.

Bernard, R. M., Borokhovski, E., Schmid, R. F., Tamim, R. M. and Abrami, P. C. (2014) 'A meta-analysis of blended learning and technology use in higher education: from the general to the applied', *Journal of Computing in Higher Education*, 26, (1), pp. 87-122.

Beyond Current Horizons (2010) *Beyond Current Horizons*. Available at: http://www.beyondcurrenthorizons.org.uk/ (Accessed: August 2014).

Biesta, G. (2007) 'Why "what works" won't work: Evidence based practice and the democratic deficit in educational research', *Educational Theory,* 57, (1), pp. 1-22.

Biggs, J. and Collins, K. (1982) *Evaluating the Quality of Learning: Structure of the Observed Learning Outcome Taxonomy.* New York: Academic Press Inc.

Black, P., Harrison, C., Lee, C., Marshal, B. and Wiliam, D. (2007) *Assessment for Learning.* Maidenhead: McGraw-Hill Education.

Black, P. and Wiliam, D. (1998) *Inside the black box: Raising standards through classroom asessment.* London: King's College.

Black, P. and Wiliam, D. (2009) 'Developing the theory of formative assessment', *Educational Assessment, Evaluation and Accountability,* 21, (1), pp. 5-31.

Bloom, B. (1984) *Taxonomy of Educational Objectives Book 1: Cognitive Domain.*2nd ed: Addison Wesley Pulishing Company.

Boekaerts, M. (2002) 'Bringing about change in the classroom: strengths and weaknesses of the self-regulated learning approach', *Learning and Instruction*, 12, (6), pp. 589-604.

Boekaerts, M., Pintrich, P. and Zeidner, M. (2000a) 'Self-regulation. An introductory overview', in Boekaerts, M., Pintrich, P. and Zeidner, M.(eds) *Handbook of Self-regulation.* New York: Academic Press.

Bogle, L., Cook, V., Day, S. and Swan, K. (2009) 'Blended Program Development: Applying the Quality Matters and Community of Inquiry Frameworks to Ensure High Quality Design and Implementation', *Journal of the Research Center for Educational Technology (RCET),* 5, (2), pp. 51-66.

Bonk, C. (2010) *Overcoming the Technology Resistance Movement*. Available at: http://publicationshare.com/Overcoming-the-Technology-Resistance-Movement-Inside-the-School.htm (Accessed: June 2014).

Bradley, B. A. and Reinking, D. (2011) 'Enhancing research and practice in early childhood through formative and design experiments', *Early Child Development and Care,* 181, (3), pp. 305-319.

Brasher, A., Conole, G., Cross, S., Weller, M., Clarke, P. and White, J. (2008) *In: Proceedings of the 2008 European LAMS Conference: Practical Benefits of Learning Design.* Cadiz, Spain:Open University.

Brown, A. L. (1992) 'Design Experiments: Theoretical and Methodological Challenges in Creating Complex Interventions in Classroom Settings', *Journal of the Learning Sciences,* 2, (2), pp. 141-178.

Brown, S. R. (1980) *Political subjectivity: applications of Q methodology in political science.* New Haven: Yale University Press.

Brown, S. R. (1993) 'A Primer on Q Methodology', *Operant Subjectivity*, 16, pp. 91-138 (The original text for this is available at: http://facstaff.uww.edu/cottlec/QArchive/Primer1.html.

Brown, S. R. (1996) 'Q Methodology and Qualitative Research', *Qualitative Health Research,* 6, (4), pp. 561-567.

Bruner, J. (1996) *The culture of education.* Cambridge, MA: Harvard University Press.

Butler, D. L. and Winne, P. H. (1995) 'Feedback and Self-Regulated Learning: A Theoretical Synthesis', *Review of Educational Research,* 65, (3), pp. 245-281.

Cameron, D. (2011) 'We shall shame schools that 'muddle through'', *The Telegraph*, 13 November 2011.

Chang, M.-M. (2005) 'Applying Self-Regulated Learning Strategies in a Web-Based Instruction—An Investigation of Motivation Perception', *Computer Assisted Language Learning*, 18, (3), pp. 217-230.

Chi, M. T., Leeuw, N., Chiu, M. H. and LaVancher, C. (1994) 'Eliciting self-explanations improves understanding', *Cognitive science,* 18, (3), pp. 439-477.

Chickering, A. and Gamson, Z. (1987) 'Seven principles for practice in undergraduate education', *AAHE Bulletin,* 39, (7), pp. 3-7.

Chickering, A. W. and Gamson, Z. F. (1999) 'Development and adaptations of the seven principles for good practice in undergraduate education', *New Directions for Teaching and Learning*, 1999, (80), pp. 75-81.

Chico (2010) *California State University: Rubric for online instruction*. Available at: http://www.csuchico.edu/roi/the_rubric.shtml (Accessed: June 2010).

Chingos, M. and Schwerdt, G. (2014) *Virtual Schooling and Student Learning: Evidence from the Florida Virtual School.* Cambridge, MA: Harvard Kennedy School.

Christensen, C., Horn, M. and Johnson, C. (2008) *Disrupting Class: How innovation will change the way the world learns.* New York: McGraw-Hill.

Christensen, C., Horn, M. B. and Staker, H. (2013) 'Is K-12 blended learning disruptive?: An introduction of the theory of hybrids', *Clayton Christensen Institute (May 2013).*

Churches, A. (2009) *Bloom's digital taxonomy*. Available at: http://edorigami.wikispaces.com/Bloom%27s+Digital+Taxonomy (Accessed: July 2011).

Clark, I. (2012) 'Formative Assessment: Assessment Is for Self-regulated Learning', *Educational Psychology Review,* 24, (2), pp. 205-249.

Cobb, P., Confrey, J., di Sessa, A., Lehrer, R. and Schauble, L. (2003) 'Design experiments in education research', *Educational Researcher,* 32, (1), pp. 9-13.

Coe, R. (2000) *Effect Size Resources*. Available at: http://www.cem.org/evidence-based-education/effect-size-resources (Accessed: March 2014).

Coe, R. (2004) 'Issues arising from the use of effect sizes in analysing and reporting research', in Scagan, I. and Elliot, K.(eds) *But what does it mean? The use of effect sizes in educational research.* Slough: National Federation for Educational Research.

Cohen, L., Manion, L. and Morrison, K. (2011) *Research Methods in Education.*7th ed Abingdon: Routledge.

Compendium Institute (2012) *Compendium Institute*. Available at: http://compendiuminstitute.net/index.htm (Accessed: December 2012).

Conlon, T. (2008) 'The dark side of Glow: balancing the discourse', *Scottish Educational Review,* 40, (2), pp. 64-75.

Conole, G. (2010a) 'Learning Design - Making Practice explicit', *ConnectEd 2010: 2nd International conference on Design Education 28th June - 1 July 2010.* Sydney, Australia, Open University.

Conole, G. (2010b) *Proceedings of the 7th International Conference on Networked Learning, .* Aalborg, Denmark, 2010. Denmark:Aalborg University.

Conole, G. (2013) *Designing for learning in an open world.* New York: Springer.

Conole, G. (2014) *Reviewing the trajectories of e-learning*. Available at: http://e4innovation.com/?m=201401 (Accessed: Jan 15th 2014).

Conole, G., de Laat, M., Dillon, T. and Darby, J. (2008) ''Disruptive technologies', 'pedagogical innovation': What's new? Findings from an in-depth study of students' use and perception of technology', *Computers & Education*, 50, (2), pp. 511-524.

Conole, G. and Wills, S. (2013) 'Representing learning designs – making design explicit and shareable', *Educational Media International*, 50, (1), pp. 24-38.

Convery, A. (2009) 'The pedagogy of the impressed: how teachers become victims of technological vision', *Teachers and Teaching*, 15, (1), pp. 25-41.

Crabtree, H., Roberts, C. and Tyler, C. (2007) *Education in a Changing Environment.*University of Salford.

Crook, C. (2012) 'The 'digital native' in context: tensions associated with importing Web 2.0 practices into the school setting', *Oxford Review of Education*, 38, (1), pp. 63-80.

Cuban, L. (1986) *Teachers and Machines: The Classroom Use of Technology since 1920.* New York: Teachers College Press.

Cuban, L., Kirkpatrick, H. and Peck, C. (2001) 'High Access and Low Use of Technologies in High School Classrooms: Explaining an Apparent Paradox', *American Educational Research Journal*, 38, (4), pp. 813-834.

Currant, B. and Keenan, C. (2009) 'Educating Systematic Transition to Higher Education', *The Brookes eJournal of Learning and Teaching*, 2, (4).

Dale, R., Robertson, S. and Shortis, T. (2004) ''You can't not go with the technological flow, can you?' Constructing 'ICT' and 'teaching and learning'', *Journal of Computer Assisted Learning*, 20, pp. 456-470.

Darbyshire, P. (2005) 'Multiple methods in qualitative research with children: more insight or just more?', *Qualitative Research*, 5, (4), pp. 417-436.

de Bono, E. (2009) *Six Thinking Hats.* London: Penguin Books.

Deignan, T. (2009) 'Enquiry-Based Learning: perspectives on practice', *Teaching in Higher Education*, 14, (1), pp. 13-28.

Design-Based Research Collective. (2003) 'Design-Based Research: An Emerging Paradigm for Educational Inquiry', *Educational Researcher*, 32, (1), pp. 5-8.

Dewey, J. (1933) *How We Think: A Restatement of the Relation of Reflective Thinking to the Educative Process.* Boston: Heath.

Dewey, J. (2009) 'Education as engineering', *Journal of Curriculum Studies,* 41, (1), pp. 1-5.

DfE. (2014) *Initial teacher training census for the academic year 2014 to 2015.* Department for Education.

Dougiamas, M. and Taylor, P. (2003) 'Moodle: Using learning Communities to Create an Open Source Course Management System', in Lassmer, D. and McNaught, C.(eds) *Proceedings of World Conference on Educational Multimedia and relecommunications 2003.* Cheapeake, VA: AACE, pp. 171-178.

Drent, M. and Meelissen, M. (2008) 'Which factors obstruct or stimulate teacher educators to use ICT innovatively?', *Computers & Education,* 51, (1), pp. 187-199.

Drysdale, J. S., Graham, C. R., Spring, K. J. and Halverson, L. R. (2013) 'An analysis of research trends in dissertations and theses studying blended learning', *The Internet and Higher Education,* 17, pp. 90-100.

Duncan, T. G. and McKeachie, W. J. (2005) 'The Making of the Motivated Strategies for Learning Questionnaire', *Educational Psychologist,* 40, (2), pp. 117-128.

Dweck, C. (1999) *Self-theories: their role in motivation, personality and development.* Philadephia, PA: Psychology Press.

Dwinal, M. (2015) *Solving the Nation's Teacher Shortage. How online learning can fix the broken teacher labor market.* Clayten Christensen Institute.

Dyment, J. E. and O'Connell, T. S. (2011) 'Assessing the quality of reflection in student journals: a review of the research', *Teaching in Higher Education,* 16, (1), pp. 81-97.

Edelson, D. (2006) 'Balancing innovation and risk. Assessing design research proposals', in Van den Akker, J., Gravemeijer, K., McKenney, S. and Nieveen, N.(eds) *Educational Design Research.* Hoboken: Routledge.

Educause (2012) *7 things you should know about flipped classrooms*. Available at: https://net.educause.edu/ir/library/pdf/eli7081.pdf (Accessed: August 2013).

Elliott, J. (2001) 'Making evidence-based practice educational', in Hammersley, M.(ed), *Educational Research and Evidence-based Practice.* Milton Keynes: The Open University.

Ellis, R., Weyers, M. and Hughes, J. (2013) 'Campus-based student experiences of learning technologies in a first-year science course', *British Journal of Educational Technology,* 44, (5), pp. 745-757.

Ellis, R. A., Goodyear, P., Prosser, M. and O'Hara, A. (2006) 'How and what university students learn through online and face to face discussion: Conceptions, intentions and approaches.', *Journal of Computer Assisted Learning*, 22, pp. 244-256.

Facer, K. and Sandford, R. (2010) 'The next 25 years?: future scenarios and future directions for education and technology', *Journal of Computer Assisted Learning*, 26, (1), pp. 74-93.

Falconer, I. and Littlejohn, A. (2007) 'Designing for blended learning, sharing and reuse', *Journal of Further and Higher Education*, 31, (1), pp. 41-52.

Fellenz, M. R. (2004) 'Using assessment to support higher level learning: the multiple choice item development assignment', *Assessment & Evaluation in Higher Education*, 29, (6), pp. 703-719.

Field, R. M. and Kent, B. E. (2006) *9th Pacific Rim First Year in Higher Education Conference: Engaging Students.* Gold Coast, Queensland:Queensland University of Technology.

Fisher, L. (2007) 'Pedagogy and the Curriculum 2000 reforms at post-16: the 'learn it, forget it' culture', *The Curriculum Journal*, 18, (1), pp. 103-114.

Flipped Learning Network (2014) *Extension of a literature review of flipped learning.* Available at: http://flippedlearning.org/cms/lib07/VA01923112/Centricity/Domain/41/Extension%20of%20FLipped%20Learning%20LIt%20Review%20June%202014.pdf (Accessed: December 2014).

Florida Department of Education (2014) *Virtual Education*. Available at: http://www.fldoe.org/schools/school-choice/virtual-edu/index.stml (Accessed: December 2014).

Florida Virtual School. (2014) *Florida Virtual School Legislative Report 2012-2013.* Florida: Florida Virtual School.

Flyvbjerg, B. (2006) 'Five Misunderstandings About Case-Study Research', *Qualitative Inquiry*, 12, (2), pp. 219-245.

Fullan, M. (2013) *Stratosphere: Integrating Technology, Pedagogy and Change Knowledge.* Toronto: Pearson.

Fullan, M. (2014) *A Rich Seam: How New Pedagogies Find Deep Learning.* London: Pearson.

Fullan, M. and Donnelly, K. (2013) *Alive in the swamp: Assessing digital innovations in education.* London: Nesta.

FVLS (2014) *Florida Virtual School*. Available at: http://www.flvs.net/Pages/default.aspx (Accessed: December 2014).

Gandy, O. (1996) 'Coming to terms with the Panoptic sort', in Lyon, D. and Zureik, H.(eds) *Computers, Surveillance and Privacy.* Minneapolis: University of MInnesota Press, pp. 132-155.

Gardner-Medwin, A. (2006) 'Confidence-based marking: towards deeper learning and better exams', in Bryan, C. and Clegg, K.(eds) *Innovative assessment in higher education.* London: Taylor and Francis.

Garrison, D. R. (2011) *E-Learning in the 21st Century : A Framework for Research and Practice,.*2 ed Hoboken: Routledge.

Garrison, D. R., Anderson, T. and Archer, W. (2000) 'Critical Inquiry in a text-based environment: Computer conferencing in higher education', *The Internet and Higher Education,* 2, pp. 97-105.

Garrison, D. R., Anderson, T. and Archer, W. (2010) 'The first decade of the community of inquiry framework: A retrospective', *The Internet and Higher Education,* 13, (1-2), pp. 5-9.

Garrison, D. R. and Vaughan, N. (2008) *Blended Learning in Higher Education: Framework, Principles and Guidelines.* San Francisco: Jossey-Bass.

Gartner Inc. (2013) *Hype Cycle for Education.* Stamford, USA: Gartner, Inc.

Giddings, L. (2007) 'A Trojan Horse for Positivism: A Critique of Mixed Methods Research', *Advances in Nursing Science,* 30, (1), pp. 52-60.

Goatman, A. and Medway, D. (2011) 'A future for undergraduate education in UK business schools?', *Journal of Marketing for Higher Education,* 21, (1), pp. 107-114.

Goh, T., Seet, B. and Chen, N. (2011) 'The impact of persuasive SMS on students' self-regulated learning', *British Journal of Educational Technology*.

Green, A. (2007) 'Issues in the Transition from Post-16 to Higher Education: A Review of Recent Literature', *International Journal of Adolescence and Youth,* 14, pp. 77-91.

Grow, G. (1991) 'Teaching learners to be self-directed', *Adult Education Quaterly,* 41, (3), pp. 125-149.

Halverson, L. R., Graham, C. R., Spring, K. J. and Drysdale, J. S. (2012) 'An analysis of high impact scholarship and publication trends in blended learning', *Distance Education,* 33, (3), pp. 381-413.

Hargreaves, A. (2002) 'Sustainability of educational change: The role of social geographies', *Journal of Educational Change,* 3, pp. 189-214.

Hargreaves, D. (1996) *Teacher Training Annual Lecture.* London:Teacher Training Agency.

Harnisch, H. and Taylor-Murison, L. (2011) 'Transition and technology - Evaluation of blended learning delivered by university staff to 6th form students', *British Journal of Educational Technology*, (Early view).

Harper, D. (2002) 'Talking about pictures: A case for photo elicitation', *Visual Studies*, 17, (1), pp. 13-26.

Harrison, A. (2012) *More teachers to learn in classroom - Michael Gove*. Available at: http://www.bbc.co.uk/news/education-18427512 (Accessed: December 2014).

Harvey, L., Drew, S. and Smith, M. (2006) *The first year experience: a review of the literature for the Higher Education Academy.* Sheffield Hallam University.

Hattie, J. (2009) *Visible Learning: A Synthesis of Over 800 Meta-analyses Relating to Achievement.* Hoboken: Routledge.

Hattie, J. and Timperley, H. (2007) 'The Power of Feedback', *Review of Educational Research*, 77, (1), pp. 81-112.

Haynes, L., Goldacre, B. and Torgerson, D. (2012) 'Test, learn, adapt: developing public policy with randomised controlled trials', *Cabinet Office-Behavioural Insights Team*.

Heinze, A. (2008) *Blended Learning: An interpretive action research study*. Thesis. University of Salford.

Heinze, A., Procter, C. and Scott, B. (2007) 'Use of conversation theory to underpin blended learning', *International Journal of Teaching and Case Studies*, 1, (1/2), pp. 108-120.

Herold, B. (2014) 'Growing Pains for Rocketship's Blended-Learning Juggernaut', *Education Week*, 21st Januray 2014.

Herrington, J., McKenney, S., Reeves, T. and Oliver, R. (2007) 'Design-based research and doctoral students: Guidelines for preparing dissertation proposal', *Research Online*.

Herrington, J. and Reeves, T. C. (2011) 'Using design principles to improve practice and promote student engagement', in Williams, G., Statham, P., Brown, N. and Cleland, B.(eds) *Changing Demands, Changing Directions. Proceedings ascilite Hobart 2011.* Hobart: ascilite, pp. 594-601.

Higgins, S., Xiao, Z. and Katsipataki, M. (2012) *The Impact of Digital Technology on Learning: A Summary for the Education Endowment Foundation.* London: EEF.

Hixon, E., Buckenmeyer, J., Barczyk, C., Feldman, L. and Zamojski, H. (2012) 'Beyond the early adopters of online instruction: Motivating the reluctant majority', *The Internet and Higher Education*, 15, (2), pp. 102-107.

Hoadley, C. (2002) *Proceedings of Computer Support for Cooperative Learning (CSCL) 2002.* Boulder, CO:Lawrence Erlbaum.

Hoeft, M. (2012) 'Why University Students Don't Read: What Professors Can Do To Increase Compliance', *International Journal for the Scholarship of Teaching and Learning,* 6, (2).

Hofer, B., Yu, S. and Pintrich, P. R. (1998) 'Teaching college students to be self-regulated learners', in Schunk, D. and Zimmerman, B.(eds) *Self-regulated learning: From teaching to self-reflective practice.* New York: Giulford, pp. 57-85.

House of Commons. (2015) *Academies and free schools.* London: House of Commons, Education Committee.

Howard, J. R. (2004) 'Just-In-Time Teaching in Sociology Or How I Convinced My Students to Actually Read the Assignment', *Teaching Sociology,* 32, (4), pp. 385-390.

Howard, S. K. (2013) 'Risk-aversion: understanding teachers' resistance to technology integration', *Technology, Pedagogy and Education,* 22, (3), pp. 357-372.

Jewitt, C., Hadjithoma-Garstka, C., Clark, W., Banaji, S. and Selwyn, N. (2010) *School use of learning platforms and associated technologies.* Coventry: BECTA.

Jezegou, A. (2010) 'Community of Inquiry in e-Learning: A Critical Analysis of the Garrison and Anderson Model', *The Journal of Distance Education,* 24, (3).

Jimoyiannis, A. (2008) 'Factors determining teachers' beliefs and perceptions of ICT in education.', in Cartelli, A. and Palma, M.(eds) *Encyclopedia of information communication technology.* Hershey, PA: IGI Global, pp. 321-334.

Jimoyiannis, A. (2010) 'Designing and implementing an integrated technological pedagogical science framework for science teachers professional development', *Computers & Education,* 55, (3), pp. 1259-1269.

Jonassen, D. (1999) 'Designing Constructivist Learning Environments', in Reigeluth, C.(ed), *Instructional-design theories and models: A new paradign of instructional theory.* Vol. II Mahwah, NJ: Lawrence Erlbaum Associates, pp. 215-239.

Jones, C. and Kennedy, G. (2011) 'Stepping beyond the paradigm wars: pluralist methods for research in learning technology', *Research in Learning Technology,* 19, (1).

Kagan, S. (1989) *Cooperative learning resources for teachers.* San Juan Capistrano CA: Resources for Teachers.

Kagan, S. (2011) *Kagan Cooperative Learning*. Available at: http://www.kaganonline.com/about_us.php (Accessed: 5th July 2011).

Kennedy, G., Judd, T., Dalgarno, B. and Waycott, J. (2010) 'Beyond natives and immigrants: exploring types of net generation students', *Journal of Computer Assisted Learning*, 26, (5), pp. 332-343.

Kirk, D. (2014) *Business Model of Education Reform Exposed*. Available at: http://millermps.wordpress.com/ (Accessed: August 2014).

Kirkwood, A. and Price, L. (2013) 'Technology-enhanced learning and teaching in higher education: what is 'enhanced' and how do we know? A critical literature review', *Learning, Media and Technology*, 39, (1), pp. 6-36.

Koehler, M. and Mishra, P. (2009) 'What is technological pedagogical content knowledge?', *Contemporary Issues in Technology and Teacher Education*, 9, (1), pp. 60 - 70.

Kolb, A. and Kolb, D. (2005) 'Learning styles and learning spaces: Enhancing experiential learning in higher education', *Academy of Management Learning and Education*, 4, (2), pp. 193-212.

Kolb, D. (1984) *Experientiall learning: Experience as the source of learning and development.* Englewood Cliffs, New Jersey: Prentice-Hall.

Lafer, G. (2014) *Do poor kids deserve lower-quality education than rich kids? Evaluating school privatization proposals in Milwaukee, Wisconsin.* Washington: Economic Policy Institute.

Lambda Solutions (2013) *Moodle Market Share Statistics*. Available at: http://www.lambdasolutions.net/blog/2013/01/moodle-market-share-statistics-show-its-the-market-leader/ (Accessed: August 2014).

Land, B. and Bayne, S. (2002) 'Screen or monitor? Survellance and disciplinary power in online learning environments', in Rust, C.(ed), *Improving Student Learning using Learning Technology*. Oxford: OCSLD, pp. 125-138.

Langer, A. M. (2010) 'Reflecting on Practice: using learning journals in higher and continuing education', *Teaching in Higher Education*, 7, (3), pp. 337-351.

Laurillard, D. (1993) *Rethinking University Teaching: A Framework for the Effective Use of Educational Technology*. London: Routledge/Falmer.

Laurillard, D. (2002) *Rethinking university teaching: a conversational framework for the effective use of learning technologies.* London: Routledge Falmer.

Laurillard, D. (2008a) 'The teacher as action researcher: using technology to capture pedagogic form', *Studies in Higher Education*, 33, (2), pp. 139-154.

Laurillard, D. (2009) 'The pedagogical challenges to collaborative technologies', *Computer Supported Collaborative Learning,* 4, (1), pp. 5-20.

Laurillard, D., Charlton, P., Craft, B., Dimakopoulos, D., Ljubojevic, D., Magoulas, G., Masterman, E., Pujadas, R., Whitley, E. A. and Whittlestone, K. (2011) 'A constructionist learning environment for teachers to model learning designs', *Journal of Computer Assisted Learning*, pp. 1-16.

Laurillard, D. and Ljubojevic, D. (2009) 'Evaluating learning designs through the formal representation of learning patterns', ALT-C 2009.

Laurillard, D. and Ljubojevic, D. (2011b) 'Evaluating Learning Designs through Formal Representation of Pedagogical Patterns', in Kohls, C. and Wedekind, J.(eds) *Investigations of E-Learning Patterns: Context Factors, Problems and Solutions.* Hershay, PA: IGI Global, pp. 86-105.

Laurillard, D. M. (2008b) *Professorial Lecture.* London:Institute of Education, London.

Laurillard, D. M. (2012) *Teaching as a Design Science, Building Pedagogical Patterns for Learning and Technology.* Abingdon: Routledge.

LDSE (2011) *Using digital technologies to support teachers in designing effective technology-enhanced learning (TEL).* Available at: https://sites.google.com/a/lkl.ac.uk/ldse/ (Accessed: July 2011).

Leese, M. (2010) 'Bridging the gap: supporting student transitions in higher education', *Journal of Further and Higher Education,* 34, (2), pp. 239-251.

Li, Q., Clark, B. and Winchester, I. (2010) 'Instructional design and technology grounded in enactivism: A paradigm shift?', *British Journal of Educational Technology,* 41, (3), pp. 403-419.

Li, S. C. and Choi, T. H. (2013) 'Does social capital matter? A quantitative approach to examining technology infusion in schools', *Journal of Computer Assisted Learning*, pp. n/a-n/a.

Littlejohn, A. (2003) *Reusing online resources: a sustainable approach to e-learning.* London: Routledge.

Littlejohn, A. and Pegler, C. (2007) *Preparing for blended e-learning.*1 ed Oxford: Routledge.

Luckin, R., Bligh, B., Munces, A., Ainsworth, S., Crook, C. and Noss, R. (2012) *Decoding Learning: The Proof, Promise and Potential of Digital Education.* London: Nesta.

Luo, H. (2011) 'Qualitative Research on Educational Technology: Philosophies, Methods and Challenges', *International Journal of Education,* 3, (2).

Lyman, F. (1987) 'Think-pair-share: An expanding teaching technique', *MAA-CIE Cooperative News*, 1, (1), pp. 1-2.

Macaskill, A. and Taylor, E. (2010) 'The development of a brief measure of learner autonomy in university students', *Studies in Higher Education,* 35, (3), pp. 351-359.

Mansell, W. (2012) 'Should Pearson, a giant multinational, be influencing our education policy?', *The Guardian*, 16th July 2012.

Marriott, A. (2007) 'The transition from A level to degree geography', *Teaching Geography*, (Spring 2007).

Masterman, E. and Manton, M. (2011) 'Teachers' perspectives on digital tools for pedagogic planning and design', *Technology, Pedagogy and Education,* 20, (2), pp. 227-246.

Maton, K. and Moore, R. (2000) 'Historical Amnesia: Victims of fashion and outbreaks of 'breaks' in the disciplinary map*', British Sociological Association Annual Conference.* University of York, BSA.

Mayes, J. (1995) 'Learning Technology and Groundhog Day', in Strang, W., Simpson, V. and Slater, D.(eds) *Hypermedia at work: Practice and theory in higher education.* Canterbury, UK: University of Kent Press.

Mayes, T. (2007) 'Groundhog day again? Keynote speech*', JISC Conference, Innovating e-learning 2007: Institutional Transformation and Supporting Lifelong Learning.* Online, 2007. JISC.

McClean, S., Hagan, P. and Morgan, J. (2010) 'Text messaging for student communication and voting', *Bioscience Education,* (16).

McKenney, S. (2013) 'Designing and researching technology-enhanced learning for the zone of proximal implementation', *Research in Learning Technology,* 21, (0).

McKenney, S., Nieveen, N. and Van den Akker, J. (2006) 'Design research from a curriculum perspective', in Van den Akker, J., Gravemeijer, K., McKenney, S. and Nieveen, N.(eds) *Educational Design Research.* London: Routledge, pp. 62-90.

McKenney, S. and Reeves, T. (2012) *Conducting Educational Design Research.* Abingdon: Routledge.

McKenney, S. and Reeves, T. C. (2013) 'Systematic Review of Design-Based Research Progress: Is a Little Knowledge a Dangerous Thing?', *Educational Researcher,* 42, (2), pp. 97-100.

McTague, T. (2014) 'Computers to replace teachers in the classroom by 2016, under radical plans being considered by new free school', *Daily Mail*, 13th June 2014.

Means, B., Toyama, Y., Murphy, R. and Baki, M. (2013) 'The Effectiveness of Online and Blended Learning: A Meta-Analysis of the Emprical Literature', *Teachers College Record*, 115, (3).

Meijer, M., Bulte, A. and Pilot, A. (2009) 'An Approach for Design-Based Research Focusing on Design Principles for Science Education: A Case Study on a Relevant Context for Macro-micro Thinking', in Plomp, T. and Nieveen, N.(eds) *Educational Design Research - Part B: Illustrative cases.* Enschede, the Netherlands: SLO, pp. 641-664.

Meyer, B. (2010) 'Independent learning: a literature review and a new project', *British Educational Research Assiciation Annual Conference.* University of Warwick, University of Warwick.

Meyer, B., Haywood, N., Sachdev, D. and Faraday, S. (2008) *Independent Learning: Literature Review.* Learning skills network: Research report No. DCSF-RR051.

Mikroyannidis, A., Connolly, T. and Law, E. L.-C. (2012) 'A Survey into the Teacher's Perception of Self-Regulated Learning', *12th IEEE International Conference on Advanced learning Technologies.* Rome, 4-6 June 2012. Institute of Electrical and Electronics Engineers (IEEE).

Mitchell, P. and Forer, P. (2010) 'Blended Learning: The Perceptions of First-year Geography Students', *Journal of Geography in Higher Education*, 34, (1), pp. 77-89.

Moodle (2013) *Pedagogy*. Available at: http://docs.moodle.org/26/en/Pedagogy (Accessed: 14 Jan 2014).

Moore, N. and Gilmartin, M. (2010) 'Teaching for Better Learning: A Blended Learning Pilot Project with First-Year Geography Undergraduates', *Journal of Geography in Higher Education*, 34, (3), pp. 327-344.

Mor, Y. (2011) 'Design narratives: an intuitive scientific form for capturing design knowledge in education', *Sixth Chais Conference on Instructional Technologies Research: Learning in the Technological Era.* Raanana, Israel, 17 Feb 2011. Chais.

Mor, Y. (2013) 'SNaP! Re-using, sharing and communicating designs and design knowledge using scenarios, narratives and patterns', in Luckin, R., Puntambeker, S., Goodyear, P., Grabowski, B., Underwood, J. and Winters, N.(eds) *Handbook of Design in Educational Technology.* London, UK: Routledge, pp. 189-200.

Mor, Y., Ferguson, R. and Wasson, B. (2015) 'Editorial: Learning design, teacher inquiry into student learning and learning analytics: A call for action', *British Journal of Educational Technology*, 46, (2), pp. 221-229.

Morris, E. (2012) 'Labour proposals for new education body could prove revolutionary', *The Guardian*, 27.02.2012.

Mostert, M. and Snowball, J. D. (2012) 'Where angels fear to tread: online peer-assessment in a large first-year class', *Assessment & Evaluation in Higher Education*, pp. 1-13.

Mulholland, H. (2012) 'Michael Gove tells academies thay can hire unqualfied teaching staff', *The Guardian*, 27th July 2012.

Murtagh, L. (2010) 'They give us homework! Transition to higher education: the case of initial teacher training', *Journal of Further and Higher Education,* 34, (3), pp. 405-418.

Neo, M., Neo, K. and Lim, S. (2013) 'Designing a web-based multimedia learning environment with Laurillard's conversational framework: An investigation on instructional relationships', *The Turkish Online Journal of Educational Technology*, 12, (3), pp. 39-50.

Nicol, D. (2006) 'Increasing success in first year courses: assessment re-design, self-regulation and learning technologies'*, ASCILITE.* Sydney, ASCILITE.

Nicol, D. (2007a) 'E-assessment by design: using multiple-choice questions to good effect', *Journal of Further and Higher Education,* 31, (1), pp. 53-64.

Nicol, D. (2007b) *REAP Re-engineering Assessment Practices in Scottish Higher Education.* Edinburgh: JISC.

Nicol, D. (2009) *Transforming assessment and feedback: enhancing integration and empowerment in the first year.* Glasgow: QAA Scotland, available at www.enhancementthemes.ac.uk/publications.

Nicol, D. (2009a) 'Assessment for learner self-regulation: enhancing achievement in the first year using learning technologies', *Assessment & Evaluation in Higher Education,* 34, (3), pp. 335-352.

Nicol, D. and Milligan, C. (2006a) 'Rethinking technology-supported assessment practices in relation to the seven principles of good assessment practice', in Bryan, C. and Clegg, K.(eds) *Innovative Assessment in Higher Education.* London: Taylor and Francis.

Nicol, D. J. and Macfarlane-Dick, D. (2006) 'Formative assessment and self-regulated learning: a model and seven principles of good feedback practice', *Studies in Higher Education,* 31, (2), pp. 199-218.

O'Connell, T. S. and Dyment, J. E. (2011) 'The case of reflective journals: is the jury still out?', *Reflective Practice,* 12, (1), pp. 47-59.

OECD. (2014) *Programme for International Student Achievement - PISA results for 2012.* OECD.

Ofsted. (2009) *Virtual learning environments: an evaluation of their development in a sample of educational settings.* London: Ofsted.

Ofsted. (2010) *Ofsted Report (Anonymised).* Ofsted.

Ofsted. (2013a) *Too many bright children let down in the state system.* Ofsted.

Ofsted (2013b) *Virtual Learning Environments: e-portfolio*. Available at: http://www.ofsted.gov.uk/resources/virtual-learning-environments-e-portfolio (Accessed: 14 Jan 2014).

Ofsted. (2013c) *Virtual Learning Environments: Eleven case studies of good practice.* London: Ofsted.

Ofsted. (2013d) *What the reports say: Extracts from Ofsted reports in 2011-2012 with references to virtual learning environments.* London: Ofsted.

Oliver, M. (2009) 'A decade on, and it's still Groundhog Day: questioning research on technology in higher education', *Enhancing Learning in the Social Sciences,* 1, (3).

Oliver, M. (2014) 'Fostering Relevant Research on Educational Communications and Technology', in Spector, J. e. a.(ed), *Handbook of Reserach on Educational Communications and Technology.* New York: Springer Science, pp. 909 - 918.

Oliver, M. and Trigwell, K. (2005) 'Can 'Blended Learning' Be Redeemed?', *E-Learning*, 2, (1), pp. 17-26.

Oliver, R. (2008) 'Engaging first year students using a web-supported inquiry-based learning setting', *Higher education*, 55, (3), pp. 285-301.

Open University (2011) *CompendiumLD learning design software*. Available at: http://compendiumld.open.ac.uk/ (Accessed: 6th June 2012).

Opportunityculture.org. (2013) *Rocketship Education. An opportunity culture case study.* Opportunity culture.

Orhan, F. (2007) 'Applying Self-Regulated Learning Strategies in a Blended Learning Instruction', *World Applied Sciences Journal*, 2, (4), pp. 390-398.

Ormel, B. J. B., Pareja Roblin, N. N., McKenney, S. E., Voogt, J. M. and Pieters, J. M. (2012) 'Research–practice interactions as reported in recent design studies: still promising, still hazy', *Educational Technology Research and Development*, 60, (6), pp. 967-986.

OULDI (2011) *Open University Learning Design Initiative*. Available at: http://www.open.ac.uk/blogs/OULDI/ (Accessed: 5th July 2011).

Pandika, M. (2014) 'Rocketship charter school litigation battles highlight community tensions', *Peninsular press*, 4th April, 2014.

Parkes, M., Stein, S. and Reading, C. (2015) 'Student preparedness for university e-learning environments', *The Internet and Higher Education*, 25, pp. 1-10.

Parr, J. M. and Fung, I. (2000) *A review of the literature on computer-assisted learning, particularly integrated learning systems, and outcomes with respest to literacy and numeracy.* Auckland: University of Auckland.

Pask, G. (1976) *Conversation Theory: Applications in education and epistemology.* Amsterdam: Elsevier.

Passey, D. (2011) 'Implementing learning platforms into schools: an architecture for wider involvement in learning', *Learning, Media and Technology*, 36, (4), pp. 367-397.

Passey, D. and Higgins, S. (2011) 'Learning platforms and learning outcomes – insights from research', *Learning, Media and Technology*, 36, (4), pp. 329-333.

Perry, C. and Allard, A. (2003) 'Making the connections: transition experiences for first-year education students', *Journal of Educational Enquiry*, 4, (2), pp. 74-89.

Persico, D. and Pozzi, F. (2015) 'Informing learning design with learning analytics to improve teacher inquiry', *British Journal of Educational Technology*, 46, (2), pp. 230-248.

Philosophy4Children (2014) *Philosophy for Children*. Available at: http://www.philosophy4children.co.uk/ (Accessed: August 2014).

Picciano, A. G., Seaman, J., Shea, P. and Swan, K. (2012) 'Examining the extent and nature of online learning in American K-12 Education: The research initiatives of the Alfred P. Sloan Foundation', *The Internet and Higher Education*, 15, (2), pp. 127-135.

Pintrich, P. (2000) 'The role of goal orientation in self-regulated learning', in Boekaerts, M., Pintrich, P. and Zeidner, M.(eds) *Handbook of self-regulated learning.* San Diego: Academic Press, pp. 451-502.

Pintrich, P. and Zusho, A. (2002) 'Student motivation and self-regulated learning in the college classroom', in Smart, J. and Tierney, W.(eds) *Higher Education: handbook of theory and research (vol. XVII).* New York: Agathon Press.

Pintrich, P. R., Smith, D. A., Garcia, T. and McKeachie, W. J. (1991) *A manual for the use of the motivational strategies for learning questionnaire (MSLQ).* Michigan: University of Michigan, National Center for Research to Improve Postsecondary Teaching and Learning.

Plomp, T. (2009) 'Educational Design Research: an Introduction', in Plomp, T. and Nieveen, N.(eds) *An Introduction to Educational Design Research.* Enschede: SLO, pp. 9-37.

Pollard, A. (2010) *Professionalism and pedagogy: a contemporary opportunity: a commentary by the Teaching and Learning Research Programme and the General Teaching Council for England.* Institute of Education, University of London.

Ponterotto, J. (2006) 'Brief Notes on the Origins, Evolution and Meaning of the Qualitative Research Concept "Thick Description"', *The Qualitative Report*, 11, (3), pp. 538-549.

Poster, M. (1996) 'Databases as Discourse; or, Electronic Interpellations', in Lyon, D. and Zureik, H.(eds) *Computers, Surveillance and Privacy.* Minneapolis: University of Minnesota Press, pp. 175-192.

Prensky, M. (2001) 'Digital Natives, Digital Immigrants Part 1', *On the Horizon*, 9, (5), pp. 1-3.

Prins, G. and Pilot, A. (2009) 'Adapting Authentic Science Practices into Contexts for Learning: The Case of Models and Modelling in Pre-University Chemistry Education', in Plomp, T. and Nieveen, N.(eds) *Educational Design Research - Part B: Illustrative cases.* Enschede, The Netherlands: SLO, pp. 619-640.

Puentedura, R. (2010) *SAMR and TPCK: Intro to advanced practice*. Available at: http://www.hippasus.com/resources/.../SAMR_TPCK_IntroToAdvancedPractice.pdf (Accessed: February 2011).

Puentedura, R. (2013) *SAMR: Moving from enhancement to transformation*. Available at: http://www.hippasus.com/rrpweblog/archives/000095.html (Accessed: July 2013).

Quality Matters (2012) *Underlying Principles of Quality Matters*. Available at: http://www.qmprogram.org/research-grants/fipse/principles (Accessed: November 2012).

Ramlo, S. E., McConnell, D., Duan, Z.-H. and Moore, F. B. (2008) 'Evaluating an Inquiry-based Bioinformatics Course Using Q Methodology', *Journal of Science Education and Technology*, 17, (3), pp. 219-225.

Ramlo, S. E. and Newman, I. (2010) 'Classifying individuals using Q Methodology and Q Factor Analysis: Applications of Two Mixed Methodologies for Program Evaluation', *Journal of Research in Education*, 20, (2), pp. 20-31.

Ramsden, P. (1992) *Learning to Teach in Higher Education.* London: Routledge.

Ratcliffe, R. (2014) 'We need more teachers, and we need them now', *The Guardian*, 30th June 2014.

Redmond, P. (2011) *ascilite 2011 Changing demands, changing directions.* Hobart, Tasmania Australia, 4-7 December 2011.ascilite.

Reeves, T. (2006) 'Design research from a technological perspective', in Van den Akker, J., Gravemeijer, K., McKenney, S. and Nieveen, N.(eds) *Educational Design Research.* Hoboken: Routledge.

Reeves, T. (2011) 'Can Educational Research be both Rigorous and Relevant?', *Educational Designer*, 1, (4).

Reeves, T., Herrington, J. and Oliver, R. (2005) 'Design Research: A Socially Responsible Approach to Instructional Technology Research in Higher Education', *Journal of Computing in Higher Education*, 16, (2), pp. 96-115.

Ritzer, G. (2004) *An Introduction to McDonaldization.* Thousand Oaks, CA: Sage.

Ritzer, G. (2007) *The McDonaldization of Society*.5th ed: Pine Forge Press.

Rocketship (2014) *Rocketship Education*. Available at: http://www.rsed.org/index.cfm (Accessed: July 2014).

Romrell, D., Kidder, L. C. and Wood, E. (2014) 'The SAMR Model as a Framework for Evaluating mLearning', *Online Learning-formerly The Journal of Asynchronous Learning Networks*, 18, (2).

Russell. (2001) *The no significant difference phenomenon: A comparative research annotated bibliography on technology for distance education*.5th ed Montgomery, AL: IDECC.

Salmon, G. (2011) *E-moderating: The key to Teaching and Learning Online*.3rd ed Oxford: Routledge.

Schmolck, P. (2014) 'PQMethod 2.35 Software for Q method analysis', [Online]. Available at: http://schmolck.userweb.mwn.de/qmethod/downpqwin.htm (Accessed: June 2014).

Schoenfeld, A. (2009) 'Bridging the cultures of educational research and design', *Educational Designer*, 1, (2).

Schon, D. (1995) 'The new scholarship requires a new epistemology', *Change*, 27, (6), pp. 26-40.

Seery, M. K. and Donnelly, R. (2011) 'The implementation of pre-lecture resources to reduce in-class cognitive load: A case study for higher education chemistry', *British Journal of Educational Technology*, pp. 1-11.

Selwyn, N. (2010) 'Looking beyond learning: notes towards the critical study of educational technology', *Journal of Computer Assisted Learning*, 26, (1), pp. 65-73.

Selwyn, N. (2011a) 'Editorial: In praise of pessimism - the need for negativity in educational technology', *British Journal of Educational Technology*, 42, (5), pp. 713-718.

Selwyn, N. (2011b) *Schools and Schooling in the Digital Age. A Critical Analysis.* Abingdon: Routledge.

Selwyn, N. (2011c) *Education and Technology: Key Issues and Debates.* London: Continuum International Publishing.

Selwyn, N. (2012) 'Ten suggestions for improving academic research in education and technology', *Learning, Media and Technology*, 37, (3), pp. 213-219.

Selwyn, N. (2014) '‘So What?’ … a question that every journal article needs to answer', *Learning, Media and Technology*, 39, (1), pp. 1-5.

Sharma, P. (2010) 'Blended learning', *ELT Journal*, 64, (4), pp. 456-458.

Shattuck, K. (2012) *What We're Learning from Quality Matters-focused Research: Research, Practice, Continuous Improvement.* Annapolis: Quality Matters.

Shattuck, K. (2013) *Review of K12 Online Education Research Literature.* Quality Matters.

Shattuck, K., Zimmerman, W. and Adair, D. (2014) 'Continuous Improvement of the QM Rubric and Review Processes: Scholarship of Integration and Application', *Internet Learning*, 3, (Spring 2014), pp. 25-33.

Shea, P. and Bidjerano, T. (2009) 'Community of Inquiry as a theoretical framework to foster "epistemic engagement" and "cognitive presence" in online education', *Compuers and Education*, 55, (4), pp. 1721-1731.

Shea, P. and Bidjerano, T. (2010) 'Learning presence: Towards a theory of self-efficacy, self-regulation, and the development of communities of inquiry in online and blended learning environments', *Computers and Education*, 55, (4), pp. 1721-1731.

Shea, P., Hayes, S., Smith, S. U., Vickers, J., Bidjerano, T., Pickett, A., Gozza-Cohen, M., Wilde, J. and Jian, S. (2012) 'Learning presence: Additional research on a new conceptual element within the Community of Inquiry (CoI) framework', *The Internet and Higher Education*, 15, (2), pp. 89-95.

Simon, H. (1969) *The sciences of the artificial.*2 ed Cambridge, Mass: The MIT Press.

Skinner, B. F. (1958) 'Teaching Machines', *Science*, 128, (3330), pp. 969-977.

Slavin, R. E. (2003) 'A Reader's Guide to Scientifically Based Research ', *Educational Leadership*, 60, (5), pp. 12-16.

Slavin, R. E. (2008a) 'Perspectives on Evidence-Based Research in Education--What Works? Issues in Synthesizing Educational Program Evaluations', *Educational Researcher*, 37, (1), pp. 5-14.

Slavin, R. E. (2008b) 'Response to Comments: Evidence-Based Reform in Education: Which Evidence Counts?', *Educational Researcher*, 37, (1), pp. 47-50.

Smyth, K., Bruce, S., Fotheringham, J. and Mainka, C. (2011) *Benchmark for the use of technology in modules.* Edinburgh: Edinburgh Napier University.

Somekh, B. (2004) 'Taking the sociological imagination to school: an analysis of the (lack of) impact of information and communication technologies on education systems', *Technology, Pedagogy and Education*, 13, (2), pp. 163-179.

Spurgeon, L., Humphreys, G., James, G. and Sackley, C. (2012) 'A Q-Methodology Study of Patients' Subjective Experiences of TIA', *Stroke Research and Treatment*, 2012, pp. 1-10.

Staker, H. and Horn, M. B. (2012) 'Classifying K-12 Blended Learning', *Innosight Institute*.

STAR (2012) *Student Transition and Retention*. Available at: http://www.ulster.ac.uk/star/index.htm (Accessed: April 2012).

State of Wisconsin. (2014) *Senate Substitute Amendment to Senate Bill 286, Preliminary draft.* State of Wisconsin.

Steffens, K. (2008) 'Technology Enhanced Learning Environments for self-regulated learning: a framework for research', *Technology, Pedagogy and Education*, 17, (3), pp. 221-232.

Steffens, K. and Underwood, J. (2008) 'Self-regulated learning in a digital world', *Technology, Pedagogy and Education*, 17, (3), pp. 167-170.

Stewart, W. (2014) 'Academy plan heralds rise of the machines', *TES*, 13th June 2014.

Svinicki, M. D. (2010) 'Student learning: From teacher-directed to self-regulation', *New Directions for Teaching and Learning*, 2010, (123), pp. 73-83.

Swan, K. and Ice, P. (2010) 'The community of inquiry framework ten years later: Introduction to the special issue', *The Internet and Higher Education*, 13, (1-2), pp. 1-4.

Swan, K., Matthews, D., Bogle, L., Boles, E. and Day, S. (2012) 'Linking online course design and implementation to learning outcomes: A design experiment', *The Internet and Higher Education*, 15, (2), pp. 81-88.

Tanner, K. D. (2012) 'Promoting Student Metacognition', *Cell Biology Education*, 11, (2), pp. 113-120.

Tearle, P. (2003) 'ICT implementation: what makes the difference?', *British Journal of Educational Technology,* 34, (5), pp. 567-583.

Thompson, P. (2013) 'The digital natives as learners: Technology use patterns and approaches to learning', *Computers & Education,* 65, pp. 12-33.

Universities UK. (2014) *The Impact of Initial Teacher Training Reforms on English Higher Education Institutions.* London: Universities UK.

Uzuner, S. (2007) 'Educationally Valuable Talk: A New Concept for Determining the Quality of Online Conversations', *Journal of Online Learning and Teaching,* 3, (4), pp. 400-410.

van den Akker, J. (1999) 'Principles and methods of developmental research', in van den Akker, J., Nieveen, N., Branch, M., Gustafson, K. and Plomp, T.(eds) *Design methodology and developmental research in education and training.* The Netherlands: Kluwer, pp. 1-14.

van den Akker, J., Gravemeijer, K., McKenney, S. and Nieveen, N. (2006) *Educational Design Research.* Hoboken: Routledge.

Van Exel, N. J. A. and De Graaf, G. (2005) 'Q methodology: a sneak preview', [Online]. Available at: www.qmethod.org/articles/vanExel.pdf (Accessed: June 2014).

Vaughan, N. D. (2010) 'A blended community of inquiry approach: Linking student engagement and course redesign', *The Internet and Higher Education,* 13, (1-2), pp. 60-65.

Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J. and van Braak, J. (2013) 'Technological pedagogical content knowledge - a review of the literature', *Journal of Computer Assisted Learning,* 29, (2), pp. 109-121.

Vygotsky, L. (1962) *Thought and language.* Cambridge, MA: MIT.

Wagner, J. (1997) 'The unavoidable intervention of educational research: a framework for reconsidering researcher-practitioner cooperation', *Educational Researcher,* 26, (7), pp. 13-22.

Walmsley, H. (2011) *Best practice models for e-learning*. Available at: http://bestpracticemodels.wiki.staffs.ac.uk/ (Accessed: August 2014).

Wang, F. and Hannafin, M. (2005) 'Design-Based-Research and Technology-Enhanced learning Environments', *Educational Technology Reserach and Development,* 53, (4), pp. 5-23.

Webler, T., Danielson, S. and Tuler, S. (2009) 'Using Q method to reveal social perspectives in environmental research', [Online]. Available at: http://www.seri-us.org/content/primer-q-methodology-available-free-download (Accessed: July 2014).

Weston, C. (2013a) *Education's coming revolution*. Available at: http://edtechnow.net/2013/01/26/industrial-revolution/ (Accessed: June 2013).

Weston, C. (2013b) *Its the technology, stupid*. Available at: http://edtechnow.net/2013/11/10/wheel/ (Accessed: February 2014).

Weston, C. (2014) *Unlocking pedagogical innovation*. Available at: http://edtechnow.net/2014/01/23/gutenberg/ (Accessed: June 2014).

Wiliam, D. (2007) 'Assessment, learning and technology: prospects at the periphery of control', *Association for Learning Technology*. Nottingham, ALTC.

Wilkinson, G. (2006) 'McSchools for McWorld? Mediating global pressures with a McDonaldizing education policy response', *Cambridge Journal of Education*, 36, (1), pp. 81-98.

Williams, M. (2004) *Exploring the effects of a multimedia case-based learning environment in pre-service science teacher education in Jamaica.* Doctoral dissertation, Thesis. University of Twente.

Wilson, B. G. (2014) 'Knowledge Creation in Design-based Research Projects: Complementary Efforts ofAcademics and Practitioners', *American Educational Research Association.* Philadelphia, AERA.

Wingate, U. (2007) 'A Framework for Transition: Supporting 'Learning to Learn' in Higher Education', *Higher Education Quarterly*, 61, (3), pp. 391-405.

Wintour, P. (2014) 'More than 400,000 school children being taught by unqualified teachers', *The Guardian*, 29th December 2014.

Woolner, P., Clark, J., Hall, E., Tiplady, L., Thomas, U. and Wall, K. (2010) 'Pictures are necessary but not sufficient: Using a range of visual methods to engage users about school design', *Learning Environments Research*, 13, (1), pp. 1-22.

Xin, C. (2012) 'A Critique of the Community of Inquiry', *The Journal of Distance Education*, 26, (1).

Yin, R., K. (2009) *Case Study Research: design and methods.* Los Angeles: Sage.

Younie, S. and Leask, M. (2013) 'Implementing learning platforms in schools and universities: lessons from England and Wales', *Technology, Pedagogy and Education*, 22, (2), pp. 247-266.

Zeidner, M., Boekaerts, M. and Pintrich, P. (2000) 'Self-regulation. Directions and challenges for future research', in Boekaerts, M., Pintrich, P. and Zeidner, M.(eds) *Handbook of Self-regulation.* New York: Acamemic Press, pp. 749-768.

Zimmerman, B., J. (1999) 'Attaining Self-Regulation', in Boekaerts, M., Zeidner, M. and Pintrich, P.(eds) *Handbook of Self-Regulation.* Burlington: Academic Press.

Zimmerman, B., J. (2002) 'Becoming a self-regulated learner: an overview', *Theory into Practice,* 41, (2), pp. 64-72.

Zimmerman, B., J. and Schunk, D., H. (2001) *Self-Regulated Learning and Academic Achievement* Mahwah: LEA.