

**How university teachers and students use  
educational technology in university classroom  
contexts to optimise learning: a study of purposes,  
principles, processes and perspectives.**

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## Abstract

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### **How university teachers and students use educational technology in university classroom contexts to optimise learning: a study of purposes, principles, processes and perspectives.**

There is an expectation that university teachers have a good understanding of the value of educational technologies in learning and teaching as well as be able to incorporate them effectively into their teaching (Carter et al, 2011, Higher Education Academy, 2011; Sharples et al, 2016). However, according to key literature (Conole, 2004; Kennedy et al, 2011; Laurillard, 2007; Selwyn, 2007; Walker et al, 2016) the extent to which educational technologies have impacted on teaching and learning practices is considered to be minimal. While universities have invested heavily in educational technologies for teaching purposes, institutional virtual learning environments are predominately being used as a vehicle for information transmission and document repository (Armellini et al, 2012; Walker et al, 2016).

The research I report here investigated the thinking and conceptions behind how Bryn, a university teacher, used educational technologies to optimise the quality of his students' learning. I also report on the thinking and decision making behind how 15 of his students used educational technologies to optimise the quality of their university learning.

The analysis of the data collected suggests that there is an evolution occurring in how university teaching staff are thoughtfully integrating educational technology into programmes and satisfying the majority of students with this development. It was also identified that influences of educational technology on student learning are mediated by students' disposition towards learning and the task and social contexts of their learning.

It is recommended that those students who are pioneer users of educational technology and ahead of the university teacher's curve be incorporated into the planning and evaluating of experiences of learning and teaching in educational technology-mediated classroom contexts and be appointed as learning coaches to those students who are somewhat bewildered and frustrated by educational technology use.

**Key words: educational technology use to optimise learning, task context of learning, social context of learning,**

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My thanks also goes to Bryn, the university teacher and the 15 undergraduate Chemistry students, who so generously shared their perceptions, thoughts and experiences about teaching and learning and their educational technology use with me. I hope this thesis does their stories justice.

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## Glossary

**Australian Teaching and Learning Council (ALTC)** now the Australian Office for Learning and Teaching (OLT) has a mission to enhance learning and teaching in Australian higher education by working with institutions, discipline groups and individuals as a collaborative and supportive partner in change, providing access to a network of knowledge, ideas and people. See [www.olt.gov.au](http://www.olt.gov.au).

**Academic Developers** contribute to the design and provision of workshops, seminars and other activities to develop staff in relation to curriculum development, the use of educational technologies, methods of teaching and assessment. Staff in these roles could also be known as professional development officers, staff developers or education developers.

**Australasian Society of Computers in Learning in Tertiary Education (ASCILITE)** is an association for academics, staff developers and trainers involved in tertiary computer-based education and training which acts as a forum for discussing issues on the use of technology in education, and promotes research and evaluation. See [www.ascilite.org](http://www.ascilite.org).

**Association for Learning Technology (ALT)** 'is the UK's leading membership organisation in the learning technology field' aiming to 'improve practice, promote research and influence policy'. See [www.alt.ac.uk](http://www.alt.ac.uk).

**Cognitive Load Theory** 'refers to the total amount of mental effort being used in the working memory'. Cognitive load theory was developed out of the study of problem solving by John Sweller in the late 1980s. See [https://en.wikipedia.org/wiki/Cognitive\\_load](https://en.wikipedia.org/wiki/Cognitive_load).

**Educational Technology** is 'the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources'. See [aect.site-ym.com](http://aect.site-ym.com). For the purposes of this thesis I will be using the term education technology within the body of my thesis.

**Educational Designers** apply appropriate learning theory to the design of learning materials and learning events to ensure that student learning is maximised.

**Evaluation of Learners' Experiences of e-learning Special Interest Group (ELESIG)** 'is a community of researchers and practitioners from higher, further and skills sector education who are involved in investigations of learners' experiences and uses of technology in learning. See [elesig.ning.com](http://elesig.ning.com).

**Espoused theory.** Theory that people say they are applying, but with which their actions may be inconsistent. See also theory-in-use.

**Generation Z** 'is the demographic cohort after the Millennials (mid-1990s to early 2000s) that are typically thought of as being comfortable with technology, and interacting on social media websites for a significant portion of their socialising. Some commentators have suggested that growing up through the Great Recession (2007 - 2009) has given the cohort a feeling of unsettlement and insecurity'. See [https://en.wikipedia.org/wiki/Generation\\_Z](https://en.wikipedia.org/wiki/Generation_Z).

**Higher Education Academy (HEA)** 'aims to enhance teaching quality in higher education institutions, and develop individual careers through teaching resources'. See [www.heacademy.ac.uk](http://www.heacademy.ac.uk).

**Higher Education Funding Council for England (HEFCE)** 'aims to create and sustain the conditions for a world-leading system of higher education which transforms lives, strengthens the economy, and enriches society'. See [www.hefce.ac.uk](http://www.hefce.ac.uk).

**Implicit learning.** The learning of professional or other skills imitating behaviour, and trial and error, rather than by explicit discussion of options.

**Joint Information Systems Committee (JISC)** 'the UK higher education, further education and skill sectors' not-for-profit organisation for digital services and solutions'. See [www.jisc.ac.uk](http://www.jisc.ac.uk).

**Learning Management System (LMS)** ‘is a software application for the administration, documentation, tracking and reporting and delivery of electronic educational technology courses or training programs’ This term is most often used in the United States of America and Australasia. See [https://en.wikipedia.org/wiki/Learning\\_management\\_system](https://en.wikipedia.org/wiki/Learning_management_system).

**Learning Technology** ‘is the broad range of communication, information and related technologies that can be used to support learning, teaching and assessment’. During the data collection phase of my research the term learning technology was used in my interview schedule. See [www.alt.ac.uk](http://www.alt.ac.uk).

**Open Education Resources** ‘are freely accessible, openly licensed documents and media that are useful for teaching, learning, and assessing as well as for research purposes’. There is no universal usage of open file formats in OER. See [https://en.wikipedia.org/wiki/Open\\_educational\\_resources](https://en.wikipedia.org/wiki/Open_educational_resources).

**Quality Assurance Agency (QAA)** is ‘the independent body entrusted with monitoring, and advising on, standards and quality in UK higher education’. See [www.qaa.ac.uk](http://www.qaa.ac.uk).

**Royal Society of Chemistry (RSC)** is ‘UK’s professional body for chemical scientists, supporting and representing its members and bringing together chemical scientists from around the world’. It is a not-for-profit organisation. See [www.rsc.org](http://www.rsc.org).

**Society for Research in Higher Education (SRHE)** ‘is a UK-based international learned society concerned to advance the understanding of higher education, especially through the insights, perspectives and knowledge offered by systemic research and scholarship’. See [www.srhe.ac.uk](http://www.srhe.ac.uk).

**Teaching Excellence Framework** is a government initiative, administered by the Higher Education Funding Council for England (HEFCE) to recognise and reward excellent learning and teaching. See <http://www.hefce.ac.uk/lt/tef/>.



**Theory-in-use** Theory represented in observed actions, which the person acting may be unaware of and which are often learned implicitly through social interaction rather than explicitly as a theory. See also espoused theory and implicit learning.

**Universities and Colleges Information Systems Association** ‘represents the whole of higher education and increasingly further education, in the provision and development of academic, management and administrative information systems, providing a network of contacts and a powerful lobbying voice’. See [www.ucisa.ac.uk](http://www.ucisa.ac.uk)

**University teacher** In the context of this thesis, I have carefully chosen to use ‘university teacher’ instead of other terms such as ‘lecturer’ or ‘academic’ when discussing teachers and teaching. It describes members of a university’s academic staff, teaching fellows, tutors, laboratory demonstrators who have some formal responsibility for teaching students in their discipline.

**Virtual Learning Environment (VLE)** ‘is a system for delivering learning materials to students via the web. These systems include assessment, student tracking, collaboration and communication tool’. This term is used in the United Kingdom. See <http://global.oup.com/uk/orc/learnvle/>.

## Chapter 1: Introduction

### 1.1 Rationale for the study

In my professional role as module convenor and tutor of a Postgraduate Certificate in Higher Education (PGCHE) course, I provide opportunities for university teachers to be able to stand back from the everyday reality of their teaching and develop a critical awareness of what they do (Ashwin et al, 2015; Trigwell et al, 2000). In this role, I recognise the value of personal experience, and develop university teachers to reflect upon their tacit and implicit knowledge and expertise when they plan, implement and evaluate their teaching practices (Argyris, 1993; Argyris and Schön, 1978; Brown and McIntyre, 1993). I also recognise the importance of the personal kinds of learning strategies and practices which university teachers develop during their PGCHE studies (Cooper and McIntyre, 1996).

The rapid pace of technological change in the past ten to fifteen years has impacted on university teachers' professional practice. This current 'digital revolution' presents real challenges to the core values and traditions of the university profession and compels university teachers to rethink the way they design and deliver their teaching (Ellis and Goodyear, 2010; Galton and Hargreaves, 2009; Laurillard, 2002). In my role, I provide support and work collaboratively with university teaching staff to rethink their teaching in light of these challenges (Beetham and Sharpe, 2013; Collis and Moonen, 2001). I have pursued my research topic to deepen my own professional knowledge and to provide a more research-informed and more relevant professional development offering for university teachers in the current changing higher education landscape context (McLean and Ashwin, 2016; Smith, 2016).

There is an expectation that university teachers become knowledgeable in how to use educational technologies to enhance their teaching (Carter et al, 2011; Doherty et al, 2012; Higher Education Academy, 2011; Sharples et al, 2016).

However, according to key literature (Conole, 2004; Kennedy et al, 2011; Laurillard, 2007; Selwyn, 2007) the extent to which educational technology has impacted on teaching and learning practices in campus-based higher education institutions is considered to be minimal. While at the same time, campus-based universities have invested heavily in educational technologies for teaching purposes (Johnson et al, 2016; Walker et al, 2012).

Recent studies identify that virtual learning environments (VLEs) are being mostly commonly used as a vehicle for information transmission and as a digital filing cabinet. VLEs are being used by some as enriching virtual learning spaces with regular interaction between students and university teachers however, this is not the norm (Armellini et al, 2012; Johnson et al, 2016).

My task is to encourage and guide university teachers to effectively incorporate educational technologies to enhance their teaching in light of the advent of Generation Z attending university (Jones, Jo and Martin, 2007; Thomas and Brown, 2011). It is important to note here, that terms such as Generation Z, Digital Natives and Millennials are contentious terms and have been extensively critiqued. See Prensky (2001); Bennett, Maton and Kervin (2008), and Jones and Shao (2011) for more contextual information and in-depth analyses of the topic.

In my professional role, I aim to provide fit-for-purpose continuing professional development opportunities for all university teachers and not just for the early adopters and educational technology innovators (Blin and Munro, 2008; Goodfellow and Lea, 2013; Russell et al, 2014).

In working to fulfil this aim, I have become interested in the thinking and perspectives that underpin university teachers and their students' use of educational technologies and how further investigation might inform my professional practice. I believe that to better understand how university teachers make sense of what they do in the classroom and how they evaluate their teaching requires including students and university classroom contexts in my focus and locating my study primarily in sites of academic practice (Boud, 1999; Boud and Brew, 2013).

## 1.2 Context and background of the study

Steel and Gunn (2011, p.1178) assert that research studies from the educational technology community ‘... fail to produce reliable evidence to answer important questions about the impact of technology on student learning and behaviour... However contentious or provocative this statement may be, it is highly relevant in the current higher education learning and teaching context. Steel and Gunn, two respected members of the educational technology community, are not alone in asking probing questions (Friesen, 2009; Selwyn 2011, 2016).

Selwyn (2011, p.212) believes that educational technology research is focussed on ‘state-of-the-art’ stories of the near future and is falling short on the depth and breadth of what is being researched. He asks why ‘... does our research and writing not provide accounts and interpretations of what actually is taking place – for worse as well as for better? Why is there a reluctance to produce in-depth, forensic accounts of the ‘everyday life’ of educational media and technology – accounts of the ordinary rather than extra-ordinary aspects of how digital media and technology are being used (and not being used)?’.

I would like to think that my research study outlined in this thesis of Bryn and his Chemistry students would find its place in the accounts of the everyday teaching life of the ordinary university teacher that Selwyn refers to (2011) and as a contemporary issue worthy of interest, will have significance for the wider educational development and educational designer community.

Over the past seven years, there has been a substantial body of higher education research conducted both in the UK through the Joint Information Systems Committee (JISC) and in Australia through the Australian Teaching and Learning Council (ALTC) on learners’ experiences of using educational technology while studying at university (Gunn and Steel, 2012; Sharpe and Benfield, 2012).

However, there has been considerably less research conducted into higher education teachers' experiences of using educational technology in campus-based research-intensive universities as much of the research conducted has been concerned with distance learning and newer, more teaching-focussed universities (Jones, Asensio and Goodyear, 2000; Goodyear, Asensio and Jones et al., 2005; Ellis and Goodyear, 2010).

Recent studies (Ellis and Goodyear, 2010; González, 2010) advance higher education research into teachers' conceptions of, and approaches to, teaching that incorporates educational technologies in more conventional universities. My research seeks to add to this new knowledge about campus-based educational technology-mediated learning and teaching contexts as the study was conducted with students and staff from an East Midlands research-intensive university in classroom contexts.

As the educational technology landscape is changing through the increase in mobile device use and the introduction of the Teaching Excellence Framework by HEFCE in 2016, all universities are responding to the issue of how to effectively support university teachers to better incorporate educational technology in their teaching. Birch and Burnett (2009) cite obstacles to the institution-wide diffusion of e-learning environments on the 'lack of academic leadership, clear vision and formal strategic planning, and the absence of clear institutional policies, processes and standards (p.121)'. The *Learning with Technology* report published by The Association of Learning Technology (2010) states that 'research typically doesn't address the problem of building as ecology of learning, or treat integration of the innovation as a research issue (p.5)'. I hope that the outcomes from my study will enrich and inform this conversation.

Future cohorts of students have expectations that their teachers will incorporate technology into their teaching and expect support in how to best use educational technologies in their learning (Gosper et al, 2011; Jisc, 2013; Markauskaite and Goodyear, 2009). How will the needs of students be best met if universities do not take an institutional level perspective to this issue using evidence-based practice?

Whilst there has been studies conducted in the higher education sector (Jones, Asensio and Goodyear, 2000; Goodyear, Asensio and Jones, 2005; Ellis and Goodyear, 2010), the majority of studies conducted in educational technology-mediated learning and teaching classroom contexts have been primarily focussed on primary and secondary classroom contexts (Hennessy and Deaney, 2009; Hennessy, Deaney and Ruthven, 2005; Hennessy, Ruthven and Brindley, 2005; Mercer 2008). My research aims to make a substantial and original contribution to this knowledge about the kinds of instructional talk and mediated by university teachers and student use of educational technology for purposes of teaching and learning in different university classroom contexts.

The research aims to investigate how university teachers and their students use educational technology to optimise learning in the classroom and develop understandings about what kinds of educational technologies university teachers and their students consider the most useful and effective for optimising the quality of learning.

The objective of my research is an illuminative study (Thomas, 2007) that investigates what is going on in classrooms where university teachers' incorporate educational technology to promote learning.

### **1.3 Understandings about educational technology**

The primary focus of my research project is around learning and how learning is optimised through the use of educational technology in classroom contexts. As there are numerous definitions and interpretations of the term 'educational technology', I would like to clarify initial assumptions and understandings around this term. The Association for Educational Communications and Technology (AECT) states that 'Educational technology is the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources' (Richey et al., 2008) which is a fitting description for my study.

This study will encompass a broad understanding of educational technology in higher education that includes particular hardware and mobile devices, systems

and applications software as well as infrastructures that transmit and receive data. The study will also incorporate educational media and tools such as virtual learning environments, video and audio, virtual classrooms and interactive whiteboards. It is anticipated that the study will also include social networking applications such as Twitter, Facebook, You Tube and WordPress being used as possible learning tools.

In my research project I envisage that both institutionally endorsed and non-institutionally endorsed educational technology will be discussed as both university teachers and university students engage with a range of technology in their personal and professional lives (Januszewski, 2001; Reiser and Ely, 1997).

#### **1.4 Understandings about learning**

I would like to clarify initial assumptions and understandings about learning in relation to my research project. As Illeris (2007) and others (Biggs and Tang, 2011; Fenwick et al, 2011; Prosser and Trigwell, 1999; Ramsden, 2003) emphasise, learning is a slippery term found in everyday language and applied to a vast range of processes. Stewart in Hunt and Chalmers (2013) states theories of learning have arisen from a range of different disciplines such as psychology, sociology and neuroscience, as well as education. This complex evidence base has led to debate and controversy as well as providing powerful vocabulary and frameworks for organising thinking (Paetzold, 2017).

Those theories of learning that resonate with this study come from the critical and humanistic traditions of Freire (1970), Dewey (1916) and Mead (1967). A tradition that is learner-centred sees learning as a personal act that fulfils one's potential and that sees learning from the student's point of view with the teacher as a facilitator rather than as a transmitter. Learning is achieved where meaning is negotiated and created through collaborative dialogue and ways of working with others (Goodyear et al, 2004; Hodgson et al, 2012; Rogoff, 1998).

Illeris (2007) puts forward the notion that there are two different processes occurring during learning (interaction between learner and their environment and psychological processing and acquisition taking place from that interaction).

Higher education research (Biggs, 2012; Phillips et al, 2012) emphasises the notion that learning leads to conceptual change, which is a natural biological development and not exclusively within an individual.

Merriam, Caffarella and Baumgartner (2006) assert that learning is influenced by the specific life context of the learner and by the society in which that learner lives. They claim that individual learner's learning experience is personal and unique.

One of the theoretical assumptions about learning that anchors my study is that learning is achieved through both public, social processes (e.g. mediated through talk and open articulation and critique in social settings) and private, individual processes (e.g. personal reflective practice and evaluation) of cognition. I am interested in understanding the collective 'interpersonal' process of learning as well as the individual 'intrapersonal' process of learning. Vygotsky (1978) argued that these two processes are linked and a key assumption in my research is that students' learning in technology-mediated learning spaces involves both kinds of learning.

Researchers (Gourlay and Oliver, 2013; Oliver, 2012) identified in their studies that university students' learning strategies both shape and are shaped by the spaces, devices and people that are available to them. This resonates with a sociocultural understanding of learning as tool-mediated or, in the case of my study, mediated by educational technology use. Furthermore, technology-mediated learning itself is shaped by particular divisions of labour among teachers and students in classrooms. In addition, there are rules of participation within the social milieu. Through the different layers of mediation, cognition and understanding are 'distributed across minds, persons, the symbolic and physical environments both natural and artificial' (Pea, 1993, p.48), which can optimise the quality of students' learning.



### 1.5 Theoretical perspectives that underpin my study

My thinking in relation to learning and educational technology use has been informed by a number of theoretical perspectives that I will explore in this section of the chapter. These include conceptions of learning and teaching using a phenomenographic approach; the sociocultural perspectives and teaching practice as reflective practice.

The first theoretical perspective that informs my study is the conceptions of learning and teaching using a phenomenographic approach (Marton and Booth, 1997; Richardson, 1999), which is concerned with the study of student learning and considers successful learning to be reliant on other factors than the capability of the student (Prosser and Trigwell, 1999).

This research perspective originated in Sweden with Ference Marton and colleagues at the University of Gothenburg more than 30 years ago and has been used since then by higher education researchers in Australia, the Netherlands and the United Kingdom (Ellis and Goodyear, 2010; Marton et al, 1993; Prosser and Trigwell, 1999; Richardson, 1999).

Research conducted by Säljö (1979), reported five qualitatively different understandings of what learning meant. These qualitatively different conceptions have been replicated in a number of studies since then, and in a number of countries and disciplinary contexts. Marton et al, (1993) included a sixth conception ‘changing as a person’ to this list.

‘Learning is seen as:

1. A quantitative increase in knowledge
2. Memorising
3. The acquisition, for subsequent utilisation, of facts, methods, etc.
4. The abstraction of meaning
5. An interpretative process aimed at understanding reality
6. Changing as a person’

(Marton et al, 1993; Säljö, 1979).

These six conceptions do not represent a developmental sequence but they are inter-related, as the latter conceptions incorporate and build on the former conceptions.

The aim of phenomenography is ‘to identify the qualitatively different ways in which different people experience, conceptualise, perceive, and understand various kinds of phenomena’ (Richardson, 1999, p.53). Phenomenography does not attempt to make statements about reality, or the nature or essence of the phenomenon itself (Bowden and Walsh, 2000). The ‘phenomenographic’ experience is relational, it is not purely objective or purely subjective and is independent of people and the world (Prosser and Trigwell, 1999).

Research on studies of university teachers’ experiences of e-learning (Ellis and Goodyear, 2010, González, 2010) using in-depth phenomenographic interviews is located in a broader field of research into university teachers’ thinking, knowledge and beliefs (Hativa and Goodyear, 2002).

This body of research on conceptions of learning and teaching, explores the intertwined relationship between teaching and learning. As Ramsden stated ‘The aim of teaching is simple: it is to make learning possible’ (2003, p.7). If university teachers can view their teaching as a holistic venture that embraces not only their teaching practice but an understanding of how students learn then they will gain an awareness around how to design tasks and assessments that result in effective and quality student learning (Marton et al, 1993; Säljö, 1979).

The second theoretical perspective that informs my study is the sociocultural theoretical perspectives that takes a particular approach to human learning and development that emerged during the 1990s from an appreciation of research on the relationship between language and cognitive development carried out by the Russian psychologist Lev Vygotsky earlier in the 20th century.

In broad terms, sociocultural perspectives seek to understand relationships between social, cultural, historical and institutional contexts that shape and are shaped by agents' cognitive development and the biological processes of change that occur within the individual (Mercer, 1995; Mercer, 2010; Vygotsky, 1978; Wertsch, 1985; Wertsch and Tulviste, 1998).

Central to Vygotsky's theory is that human beings through their creation of language are a unique species and this is what separates us from other animals. He also argues that the uniqueness of the social milieu with regards to socio-cultural settings is what determines our development of higher mental activities. It is through our use of language, symbols, signs and tools that we have been able to develop our thinking and coordinate social behaviour. Vygotsky's focus on the individual in a sociocultural context is highlighted by his concept of the 'zone of proximal development' (ZPD), that is, the range of potential each person has for learning within a social context. Vygotsky argued that it is within the ZPD that cognitive development is enhanced through the supportive intervention of a more knowledgeable other (Wertsch, 1991). This can include another person, an artefact as well as a tool.

Sociocultural researchers propose that tools and artefacts, including language, mediate learning on both 'inter-mental' and 'intra-mental' planes. These researchers often cite the discipline of discourse analysis to highlight the important influence dialogue has on mediating development of children's reasoning and joint construction of knowledge and understanding (Alexander, 2000; Mercer, 2010; Mercer and Littleton, 2007). Even though my study will not employ discourse analysis, its importance in how learning is mediated bears relevance to my study.

Mercer has expanded on Vygotsky's concept of zone of proximal development. His 'intermental development zone' concept focusses on ways that a teacher and their learners or a group of learners at similar levels of understanding stay attuned to one another's changing states of knowledge and understanding over the course of an educational activity and co-construct knowledge (Fernández et al, 2001; Mercer, 2000).

A zone that ‘... is meant to capture the way in which the interactive process of teaching and learning rests on the maintenance of a dynamic contextual framework of shared knowledge, created through language and joint action’ (Fernández et al., 2001, pp.41-42) and tool mediation.

The sociocultural theoretical concepts discussed above, have helped me understand educational technology use in classrooms as an example of tool-mediated learning. Sociocultural theorists do not merely point to the importance of language mediation but also to tool-mediation more generally and this idea of tool mediation (i.e. tool-mediated learning) allows me to theorise the importance of educational technology use as a particular sociocultural mode of tool mediation (Pea, 1993).

The third theoretical perspective that informs my study is the model of teaching practice as reflective practice (Argyris and Schön, 1978) and the research in school settings by Cooper and McIntyre (1996) about the strategies, craft knowledge and perspectives developed by teachers on the basis of their direct and long experience of teaching. I would like to see if this craft knowledge and reflective practice is evidenced by students in my study on the basis of their direct and long experience of learning. Both teachers and students hold a complex, practically orientated set of understandings, which they use actively.

This ‘practical knowledge’ is not fully understood, tacit and therefore not always amenable to sharing. To provide university teachers and their students with the opportunity to reflect on, and attempt to articulate their experience of, can realise the value of this knowledge and contribute to growth in critical perspectives on practices. This perspective also focusses on the ‘theory-in-use’ work of Argyris and Schön (1978), which can be a vehicle that explains what university teachers and their students do in a given situation in order to achieve an intended outcome.

## 1.6 Compatability of theoretical perspectives

Key higher education learning and teaching research (Ashwin, 2009; Haggis, 2003; 2008; Webb, 1997) identifies that those with leanings towards socio-cultural perspectives and other researchers may reject the phenomenographic approaches to learning and teaching research findings on a number of grounds, for example that this particular research does not take into account of student difference and diversity and that it divorces itself from socio-political concerns. McLean and Trigwell claim that relational research 'is intensely interested in difference because what matters is the world as experienced by individuals' (2006, p.7).

The aim of this research is connect the process of teaching with the process of learning and the relationship between how university teachers approach their teaching and their students approach their learning. It is also interested in exploring the relationship between how university teachers experiences and their student experience learning and teaching within their university modules where educational technology is used to optimise learning (McLean and Trigwell, 2006; Säljö, 2001).

Instead of wanting to assert one theoretical perspective over another my study has synthesised insights offered by all three theoretical perspectives I have outlined above. The approaches to learning and teaching theoretical perspective complements the socio-cultural theoretical perspective and the teaching practice as reflective practice theoretical perspective as all three have a similar focus on how a teacher's teaching practice and task design creates an environment for learning (McLean and Trigwell, 2006).

## 1.7 Focus of my research

The main purpose of this study is therefore to investigate the thinking and perspectives that underpin university teachers' and their students' use of educational technologies in classroom contexts. In order to realise this ambition, my research has particular intentions.

- To critically investigate the existing educational technology-mediated empirical research and identify key propositions that emerge from the reviewed research literature about how university teachers and their students are using educational technologies to optimise learning.
- To design a small scale qualitative research study which will involve a differentiated interview strategy to understand more about how educational technology use influences and mediates the teaching and learning experiences of a group of undergraduate university students and their university teacher.
- Considering the findings produced, to propose a conceptual model of influences on learning using educational technologies, mediated by students' dispositions, and the task and social contexts of their learning.
- To formulate recommendations for universities and university teachers in relation to how they might address the policy and practice implications that have been identified in the research findings.

I now turn my attention to outlining the overall structure of my thesis.

### *Overview of chapters*

My thesis is arranged into four further chapters as follows:

#### *Chapter Two*

- I contextualise my study in relevant empirical research that has investigated how university teachers and students use educational technology to promote learning. I consider the different kinds of research being conducted and what themes emerge from the reviewed literature.
- In light of this review of the literature, I formulated four research questions that shape the design of the study and are critical to expanding our current understanding of educational technology use in university classroom contexts.

### *Chapter Three*

- I present the qualitative research strategy and the development of a differentiated interview strategy aimed at generating relevant data helpful in addressing my research questions. I also summarise the data collection methods I implemented and the inductive and deductive processes and procedures I employed for analysing data.

### *Chapter Four*

- I report the findings and present a conceptual model of how learning is mediated by students' use of educational technologies, their dispositions, and task and social contexts of learning.

### *Chapter Five*

- I recapitulate the purpose of my study and the key findings. I also discuss the links between my research findings and findings from the reviewed literature in Chapter Two. I propose a framework of different modes of educational technology-mediated learning in university classrooms. I offer recommendations for policy and implications for practice that have arisen out of the research conducted.

Having briefly described the content of each chapter, I turn now to a critical overview of literature related to educational technology use for promoting learning. Four research questions are identified, which I focus on in my study concerning educational technology-mediated learning.

## Chapter 2: Literature Review

### 2.1 Introduction

Throughout my research project, I aimed to investigate how university teachers optimise the quality of their students' learning opportunities in educational technology-mediated learning and teaching contexts. I set out to develop understandings about what kinds of educational technologies university teachers and their students considered the most useful and effective for supporting learning. A literature search was conducted to find relevant empirical research that investigated how university teachers use educational technologies to promote learning and 37 peer reviewed journal articles were reviewed.

To ensure relevant empirical research was explored, I applied particular inclusion and exclusion criteria. These criteria are outlined in detail on page 18 of this chapter.

Four key patterns of findings emerged from the reviewed research.

1. There is a distinct variation in university teachers' conceptions regarding the use of educational technologies to promote learning.
2. There is a gradual pedagogical evolution occurring in terms of technology use in classrooms.
3. There are effects in the use of educational technologies in promoting learning for particular students in 'guided instruction' contexts.
4. The contextual 'uniqueness' of each pedagogical challenge does not always make it possible for teachers to generalise or transfer identified practices from the context under study to other pedagogical contexts.

These propositions bore on the research design and methodologies considered for the research project and directly informed its design.



### 2.1.1 Research context

The broad context of my research is higher education with a focus on how university teachers incorporate educational technology in their teaching. More specifically it is about how university teachers incorporate educational technology to optimise learning in their classrooms.

Throughout my research project, I investigated how university teachers promote the highest quality of learning opportunity in technology-mediated teaching and learning contexts. I also developed understandings about what kinds of educational technologies university teachers and their students consider the most useful and effective for optimising the quality of learning.

This research is concerned in particular, with how studies of technology-mediated learning and teaching conducted in primary and secondary classrooms (Hennessy and Deaney, 2009; Hennessy, Deaney and Ruthven, 2005; Hennessy, Ruthven and Brindley, 2005; Mercer 2008) can inform future research focussed on teaching and learning in university classrooms. I was especially interested in the potential of sociocultural theoretical frameworks used in these school-based studies for informing my own developing thinking and the theorisation of my study.

My review of literature is structured by four main questions. The first is what type of research is being conducted in the field of educational technology in higher education and what themes have emerged from this research (Bennett and Oliver 2011; Conole, 2004; Conole and Oliver, 2007).

The second is what theoretical frameworks and learning perspectives inform this higher education research (Bennett and Oliver, 2011; Conole, 2004; Conole and Oliver, 2007; Czerniewicz, 2010; Kirschner et al, 2006; Steel and Gunn, 2011).

The third raised questions about university teachers' beliefs and concepts towards incorporating educational technology in their classrooms and how these beliefs influence their decisions about using or not using educational technologies in their teaching (Ellis and Goodyear, 2010; González, 2010; Kennedy et al, 2011).

The fourth dealt with the perceived and real constraints and barriers (pedagogical, organisational, technical and social) that arise when incorporating educational technologies in higher education classrooms and how an appropriate governance structure — one that is planned, managed and reviewed continuously can alleviate and possibly eradicate some of these constraints and barriers (Conole and Oliver, 2007; Sachs and Gosper, 2011).

## 2.2 Identifying relevant literature

To identify relevant literature for my research project a literature search was conducted using three electronic databases, the British Education Index (BEI), the Australian Education Index (AEI) and the Education Resources Information Center (ERIC).

At first, broad search terms such ‘educational technology’ and ‘learning’ as well as ‘learning technology’ and ‘learning’ were applied. These searches yielded thousands of documents. Specific inclusion and exclusion criteria such as record or document type and dates were applied to the search however; the results were 326 articles in the BERA database, 226 documents in ERIC, and 254 documents in AEI. In the ERIC database it was possible to select a particular ‘suggested subject’ from a selection of 16 subjects. When the ‘learning and educational technology’ suggested subject was applied this narrowed the number of documents in the literature search to 38 articles in ERIC.

The aim of the literature search was to find relevant literature that reported empirical research that investigated how university teachers use educational technologies to promote learning. To draw a more accurate picture the terms used in the database searches needed to be more specific than the initial terms that proved too broad for my purposes. The terms ‘university teachers’ and ‘educational technology’ and ‘promote learning’ as well as ‘classroom teaching using technology’ and ‘educational technology to promote learning’ were used and yielded 45 documents in BEI, 43 documents in AEI and 51 documents in ERIC.

As part of this search, specific inclusion and exclusion criteria were applied to refine the search and to focus specifically on the proposed research topic area.

The following inclusion and exclusion criteria were used:

*Inclusion criteria*

- Peer reviewed journal articles
- Published between 2005 – 2015
- Research conducted in a campus-based teaching and learning context
- Articles with an explicit account of research design

*Exclusion criteria*

- Conference papers and proceedings
- Reports
- Published prior to 2005
- Distance learning

It is important to note, that the exclusion criteria of ‘published prior to 2005’ was specifically applied to this search as there had been a number of changes in the educational technology field as outlined in the New Media Consortium’s *The Horizon Report, 2005 Edition* (NMC, 2005). The report indicated a new chapter, one that provides a more mobile and participatory learning experience, had begun to emerge and indeed continues to gain momentum as outlined in the *Horizon Report: 2016 Higher Education Edition* (Johnson et al, 2016). The aim to include research published from 2005 and not earlier was to try and capture this new chapter in the field.

Of the 53 articles found, eight were difficult to retrieve as they were not held in the subscribed databases of the University of Leicester library. During a thorough reading for relevance of all of the 53 abstracts of the resulting literature searches, eleven of the articles were deemed informative but not specific enough to the research topic area. This included six of the difficult to retrieve articles. This generated a total of 34 articles for review which included two externally sourced articles.

A further search or trail was conducted using the reference lists of particular articles and a further three articles were added to the list of relevant literature on this basis, providing a total of 37 articles for review.

All papers included for this literature review were then read and analysed in detail.

A detailed summary of the literature, including relevant details of conceptual and theoretical frameworks, methods of data collection and number of participants can be viewed in Table 2.1 overleaf.

**Table 2.1: Range of reviewed literature: theory, method, scale**

	<b>Author</b>	<b>Year</b>	<b>Conceptual Framework/ Theories</b>	<b>Research Methods</b>	<b>Sample</b>
1	Mercer, N.	2008	Sociocultural theoretical perspective	Applied interventional research lesson observation	1 primary school teacher
2	Hennesy, S., Ruthven K. and Brindley, S.	2005	Affordances and constraints theories	Focus group interviews	18 secondary school
3	Hennesy, S., Deaney, R. and Ruthven, K.	2005	Sociocultural learning theory	Cross-case analysis; group meetings; teaching/research plans; classroom observation; semi-structured post-lesson interviews	15 secondary school teachers
4	González, C.	2010	Conceptions of teaching from a phenomenographic perspective	Phenomenographic interviews	18 university teachers
5	Ellis R.A., Steed, A.F. and Applebee, A.C.	2006	Conceptions of teaching from a phenomenographic perspective	Phenomenographic interviews	22 university teachers
6	Steel, C.	2009	Affordances and constraints theories	Stimulated recall; concept mapping; interviews	3 university teachers
7	Hennesy, S. and Deaney, R.	2009	Sociocultural theoretical perspectives	Collaborative analysis of video recordings of classroom activity and other data	8 secondary school teachers
8	Johnson, E.M., Cowie, B., De Lange, W., Falloon, G., Hight, K. and Khoo, E.	2011	Activity theory	Key informant interviews; focus groups; online survey	400 university students

9	Lameras, P., Levy, P., Pavaskakis, I. Webber, S.	2011	Conceptions and approaches to teaching from a phenomenographic perspective	One-to-one interviews	25 computer science university teachers
10	Kearney, M. and Schuck, S.	2008	Sociocultural theoretical perspective	Qualitative research paradigm; interpretative study by 40 classroom observation	4 primary schools 2 secondary schools
11	Taylor, L. and Clark, S.	2010	Conceptions and approaches to using educational technology in teaching	In class survey; focus groups	1938 university students
12	Krentler, K.A. and Willi-Flurry, L.A.	2005	Not specified	Instructor posted questions and issues; student responses; end- of-term questionnaire	549 university students
13	Farmer, B., Yue, A. and Brooks, C.	2008	Social constructivist educational theory	Online observation; content analysis of blogs, subject message boards and online discussions; end-of-semester online and paper-based questionnaire	225 university students
14	Tamim, R.M., Bernard, R.M., Borokhovski, E., Abrami, P.C. and Schmidt, R.E.	2011	Affordance and constraints theories	Systematic review of literature	40 years of published research
15	Mikropoulos, T. A. and Natsis, A.	2011	Not specified	Review of peer reviewed educational virtual environments/realities literature	53 peer reviewed journal papers
16	Stevenson, I.	2008	Activity theory	Before-and-after activity teacher interviews	48 school teachers 24 primary school students 24 secondary school students

17	Jump, L.	2011	Bernstein's sociological theory of pedagogy	Critical appraisal of small context-specific case studies	Case studies of 16 articles (2007-2010)
18	Deaney, R., Ruthven, K. and Hennessy, S.	2006	Teachers' perceptions	Cross-case analysis on multiple sources (practitioners research plans, reports, observation and interviews); lesson observations; two minute interviews post observation then extended, semi-structured, post-lesson interviews; observed lessons	10 small-scale projects including 10 to 20 secondary school teachers
19	Warwick, P. and Kershner, R.	2008	Collaborative learning (social and cognitive aspects)	Teachers' written analyses and discussions of work carried out in their classrooms.	7 secondary school teachers
20	Gynnild, V., Myrhaug, D. and Pettersen, B.	2007	Surface and deep approaches to learning	Semi-quantitative survey Statistical analysis of grade awarded to students Approaches to studying questionnaire	101 university students
21	Duran, M., Gallardo, S., Toral, S.L., Martinez-Torres, R. and Barrero, F. J.	2007	Learner-centred approaches to teaching	Questionnaire distributed in the control and experimental groups	250 university students
22	Viilo, M., Seitamaa-Hakkarainen, P. and Hakkarainen, K.	2011	Not specified	Classroom ethnography; teacher's weekly reflective diary; video-recorded classroom practices	32 university students

23	Holvikivi, J.	2007	Cultural anthropology and sociocultural theory of learning	Student surveys, study records from several years, analysed textual data, student learning logs, factual classroom observations, 31 MCQ and open questions - analysis of logs	62 university students
24	Uren, M. and Uren J.	2009	Discovery learning	Online student experience survey	25 university students
25	Ruckert, E., McDonald, P.L., Birkmeier, M. et al	2014	Collaborative learning Experiential learning	Mixed-method questionnaire; formative assessments; anonymous online in-class survey; end-of-semester course evaluations	4 university faculty members 2 instructional designers
26	Alias, N. and Siraj, S.	2012	Behaviorism Cognitivism Constructivism	Interviews; index of learning style questionnaire; MCQ texts pretests and post-tests	14 university students 2 university teachers
27	Tunmibi, S., Aregbesola, A., Adejobi P. and Ibrahim, O.	2015	Not specified	Questionnaire; descriptive and statistical method analysis	67 university students
28	Mettiäinen, S.	2015	Self-directed learning	Group interviews; survey; regular questions every day; teachers online survey	9 university teachers 112 university students
29	Medzini, A., Meishar-Tal, H. and Sneh, Y.	2014	Authentic learning Contextual learning	Pre-course questionnaire; summary questionnaire	10 university students
30	Cerezo, L., Baralt, M., Suh, B.R. and Leow, R.P.	2014	Psycholinguistics	Analysis, rating and validation of studies	16 peer reviewed studies
31	Wu, P-H., Hwang G-J., Milrand, M., Ke, H-R. and Huang, Y-M.	2012	Cognitivism	Concept map training (3 hours); test sheets questionnaire for evaluation; post-test questionnaire of learning attitude technology acceptance	81 university students



32	Hutchison, A., and Wang, W.	2012	Phenomenological methodology	Blog posts in response to reading books; semi-structured interviews; blog postings correspondence on the social networking site interviews	15 university students
33	Garcia, E., Elbeltagi, I., Brown, M. and Dungay, K.	2015	Connectivist learning model	Open-ended teacher and student surveys; interviews following the project	33 university students 2 university teachers
34	Kulesza, A.E., Clawson, M.E. and Ridgway, J.S.	2014	Student-centred learning	Multiple choice clicker student quizzes at the beginning of each lecture; student achievement data aligned to general education curriculum objectives	22 university students
35	Gegenfurtner, A. and Seppänen, M.	2013	Visualisations on cognitive and educational psychological research	Individual sessions; eye-tracking observation; quantitative and qualitative analyses	9 medical professionals
36	Aloesnita N., Alwi, N. M., Adams, R. and Newton, J.	2012	Not specified	Interactive problem-solving task online role play; questionnaire; post-task group interviews; text chat performance	96 university students
37	Levac, D., Millar, P. and Missiuna, C.	2012	Contemporary neurological rehabilitation model	Semi-structured interviews	6 physiotherapists

### 2.3 Key educational technology research themes

In this section I consider the different kinds of research being conducted in the field of educational technology in higher education and what themes have emerged from the reviewed literature.

Conole and Oliver (2007) outline four main themes to e-learning and educational technology research. These themes are pedagogical, technical, organisational and wider sociocultural factors. Of the 37 articles reviewed, 29 could be categorised under the pedagogical theme and the other eight could be categorised under the sociocultural factor theme. What these four themes illustrate is that the breadth of research in the field is vast; each theme is developed with reference to particular theoretical frameworks, perhaps due to historical and disciplinary influences. Furthermore, the four themes are interconnected thus complex research questions arise in this field.

According to Selwyn (2011) educational technology research is focussed on ‘state-of-the-art’ stories of the near future and is falling short on the depth and breadth of what is being researched. From the reading of the literature reviewed, Selwyn’s claim is perhaps a provocation, as 13 of the articles I reviewed deal with simple educational technologies such as podcasts and interactive white boards (Hennessy and Deaney, 2009; Kearney and Schuck, 2008; Taylor and Clark, 2010; Tunmibi et al, 2015; Warwick and Kershner, 2008). Only five of the 37 articles deal specifically with more sophisticated educational technologies, that could be described as ‘state-of-the-art’, such as real-time simulations and educational virtual realities (Duran et al, 2007; Gynnild et al, 2007; Mikropoulos and Natsis, 2011; Wu et al, 2012).

It is important to highlight here that the heterogeneous nature of the educational technology field identifies challenges and complexities in the quality and type of research conducted (Gunn and Steel, 2012; Selwyn, 2011).

Extensive reviews of published research in the field in higher education contexts conclude that most studies have either been pragmatic, concentrating on applications of new technologies and the pursuit of behavioural evidence of improved learning outcomes, or focused on matters of practical implementation and design (Bennett and Oliver, 2011; Conole, 2004; Steel and Gunn, 2011).

Twenty four of the 37 articles reflect these comments. These articles aim to analyse and unpack university teachers' experiences, which is a complex multi-faceted task and the methods used to pursue this research are a combination of qualitative and pragmatic research approaches.

As summarised in Table 2.1 above, 20 of the articles dealt with research projects that were small in scale and involving only a small numbers of participants. All of these projects used a variety of data collection methods, such as detailed interviews, follow-up meetings and reflections.

These small-scale studies document research that builds on previous research and incrementally and collectively build a strong narrative captured by the four propositions that I discuss in detail in Section 2.7 below.

Four articles reported research reviews. Mikropoulos and Natsis (2011) reviewed 53 empirical research studies conducted over a ten-year period in educational virtual realities. Tamim et al. (2011) summarised 40 years of research on computer technology use and its effect on student achievements that encompassed 1,055 primary studies.

Jump (2011) reviewed and synthesised small context-specific case studies to capture contemporary approaches to pedagogy within the context of technology and universities.

Cerezo et al (2014) analysed 16 studies to see if there is a difference between face-to-face language learning and computer assisted language learning (CALL).

These four detailed and thorough articles were included in the literature search as their findings have added depth and breadth to current understandings of technology-enhanced teaching and learning.

## **2.4 Theoretical frameworks influencing educational technology research**

In this section I consider theoretical frameworks that have influenced the reviewed research and asked these questions. Are there any theoretical frameworks that are commonly used across the reviewed studies? How applicable are they for my research project?

There is a call for a ‘... more dynamic relationship between theory and practice’ (Bennett and Oliver, 2011 p.179) in order to avoid the field becoming a narrow and derivative one. There is ‘... a concern that there is no one meta-theory linking the disciplines feeding into the community of educational technologists or unifying the discipline internally (Czerniewicz, 2010 p.527). It can be claimed that these comments are reflected in the reviewed research in so far as there are 11 different theoretical frameworks that have been identified from the 37 articles. These frameworks are identified in Table 2.1 above. It is important to note that sociocultural theoretical perspectives informed the research reported in seven of the 37 articles.

The argument that this is a field that does not have a single theoretical foundation and that those that are utilised tend not to be cohesive and are often not well specified (Bennett and Oliver, 2011; Czerniewicz, 2010; Steel and Gunn 2011;) is reflected in the literature reviewed, with 16 different theoretical frameworks identified in 32 of the reviewed articles. However, the purpose of particular articles was to solve a pedagogical problem (for example, dealing with a large cohort of first year undergraduates), where the educational theory was used to illuminate understandings of the use of educational technologies developed through close analysis of data (Farmer, Yue and Brooks, 2008; González, 2009, 2010; Gynnild et al, 2007; Hennessy, Deane and Ruthven, 2005; Kulesza et al, 2014; Medzini et al, 2014; Viilo et al, 2011).

The literature reviewed is truly global, as it encompasses North America, Australasia, the UK, Africa and Europe. Each of these areas has a different historical and theoretical experience with regard to educational technology research that, in turn, impacts on the theoretical frameworks researchers are exposed to, influenced by, critical of, incorporate or ignore.

The educational technology field (particularly in the USA and Australia) has its roots in the science of instruction, instructional technology, and instructional design, which are based on theories of cognition with a positivist perspective (Conole and Oliver, 2007; Czerniewicz, 2010; Kirschner et al, 2006). Cognitive load theory has, in large part, not been seen as useful by practitioners in the educational technology field because research using this theoretical framework has been conducted in laboratories and not in authentic, real-life or complex learning contexts.

However, cognitive architecture researchers claim that the ideologies embedded within constructivism (Mayer, 2004) have dominated in the 21<sup>st</sup> century with no real body of empirical research to substantiate their claims. There are evidence-based findings that the cognitive load theoretical concept in particular, can inform the field theoretically (Bennett and Oliver, 2011; Kirschner et al, 2006) particularly in the area of ‘minimum guidance’ versus ‘guided instruction’ and cognitive load when incorporating technology to promote learning.

Cook (2002) argues that researchers who treat theory as if it was simply and solely a foundation for applied design fail to represent the richness of work that can, and sometimes is, undertaken in the field.

A scholarly approach to research in learning technology should build knowledge, including new theories; integrate work from different disciplines in a thoughtful way; and apply it to practical problems and concerns. (Bennett and Oliver, 2011, p.186)

These comments are reflected in the reviewed literature to varying degrees of success. Ten of the 37 reviewed articles integrate work from different disciplines (Johnson et al, 2011; Krentler and Willi-Flurry, 2005; Stevenson, 2008; Taylor and Clark, 2010; Uren and Uren, 2009); for example, engineering, education and anthropology (Holvikivi, 2007); design technology, ethnography and education (Viilo, 2011); marine engineering, education, and computer science (Gynnild, et al 2007); cultural and media studies, education and writing practices (Farmer, Yue and Brooks, 2008); and psychology , education and instructional design (Alias and Siraj, 2012).

From the reviewed literature, there are five theoretical frameworks identified that have some relevance to my research. They are: student approaches to learning from a phenomenographic perspective, which is identified in two articles; university teachers' conceptions to teaching incorporating technology from a phenomenographic perspective, which is identified in three articles; sociocultural perspectives, explored in seven articles; the related perspectives of activity theory, explored in two articles; and affordance and constraints theories, loosely identified in four articles.

For the purposes of exploring useful theoretical frameworks for my research, three of the five educational theoretical frameworks are elaborated on in this section and one will be discussed in Section 2.5.

#### **2.4.1 Students' approaches to learning using educational technologies**

Phenomenographic studies on students' approaches to learning focus on the learners' experiences.

‘Good teaching and good learning are linked through the students’ experiences of what we do. It follows that we cannot teach better unless we are able to develop understandings of practice their points of view and accounts of experience’. (Ramsden, 2003, p.84)

The concept of surface and deep approaches to learning and an approach to learning as a *response to an educational context* rather than an internal characteristic of a student that is relational or context dependent (Marton and Säljö, 1976; Prosser and Trigwell, 1999; Ramsden, 2003) is a widely acknowledged concept in teaching and learning in the higher education field (Kandlebinder and Peseta, 2009).

This concept has provided the foundation for further research that incorporates the use of educational technology in learning and how students approach these contexts (Ellis and Goodyear, 2010). The relationship between the quality of student learning and the quality of teaching are inextricably linked and relate to both face-to-face as well as online environments.

Research in students' approaches to learning has played a major role in bridging the gap between theory and practice of university learning and teaching (Ramsden, 2003), where the research focus is on learning in naturally occurring contexts of learning and is about *how* students learn from the students' own viewpoints about their approach to learning and their thinking that underpins their learning from their perspectives.

Twelve of the 37 articles reviewed focussed on students and their use of educational technologies as part of their learning. A New Zealand study reported university teachers incorporated educational technologies to deal with diverse and changing cohorts and help bridge students' conceptual, visual and spatial thinking in the disciplines of earth and ocean science, education, screen and media studies and pre-degree academic literacy (Johnson et al, 2011).

The findings in an Australian study of economics and business university students revealed that students used podcasts to reinforce key points and provide flexibility in when and where they could access their learning resources (Taylor and Clark, 2010).

A US study of marketing students at a state university revealed that those students who were majoring in Marketing and engaged in class discussions online frequently and consistently performed significantly better than those that did not (Krentler and Willi-Flurry, 2005).

The results of a Spanish study of undergraduate electrical engineering students, revealed a high influence on student satisfaction of their studies (Duran et al, 2007) through the incorporation of simulations of a virtual scenario.

A Finnish study at a University of Applied Sciences, (Mettiäinen 2015) investigated nursing teachers' and students' attitudes to, and experiences of, using an electronic assessment and feedback tool in clinical training supervision. Students were challenged to reflect on their learning experiences and by documenting this in the online tool supervisors were alerted to their learning needs and could engage with those who were having difficulties more effectively.

In a UK study, using a connectivist educational collective blog model (Garcia et al, 2015), university students and teachers blogged as part of their *Illustrative Practices* module to explore the implications of how using a blog might change the manner in which learning and teaching occurred in the module. Not all participants found the experience beneficial to their learning and some preferred face-to-face discussion over online discussion using the blog.

#### **2.4.2 University teachers' conceptions of teaching using educational technologies**

There is a body of research on teaching conceptions and approaches, located in a broader field of research into university teachers' thinking, knowledge and beliefs (Ellis and Goodyear, 2010) that has identified that some ways of teaching are not related to successful student learning (Prosser and Trigwell, 1999; Ramsden, 2003).



The three articles that have adopted this broad theoretical framework to inform their research (Ellis, Steed and Applebee, 2006; González, 2010; Lamerás et al, 2011) illustrate that university teachers' pedagogical beliefs about teaching are influential on how they may or may not incorporate technology effectively in their teaching to promote learning.

An Australian study of university teachers (González, 2010) discovered four qualitatively different ways university teachers conceived e-learning. They were: a) to provide information to students; b) for occasional communication among module participants; c) to engage students in online discussions and d) to support knowledge-building tasks. To provide a more detailed picture, four dimensions were provided. They were: the role of the teacher; the role of students; the module participants' interaction; and the perception of embeddedness of the online learning with the face-to-face component of the module.

A Greek study of computer science university teachers (Lamerás et al, 2011) illuminated a spectrum of teachers' conceptions and approaches from 'teacher-focused and content-orientated', through 'student-focused and content-orientated', and to 'student-focused and process-orientated'. This study has highlighted that the pedagogical beliefs and context of the face-to-face teaching are more influential in shaping approaches to blended learning using a virtual learning environment than the tool features of the VLE itself.

### **2.4.3 Sociocultural theoretical framework**

The concept that '... higher mental processes in the individual have their origin in social processes...' and the concept that '... mental processes can be understood only if we understand the tools and signs that mediate them...' (Wertsch, 1985, pp.14 -15), provide a useful framework in attempting to understand how university teachers incorporate educational technology to promote learning.

The Vygotskian social constructivist perspective on learning has influenced the research of sociocultural theorists (Mercer 1995; Mercer 2000; Mercer and Littleton 2007) and relates directly to the proposed research in a number of ways.

For example, the view that Vygotsky's idea that learning with instruction in a formal learning situation is an ordinary, everyday essential feature of human mental development, and the view that the limits of a person's learning or problem-solving ability can be expanded and extended with the right kind of social support (Mercer 1995), provide a strong impetus for the proposed research.

Mercer expanded on Vygotsky's concept of zone of proximal development: '...the distance between the actual development as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers...' (Vygotsky, 1978, p.86), which he considers to be static, through his 'inter-mental development zone' concept, which focusses on the way that a teacher and their learners stay attuned to one another's changing states of knowledge and understanding over the course of an educational activity and co-construct knowledge.

Seven of the 37 articles reviewed, that employ the sociocultural theoretical framework provide a number of effective methods of data collection, albeit time consuming and labour intensive, and elaborate on understand teaching and learning as an inter-mental process by attempting to capture and document this concept and make sense of the findings from their research.

## **2.5 University teachers' beliefs and conceptions of the usefulness of educational technologies**

In this section I consider what are university teachers' beliefs and conceptions in relation to incorporating educational technology in their classrooms. How do these beliefs influence university teachers' decisions about incorporating or not incorporating educational technologies in their teaching?

Fifteen of the 37 reviewed articles deal with university teachers' beliefs and conceptions and use a number of different theoretical frameworks.

These small-scale sample studies incorporate data collection methods such as video recordings of classroom teaching and follow up in-depth interviews (Hennessy and Deaney, 2009); the use of focus group interviews (Hennessy, Ruthven and Brindley, 2005); one-to-one extensive phenomenographic interviews (González, 2010); stimulated recall and concept mapping interviews (Steel, 2009); and observation of professional sessions (Gegenfurtner and Seppänen, 2013).

The findings of these research projects show that there is a distinct variation in the epistemological beliefs and concepts of university teachers and school teachers in how they interpret the effectiveness of using educational technologies for promoting learning (Deaney, Ruthven and Hennessy, 2006; González, 2010; Levac et al, 2012; Steel, 2009). The findings from the two Australian studies (González, 2010; Steel, 2009) illustrate that there are some university teachers who perceive educational technologies as a medium for engaging communication-collaboration-knowledge building while there are others who perceive it as a delivery medium, rather than a space for learning.

The research reviewed in Steel's study (2009) revealed that university teachers were in agreement in the assertion that the use of educational technologies must derive from educational need.

However, the findings in an English study (Hennessy, Ruthven and Brindley, 2005) showed that school teachers' beliefs on how effective educational technologies could be to promote learning were affected by what they perceived as 'educational need' and their knowledge of educational technologies affordances. When this was congruent, then the assimilation of these technologies into their ongoing teaching practices and the established curriculum occurred.

However, the velocity of change in the affordances of educational technology does present significant challenges for university teaching staff as they consider the minimal institutional incentives offered (Hennessy and Deaney, 2009; Steel, 2006; 2009).

The concept of the scholarship of teaching, which focuses on the notion of teaching being carefully planned, has relevance to the proposed research topic and is articulated in the reviewed literature.

To incorporate educational technologies effectively in university teaching to promote learning requires time and careful planning (Steel, 2009).

For Boyer (1990), teaching was a dynamic and carefully planned endeavour. This scholarly approach to teaching takes it from a position of being something everyone can do without much thought, to a position where teaching is something much more sophisticated and thoughtful that both educates and entices future scholars.

## **2.6 Affordances, constraints and barriers to educational technology use**

In this section I consider the perceived and real affordances, constraints and barriers facing university teachers when incorporating educational technology in their teaching. This perspective is outlined in the four articles in the reviewed literature.

The term affordance originally invented by Gibson the perceptual psychologist, described the actionable properties between a person or animal and the world (1977; 1979). For Gibson ‘affordances are a relationship. They are part of nature: they do not have to be visible, known or desirable’ (Norman, 2017). The term has now taken on other meanings beyond the original ‘relationship’ and in the context of my literature review is a broader concept informed by the work of Norman on perceived logical and cultural constraints (1988, 2013) that these constraints and barriers could be either organisational, technological or pedagogical.

Of these four reviewed articles that investigate pedagogical issues informed by affordances and constraints, university teachers make decisions on when, where and how to incorporate educational technologies in their classrooms to optimising learning depending on the contextual affordances and constraints they face whilst teaching in their institutions.

University teachers will incorporate those educational technologies that offer affordances for what they already do in their teaching, rather than those that radically change teaching and learning practices (Kennedy et al, 2011; Kirkup and Kirkwood, 2005). This claim has been substantiated in the findings in all four articles that investigate this phenomenon (Hennessy, Ruthven and Brindley, 2005; Mikropoulos and Natsis, 2011; Steel, 2009; Tamim et al, 2011).

## **2.7 Propositions of educational technology use identified in the reviewed literature**

There are particular issues, challenges, and ideas, which have arisen from the reviewed literature. In analysing the reviewed literature and synthesising salient and recurring themes and consistent findings of the 37 articles, a list of propositions was created through an iterative process to assist me with my research design. The four clear propositions that emerged from my review of the research findings are as follows:

1. There is a distinct variation in university teachers' conceptions regarding the purpose, usefulness and benefit of using educational technologies to promote learning. These pedagogical beliefs are strong and influential.
2. There is a gradual pedagogical evolution occurring, which is driven by the curriculum context and university policies. However, this is hindered by external constraints and significantly challenged through the velocity of change.
3. There are significant effects in the use of educational technologies in promoting learning for those students who are technically proficient and competent in using the technology; the frequency of their engagement with the educational technology driven activity, and where the educational technology supports the instruction (university teacher led and directed) rather than providing direct instruction (students working alone with the technology).

4. The contextual ‘uniqueness’ of each pedagogical challenge solved through the integration of educational technologies in specific and particular contexts of practice makes it difficult to transfer the ‘pedagogical solution’ to other pedagogical contexts.

Each of these four propositions provides direction and guidance for my research project. However, it is difficult to gauge consistently from the reviewed literature to what extent the educational technologies reported in the literature were used by the students as part of their wider classroom learning.

One can assume that university teachers incorporate the university-endorsed VLE to support students learning outside the classroom (Taylor and Clark, 2010), though this is not the case for university teaching that encompasses laboratory work or studio based work (Duran et al, 2007; Garcia et al, 2015; Holvikivi, 2007).

The research project provides the opportunity to analyse and make visible the ‘invisible’ work done by teachers in guiding and directing classroom practices (Garcia et al, 2015; Viilo et al, 2011) and is informed by the sociocultural theoretical framework and its need for extended observation studies. Primary and secondary schooling is structured in such a way that students can be together for the whole academic year, while this is not always the case in higher education, a point that will be taken into account in my research design.

This interest in the ongoing conversation between teachers and their students relies on suitable participants willing to endure the time commitments over an extended time period with multiple classrooms observations. However, studying teaching and learning interactions in university classroom contexts of educational technology use over extended time periods does pose exciting challenges to a solo researcher in higher education.

To conclude, the current state of educational technology research is theoretically in flux. As a relatively young field it is still working towards articulation of its theoretical foundations. My research is informed by the findings from the reviewed literature.

In an attempt to garner useful and rich data to help me explore my research focus the sociocultural theoretical framework was considered as a powerful framework to employ in my study. Also, on reflection on the literature reviewed, and the different frameworks referenced, I considered the studies informed by socio-cultural frameworks largely conducted in primary and secondary schools to be highly informative. As a result, it was considered that this framework could be relocated into a UK higher education context for the purposes of my proposed research.

## 2.8 Research questions

In the light of this review of the educational technology-mediated learning literature, I formulated the following research questions, which shaped the design of this study.

- How do university teachers and students use educational technologies to optimise learning in classroom contexts?
- What thinking underpins how university teachers approach educational technology use in their classroom teaching?
- What thinking underpins how students' approach educational technology use in classroom lessons to support their own learning and one another's learning?
- What differences are there between university teachers and their students (as well as between students) in their approaches to incorporating educational technologies in their teaching and learning?

In the next chapter, I present the research design and its underpinning thinking that I developed in order to address these research questions.

## Chapter 3: Research Design and Methodology

### 3.1 Introduction

A key focus of my research is developing understandings of university teachers' perspectives towards and strategies employed, in educational technology-mediated classroom lessons as well as the range of thinking that underpins those strategies. My interest is in understanding the thinking behind a university teacher's strategies that are construed as supportive of students' learning in educational technology-mediated classroom contexts.

I am also interested in developing understandings of how educational technology mediates the learning experiences and achievements of university students from their points of view. Therefore, a key focus of my research design involved a focus on students' learning strategies, beliefs and values about learning particularly in educational technology-mediated contexts of classroom learning in a university setting.

The aim of my research design was to further develop these understandings with regard to the following central research question:

- How do university teachers and students use educational technologies to optimise learning in classroom contexts?

In order to guide the data collection process, my research design was shaped by the three subsidiary research questions:

- What thinking underpins how university teachers approach educational technology use in their classroom teaching?
- What thinking underpins how students' approach educational technology use in classroom lessons to support their own learning and one another's learning?
- What differences are there between university teachers and their students (as well as between students) in their approaches to incorporating educational technologies in their teaching and learning?



### 3.2 Qualitative research strategy

As an educational researcher, I ‘... need a research epistemology that explores possibilities by giving voice to people who are directly affected by social and educational situations, and to encourage researchers to develop a capacity for reflection on both means and ends in education’ (Hartas, 2010, pp.49-50).

Therefore, I considered particular research paradigms and approaches to inform my research design.

My foundation of inquiry is influenced by the pragmatism worldview of research design, one of the four research worldviews for quantitative, qualitative and mixed methods research as outlined by Creswell (2009) and Creswell and Plano Clark (2007). This worldview has helped me create a foundation of inquiry in which to conduct my research. I see pragmatism as the primary worldview for my research because I am concerned with practical matters and am guided by practical experience (Johnson and Onwuegbuzie, 2004; Robson, 2011; Thomas, 2007; 2009).

My research has adopted a ‘bottom-up’ approach, and the research process and decisions about methods of data collection were shaped by the research questions and the kinds of data that would be most useful to me in addressing those questions (Tashakkori and Teddlie, 2010).

I believe my study places a high regard for the reality of and influence of the inner world of university teachers and their students in action that explores their day-to-day engagements with educational technologies for supporting teaching and learning. I also consider observation, experience, and experiments all useful ways to gain an understanding of university teachers and students and their worlds. I view knowledge as being both constructed and based on the reality of the world we experience and live in and what we do in our day-to-day lives as we interact with our environments. I take an ‘...explicitly values-orientated approach to research that is derived from cultural values; specifically endorses shared values such as democracy, freedom, equality, and progress...’ (Robson, 2011, p.29)

I would like to consider that the skills of a university teacher and students when incorporating educational technology in contexts of teaching and learning are not easily reducible to either technique or to theory. That ‘...knowing how to do something, in other words, is not predicated on knowing principles for doing it or the possession of articulated knowledge’ (Thomas, 2007, p.84). I regard ‘pedagogy as experimentation in thought, rather than representation of knowledge as a thing already made...’ (Ellsworth, 2005, pp.27–28).

In preparation for my fieldwork, I considered some of the key features, strengths and weaknesses of the three approaches to research (quantitative, qualitative and mixed-methods) as a basis for investigating my research questions. Key features of qualitative research that are applicable to my particular study are that one needs to understand the meanings of informants to properly understand technology use in classrooms and therefore an inductive approach was adopted to make those participant meanings the starting point of my enquiry.

A qualitative approach to research assisted me in generating richly detailed understandings of technology use as a situated phenomenon embedded in particular local contexts. Perceived weaknesses of this approach may mean that findings may not be general to other people or settings, the data analysis will be time consuming, and results may risk falling under the influence of my personal biases and subjectivities (Robson, 2011)..

After weighing up the strengths and weaknesses of the qualitative research approach to conduct research, I was convinced that in order to maximise the quality of my data, a qualitative in-depth face-to-face interview method supporting the articulation of different facets of teachers’ and students’ perspectives and thinking would be the most suitable choice to generate sufficient data to help me answer my research questions.

In summary, the focus of my research design planning was towards ‘... understanding meaning individuals give to a phenomenon inductively’ (Creswell and Plano Clark, 2007, p.29).

My research has been influenced by sociocultural and phenomenographic theoretical perspectives. A sociocultural ontology of human activity views knowledge as a social construct where this activity is shaped by physical and psychological tools that are in turn developed in human activity. ‘... Humans are seen as creatures who have unique capacity for communication and whose lives are normally led within groups, communities and societies based on shared ‘ways with words’, ways of thinking, social practices and tools for getting things done’ (Mercer, 2004, p139).

This perspective employs a Vygotskian framework (Mercer, 2004) and views learning as ‘an integral part of the generative social practice in the lived-in world’ (Lave and Wenger, 1991, p.35). In terms of conducting research, a sociocultural ontology considers that events or incidents do not work in isolation and that what happens is framed by what happened before and it is understood in a context by what happens next and that joint making by individuals together is framed by tool, physical context and history (Mercer, 2004).

A central assumption of the phenomenographic theoretical perspective is that there is a variation in people’s experiences of the same thing and that experience is relational and not purely objective (Prosser and Trigwell, 1997). It does not attempt to make statements about reality, or the nature or essence of the phenomenon itself.

For Åkerlind, phenomenographic ontology ‘provides a way of looking at collective human experience of phenomena holistically despite the fact that such phenomena may be perceived differently by different people and under different circumstances’ (2005, p.72).

What epistemological assumptions if any, arise from the sociocultural theoretical perspective that underlies my research design? As Crotty asserts, epistemology is ‘... the theory of knowledge embedded in the theoretical perspective and thereby in the methodology...’ (1998, pp.8-9).

For example, that knowledge is not a property but a social construction and that our way of knowing comes from our experience of the world is clearly one assumption. Epistemological assumptions concur that learning is situated by the activity in which it takes place and that looking solely at the individual to understand their learning is not sufficient (Vygotsky, 1978). Epistemological assumptions of sociocultural theoretical perspectives also suggest that the mediation of learning through technology use is best examined itself as a social process developed in situated contexts of social practice (Brown et al, 1989; Lave and Wenger, 1991).

### 3.3 Research design overview

In order to successfully gather useful data in response to the research questions I had developed, I adopted a qualitative research design as outlined in Table 3.1 below. This qualitative design incorporated a differentiated interview strategy comprising generalised and contextualised interviews.

**Table 3.1: Research design overview**

<b>Main research question:</b> How do university teachers and students use educational technologies to optimise learning in classroom contexts?				
<b>Subsidiary research questions</b>	<b>Methods of data collection</b>			
1. What thinking underpins how university teachers approach educational technology use in their classroom teaching?	generalised university teacher interviews		contextualised university teacher interviews	
2. What thinking underpins how students' approach educational technology use in classroom lessons to support their own learning and one another's learning?		generalised student interviews		contextualised student interviews
3. What differences are there between university teachers and their students (as well as between students) in their approaches to incorporating educational technologies in their teaching and learning?	generalised university teacher interviews	generalised student interviews	contextualised university teacher interviews	contextualised student interviews

My research design was shaped by my interest in understanding more about how educational technology use influences and mediates the teaching and learning experiences and achievements of a group of university Chemistry students taught by Bryn, one of their university teachers.

A key focus of my research design involves understanding Bryn's perspectives and thinking that underpin the range of strategies he employs in educational technology-mediated classroom contexts to support his students' learning. Students' perspectives, beliefs and values about learning and the learning strategies they apply in their university studies and in particular in educational technology-mediated learning contexts are also a key focus of this research (Flick, 2014; Hartas, 2010).

### **3.3.1 Interviewing strategy**

In order to develop rich understandings of my informants' learning and teaching experiences and pedagogical thinking, I developed a qualitative interview strategy that incorporated both generalised and contextualised semi-structured in-depth face-to-face interviews.

This differentiated interview strategy is anchored in the qualitative semi-structured tradition (Foddy, 1993; Kvale, 1996; Rubin and Rubin, 2005; Seidman, 2011) which helped develop the design, conducting of and analysis of the generalized interviews.

The focus of the post-lesson contextual interviews was on the discussion during these in-depth semi-structured interviews which was grounded in the specific concrete lesson events and commentaries of specific classroom practice of my informants (Rickinson, 1999; Hennessey et al., 2005; Deaney et al., 2006).

My research included generalised university teacher interviews and generalised student interviews as well as contextualised university teacher interviews and contextualised student interviews (Foddy, 1993; Powney and Watts, 1987).

The purpose of each data collection method of my differentiated interview strategy is explained in further detail in Table 3.2 Overview of research methods; purpose of use, overleaf.

**Table 3.2: Overview of research methods; purpose of use**

<b>Research method</b>	<b>Purpose of use</b>
Generalised university teacher interviews	<p>Elicit accounts from a university teacher of their broad pedagogic understandings, beliefs and values in relation to teaching in a variety of classroom learning contexts, both contemporary and in the past, involving educational technology.</p> <p>Elicit accounts of their professional craft knowledge in relation to the use of educational technology to support students' learning, particularly successful educational technology use.</p>
Generalised student interviews	<p>Elicit accounts from students of their learning strategies, beliefs and values in relation to learning in a variety of classroom learning contexts involving educational technology use both contemporary and in the past.</p> <p>Capture the variety and range of patterns of generalised learning strategies, beliefs and values that inform the participation of a group of students in a university classroom.</p> <p>Elicit a full range of students' university learning experiences which feature educational technology use (fieldwork focus).</p>
Contextualised university teacher interviews	Elicit accounts from a university teacher of their professional knowledge, purpose, beliefs and values that underpin their practice in relation specific teaching contexts involving educational technology use.
Contextualised student interviews	Elicit accounts from students of the learning strategies, beliefs and values in relation to learning in specific classroom learning contexts involving educational technology use.

### **3.3.2 Differences between generalized and contextualized interviews**

In the attempt to collect rich, diverse and in-depth data that will help me address my research questions a combination of two different types of interviews was required. This research design has come from similar socio-cultural research conducted in primary and secondary schools (Hennessey et al., 2005; Deaney et al., 2006).

As outlined in the table above, my semi-structured face-to-face generalised interviews aimed to elicit a full range of learning and teaching experiences which feature educational technology use as well as, aimed to capture broad pedagogical understandings, beliefs and values of learning and teaching in higher education. The purpose of generalised interviews is to capture variety and range within many learning and teaching experiences that spanned over different periods of time.

Whilst on the other hand, the purpose of the contextualised post-lesson interviews was to gain access to specific classroom learning, beliefs and values that were identified in specific lessons at specific moments of time (Hennessey et al., 2005; Deaney et al., 2006).

Overall, the differentiated interview strategy I selected, provided me with the opportunity to collect rich data as I was able to gain access to different aspects of Bryn's thoughts, experiences and knowledge as these relate to his use of educational technologies in his teaching to optimise his students' learning of chemistry. This strategy also proved useful in helping me gain access to different facets of his students' thoughts, experiences and knowledge as these relate to students' use of educational technologies in their studies during their undergraduate Chemistry degree.

### ***Generalised interviews***

Generalised interviews were aimed at exploring with teachers and students their broader kinds of thinking that apply across all contexts and experience of practice, now and in the past. This approach to interviewing was selected as I am interested in eliciting rich accounts of as full an array as possible of Bryn and his students' successful learning and teaching experiences and the role educational technology played in these experiences. I wanted to establish an interview context where all informants are asked the same broad questions in flexible ways that enabled the interviews to take on a conversational flow.

In these generalised interviews I was much more concerned with teachers' and students more general ideals (i.e. about effective teaching and learning effective use of educational technology, the kinds of learning a university teacher is aiming to promote).

I was also interested in the common principles that run through a teacher's teaching more generally in different contexts and throughout time, the common principles that run through a student's approaches to learning more generally in different contexts and over time (Elbaz, 1983; Prosser and Trigwell, 1999).

My interview approach and the flexibility of the semi-structured informant-style approach provided scope for each informant to tell their authentic, personal accounts of learning and teaching experiences. There was a common core of interview questions but there was also flexibility within the generalised interviews to allow for articulation and development by informants of their own personal unique stories.

Informants during the generalised interviews were free to recount how they used educational technologies to promote learning across a range of different classroom contexts throughout their lives and not restricted to their time at university. The generalised interviews started with a holistic focus and supported each informant to develop accounts of their broad pedagogic frameworks, what Elbaz (1983) refers to as 'images' and 'principles of practice', as they related to different contexts of educational technology use related in some way to some aspect of their learning. The aim of this approach was to focus on their broader, less context dependent ideological and pedagogic understandings, values, principles and beliefs regarding educational technologies that ranged across multiple contexts both contemporary and in the past and in different technology-mediated learning contexts such as at university, at secondary school, or with friends or family.

I did not want to constrain my informants to an exclusive focus on specific events and decisions during any particular lesson or experience. I wanted them to talk freely about using educational technologies to promote learning in any and all contexts that occurred to them at the time of the interview to be important to their learning at points or during periods throughout their lives.



### *Contextualised interviews*

Contextualised interviews were, by contrast, focused on specific contexts of teaching and learning and conducted after such teaching and learning had taken place. The literature into teachers' thinking distinguishes or differentiates between more contextualised kinds of thinking and knowledge on which teachers draw when teaching in lessons on particular occasions and their more general beliefs and ideals. These contextualized interviews were focused on eliciting accounts of the former kind.

This concept is explored in the literature on teachers' professional craft knowledge (Brown and McIntyre, 1993; Cooper and McIntyre, 1996) a form of experience-based expertise that experienced teachers have developed through their teaching careers and draw on in the course of classroom teaching. It is also explored in the reflection in professional practice and theory-in-use of teaching studies (Argyris, 1993; Argyris and Schön, 1978; Ashwin et al, 2015; Schön, 1983), and the 'rules of practice' and 'practical principles' research (Elbaz, 1983). It is accounts of this kind of contextualised thinking and knowledge of teaching and learning I am trying to access through the post-lesson contextualised interviews.

In gathering effective data for my research, these contextualised interviews were carried out directly after the observed lessons or as soon as possible after the lesson had finished on the same day. This was to ensure that entire interview was contextualised round the detailed thinking behind the teacher's and students' practices in the specific observed lesson.

I was particularly interested to find out whether Bryn's and his students' generalised and contextualised thinking would be similar or different. I was interested in what the students said when asked about educational technology to promote learning in a general way compared to what the students said in relation to specific lesson contexts and how the students used educational technologies to promote learning in particular classroom contexts.

Through my differentiated interview strategy, I was able to provide support for my informants to reveal a range of different facets of their perspectives and craft knowledge in relation to their educational technology-mediated classroom learning and teaching practices and to develop highly detailed and contextualized and more generalised understandings about their use of educational technologies in university classroom contexts to promote learning.

### **3.4 Research participants**

My exploratory interpretative case study (Flyvbjerg, 2011; Stake, 2008; Yin 2009) occurred within the natural environment of a particular School of Chemistry at a research-intensive East Midlands University. I set out to develop multilayered understandings (Stake, 1995) of this higher education learning and teaching environment and immersed myself in the life of the School, and its lecture theatres and classrooms and developed relationships with some of its academic staff and its undergraduate students (Blaxter et al, 2010; Thomas, 2016). This immersion spanned over an 18-month period from November 2013 until April 2015.

My research design used purposeful sampling (Denscombe, 2010) to select a university teacher and some of their students. As Denscombe noted, ‘We can get the best information through focusing on a relatively small number of instances deliberately selected on the basis of their known attributes’ (2010, pp 34-35). In selecting the informants for my research, I selected a university teacher who was actively using educational technologies in their campus-based university teaching and was known by their peers as someone who is interested in promoting learning through the incorporation of educational technology in their classroom teaching and was willing to invite me into their classroom and work with their students.

My decision to work with one university teacher was influenced by a number of factors. My study was a small-scale solo enquiry, so I did not have the resource and time to carry out detailed multi-layered analysis of more than one teacher and their group of students if I was to achieve the level of contextual detail I was aiming for. Bryn was selected because he had excelled on eLearning 20-credit module I convened as part of the Postgraduate Certificate in Academic Practice in Higher Education (PGCAPHE).

Bryn was a fairly experienced university teacher with more than five years' experience teaching at university level. He was also committed to incorporating and fostering the use of educational technologies in his routine teaching. Finally, Bryn was very interested in the focus of this research and was willing to commit time to it.

My aim was to achieve access to a group of university students on a number of different occasions over an extended period of time during their formal classroom studies.

I also wanted to work with a motivated university teacher, skilled in promoting educational technology-mediated pedagogy in his subject teaching. This way, I felt that through his accounts I could record, from a university teacher's perspective, the thinking and practice behind effective educational technology-mediated pedagogy in the university classroom.

I was confident in the strength and sophistication of his pedagogic knowledge and knowledge of educational technology use in classrooms through his successful completion of the full Postgraduate Certificate in Academic Practice in Higher Education (PGCAPHE).

An overview of the research methods used, the participants involved and the time context of the research conducted is outlined in Table 3.3 below.

**Table 3.3: Overview of research methods; participants and time context**

Phase	Research method	Participants		Time context
1	Generalised university teacher interview	Bryn - university teacher		Semester 1, 2013 – 2014 (1 x 30-minute interview)
2	Generalised university teacher interview	Bryn - university teacher		Semester 2, 2014 – 2015 (1 x 30-minute interview)
1	Generalised student interviews	12 - 1 <sup>st</sup> year undergraduate students		Semester 1, 2013 – 2014 (1 x 10 to 15-minute interview)
		<ul style="list-style-type: none"><li>• Brigitta</li><li>• Josh</li><li>• Sam</li><li>• Maggie</li><li>• Nareem</li><li>• Rebecca</li></ul>	<ul style="list-style-type: none"><li>• Sebastian</li><li>• Sophie</li><li>• Stephen</li><li>• Susanna</li><li>• Wai Azizah</li><li>• Ester</li></ul>	
2	Generalised student interviews	7 – 2nd year undergraduate students		Semester 2, 2014 – 2015 (1 x 30-minute interview)
		<ul style="list-style-type: none"><li>• Josh</li><li>• Sam</li><li>• Maggie</li><li>• Wai Azizah</li></ul>	<ul style="list-style-type: none"><li>• Duncan</li><li>• Bronwyn</li><li>• Gulwant</li></ul>	
1	Contextualised university teacher interviews	Bryn – university teacher		Semester 1, 2013 – 2014 (4 x 20-minute interviews)
1	Contextualised student interview	6 – 1 <sup>st</sup> year undergraduate students		Semester 1, 2013 – 2014 (11 x 10 to 15-minute interviews)
		<ul style="list-style-type: none"><li>• Brigitta</li><li>• Josh</li><li>• Sam</li></ul>	<ul style="list-style-type: none"><li>• Nareem</li><li>• Sebastian</li><li>• Susanna</li></ul>	

As outlined in Table 3.3 above, I gained access to Bryn, a university teacher and to 12 first year Bachelor of Science and MChem students studying the first year compulsory module, *CH1000 – Chemical Principles* during Phase One of my fieldwork. All of the 120 first year Chemistry students enrolled in the module were invited to participate in the research by Bryn and myself at the beginning of one of their first module lectures.

At the beginning of two module lectures I was introduced by Bryn to the students and spoke for 5 minutes about the research project and its aims. I explained to the cohort that student participation in the project would assist me in my role at the University where I support university teachers to enhance their teaching.

At the end of each lecture, I provided written information on the project (see Appendix E) to those students who expressed their interest in participating in the project. As a result, 12 students participated in Phase One of the generalised interviews element of my study.

During Phase Two of my fieldwork, I gained further access to Bryn and seven second year Bachelor of Science and MChem students studying *CH2013 – Science Communication & Career Skills*. Of these seven students, four had participated in Phase One of the generalised student interview element of the project. Of these four, two had also participated in the student contextualised interview element of the project.

All 12 students from Phase One had been invited to participate in Phase Two of the project. Ten of those students expressed their interest to continue in the research however, only four were eventually interviewed. Two of these students had also been involved in the contextualised student interviews and were very keen on continuing to participate in the research. A further three students expressed their interest in participating and were interviewed as part of Phase Two of the project. Seven students in total were interviewed during this phase of the fieldwork.

Six students volunteered to participate in the post-lesson contextualised student interview element of my study. These students were part of a problem-based learning (PBL) group that met weekly for an hour to work through the assigned problems in the *CH1000 – Chemical Principles* module. These students attended a workshop comprising 30 students in total which was facilitated by Bryn, their university teacher. He was supported in the workshop by a postgraduate research student employed by the department as an associate lecturer. I attended four problem-based learning workshops over a period of a six weeks. Five of the students participated in two post-lesson contextualised student interviews and one student participated in one post-lesson contextualised student interview.

### 3.4.1 Learning and teaching context of the research

To illustrate the learning and teaching context for both Bryn and his students in the School of Chemistry I will discuss in some detail the two modules students were studying during the two phases of fieldwork I conducted as part of my research. The two modules were *CH1000 – Chemical Principles* during Semester 1, 2013 – 2014 and *CH2013 – Science Communication & Careers Skills* during Semester 2, 2014 – 2015.

#### 3.4.1.1 CH1000 – Chemical Principles

*CH1000 – Chemical Principles* is a 20-credit compulsory first year chemistry module for students studying on the Bachelor of Science (BS) in Chemistry, Pharmaceutical Chemistry or Chemistry with Forensic Science programmes, as well as those students studying on the Masters in Chemistry (MChem), Pharmaceutical Chemistry or Chemistry with Forensic Science programmes.

In response to the ‘Chemical Skills Pipeline’ research commissioned by the Royal Society of Chemistry (2009) and funded by the Higher Education Funding Council for England (HEFCE), the Royal Society of Chemistry, through a competitive tender process, funded a number of UK University Chemistry departments to reinvigorate their curriculum and address key outcomes from the research.

In 2007, Bryn was recruited by the School of Chemistry as a temporary teaching fellow to create a suite of specific ‘chemical principles’ problem-based learning scenarios suitable for first year students enrolled in the *CH1000 – Chemical Principles* module. PBL was just one of the learning and teaching approaches used in the module. Lectures, laboratory sessions and workshops were also employed.

The focus of the redesign was to implement problem-based learning into the curriculum, something quite new to the School of Chemistry but not new to the University in question. Expertise was drawn from the University’s Centre for Interdisciplinary Science on how to effectively develop rich and engaging ‘real-world’ chemistry problems.

The purpose of the introduction of problem-based learning into the curriculum was to provide the first year Chemistry students with multiple opportunities to apply their disciplinary knowledge to practical ‘real-world’ like assessment tasks.

Bryn was also employed to ensure that the educational technologies that were available to students in this compulsory module were better utilised in light of demands from the chemical industry as reported in the research commissioned by the Royal Society of Chemistry (2009) and from the module feedback provided by previous students. As Bryn reported in one of his generalised university teacher interviews, prior to the commencement of the curriculum redesign project he was employed to work on, the majority of students were not satisfied with the module and did not engage with it to a satisfactory level. The subsequent evaluation of the module redesign conducted by Bryn as part of the project was positive with students valuing the opportunity to work in teams, practice their communication skills and develop time management and organisational skills.

The Department of Chemistry and the project team wanted to ensure that there was congruence between the skills employers of Chemistry graduates perceived to be lacking in new graduates on one hand and what students felt their modules were not enabling them to develop on the other. These skills included spoken communication skills, team work, interpersonal skills, leadership, and presentation skills.

Through the module’s redesign, the module convenor and teaching team refined and enhanced the module’s curriculum in light of the Quality Assurance Agency’s Subject Benchmark Review (QAA, 2014) and adapted pedagogic approaches that took a more explicit account of recent increased use of mobile devices and greater access to wireless networks (Wi-Fi) by students.

The aims of *CH1000 – Chemical Principles* are to reinforce a student’s knowledge of the fundamental principles of chemistry and provide essential mathematical skills necessary for a chemistry degree.

The topic areas explored in the module are:

- Nature of atoms
- Molecules and chemical bonds
- Shapes of molecules
- Structures of solids
- Periodic trends in physical and chemical properties of chemical compounds
- Basic concepts of quantum chemistry and spectroscopy
- Using and manipulating mathematical equations and functions in science, using units, manipulation and graphical representation of data.

These topic areas are taught using a range of learning and teachings methods such as lectures, tutorials and group problem-solving workshops. In the face-to-face sessions (both large group and small group teaching) students work on example problems, set texts, review marked work and solve problems in problems based learning groups.

*CH1000 – Chemical Principles* is enhanced by a VLE site where students' access module information via announcements, complete online tasks including online quizzes as well as working in groups of six on specific problems in their problem-based learning groups using the VLE's group tool feature.

The assessment for the module comprises:

1. Two end-of-semester exams:
  - a. Chemical principles – 60%
  - b. Applied mathematics – 7.5%
2. Marked tutorials – 10%
3. Two mid-term computer tests – 14%
4. Problem-based learning group work – 7.5%



The chemistry problems students were required to solve in their problem-based learning workshops, in their problem-based learning group, were:

1. Develop a learning resource on the fundamental concepts of chemistry for trained biologists studying on a foundation level degree course. Students collaboratively develop a Wiki (by collaboratively modifying their document's content and structure) with diagrams for students with a non-chemical background.
2. Produce an A3 poster on an inspirational chemist to be shown at the Royal Society of Chemistry's event to engage a non-specialist audience about chemistry.
3. a) Review a pre-proposal submitted to a funding council research committee on solid state chemistry. Decide if the proposal is scientifically sound and decide if the research is justifiable. (Consider the feasibility, novelty, alternatives and impact). Decide if you will accept, reject, or accept with changes.  
b) Review an extract for a yet-to-be published A Level Chemistry textbook. Critique the science presented. Address the group with discussion questions.
4. Construct an instrument to recycle metals from spent car catalytic converters. Provide a report including a diagram of the apparatus, description of the method and a calibration curve with instruments.

Students are also asked to complete a peer-assessment task. They are asked to review and constructively critique the work of their peers in their problem-based learning group and to reflect on the skills they developed by solving the problems and participating in the problem-based learning workshops.

#### **3.4.1.2 Phase 2: CH2013 - Science Communication & Careers Skills**

*CH2013 – Science Communication & Career Skills* is a compulsory five-credit module for all second year Chemistry students which aims to give students experience of communicating scientific content to a range of audience types, including the general public and peers, by using the approaches adopted by professional chemists.

The module also provides students with focused guidance on how to search and apply for jobs in the field of chemistry. In the career skills workshops students gain experience on how to write a Curriculum Vitae (CV) as well as learn to write application letters customised for a range of different types of jobs. Students also participate in workshops on how to communicate science using written and oral means, including proofreading scientific articles and writing and peer reviewing academic journal articles.

The intended learning outcomes of the module are:

- Identify and research scientific concepts of interest to a defined target audience and prepare media resources that will communicate these concepts in an effective way.
- Create, review and edit written scientific content suitable for a range of audiences (including writing academic journal articles and job applications).
- Proofread scientific reports and papers.
- Work as part of a team on an open-ended scientific problem.
- Give an oral presentation on a scientific concept.
- Produce a high standard CV and application letter for a variety of job scenarios.
- Reflect on subject specific and transferable skills development during their degrees and careers.

The assessment for the module comprises:

1. Careers continuous assessment (CV writing, application letter exercises and articulating your skills in the recruitment process exercise) 30%
2. Problem-based learning group exercise – 30%
3. Science communication continuous assessment (proof reading task and abstract/title writing task) – 40%

In light of the illustration provided in this section concerning the two modules students were studying as part of their degree during my fieldwork, I will now provide a recount of the differentiated interview strategy I conducted.

### **3.5 Implementing the differentiated interview strategy for supporting development of accounts of technology use to support learning**

#### **3.5.1 Introduction**

In this section I will present the implementation of the differentiated interview strategy I employed in my fieldwork.

Bryn was extremely generous with his time during the study and invited me into his classroom with enthusiasm. I was able to meet the entire cohort at particular lectures at the beginning of my fieldwork. At these lectures I was able to introduce myself, talk about my research project and explain why I was interested in technology-mediated learning. During this time, I attended other taught sessions and participated in specific activities conducted over Semester 1, 2013 – 2014 in the Department of Chemistry. This entailed contributing to classroom group work and discussion as well as participating with students on specific tasks. Some students may have felt uncomfortable with my presence at first, however, as they got used to my presence it helped with gaining informants for interviews and building up a non-threatening atmosphere during the interviews in both phases of the fieldwork. I had the opportunity of meeting with other members of teaching staff on the module and situating myself within their teaching environment without appearing to be aligned with them and, at the same time, getting a better understanding of the curriculum aims and objectives of the two modules. I made every effort to conduct my interviews within the department and ensured that I made myself available to students in their site of learning.

During Phase One of my data collection, I participated in a peer review assessment of the poster design activity, attended lectures and problem-based learning workshops. In Phase Two of my data collection, I reconnected with informants and regularly attended lectures and seminars during Semester 2, 2014 – 2015. I also participated in an assessment task where student groups were involved in a press launch. During this role play, each group presented to ‘members of the press’ their project proposal (the assessment task) and responded to factual questions based on specific disciplinary knowledge posed by ‘the press’ (other students). This activity was peer reviewed and formally assessed.

This was an opportunity for students to work collaboratively in groups as well as utilise their theoretical knowledge in a practical ‘real-world’ like way.

Prior to each interview I conducted, I spoke to each informant about the aims of the research and the origins of the research and my interest in the topic. I also had each informant sign the appropriate participant research consent form and all informants confirmed that I had their permission to audio record their interviews.

### **3.5.2 Generalised university teacher interviews**

In November 2013, I conducted a 30-minute generalised university teacher interview with Bryn in order to elicit his account of his broad pedagogic understandings, beliefs and values as well as his professional craft knowledge in relation to the use of educational technologies to support his students’ learning, particularly successful educational technology use. In December 2014, I conducted a second 30-minute generalised university teacher interview with Bryn to dig deeper and elicit a broader account of his thinking behind his pedagogical approaches when incorporating learning technologies into his teaching. These two interviews were audio recorded and conducted in a private informal learning space within the university.

These generalised interviews garnered data to address the following subsidiary research questions:

- What thinking underpins how university teachers use educational technologies in their classroom teaching?
- What differences are there between university teachers and their students (as well as between students) in their approaches to incorporating educational technologies in their teaching and learning?

The following questions were asked in the two generalised university teacher interviews:

- Can you tell me a story from any part of your teaching experiences (all your classes and lectures) at the University of Leicester that has been really successful?
- In relation to your story, what role did learning technology play in that teaching, if applicable?
- How did you use the technology in your teaching?
- How did your use of the technology in that situation help your students learn?
- What are the different ways that learning technology helps you in your teaching?
- Is it useful?
- If so, how is it useful?

### 3.5.3 Generalised student interviews

During November and December 2013, I conducted 12 generalised student interviews with first year undergraduate university Chemistry students enrolled in the compulsory *CH1000 – Chemical Principles* module. All of the 12 interviews were audio recorded.

The generalised student interviews conducted garnered data to answer the following subsidiary research questions:

- What thinking underpins how students' approach educational technology use in classroom lessons to support their own learning and one another's learning?
- What differences are there between university teachers and their students (as well as between students) in their approaches to incorporating educational technologies in their teaching and learning?

The following questions were asked in all of the 12 generalised student interviews conducted:

- Can you tell me a story from any part of your learning experiences (all your classes and lectures) at the University of Leicester that has been really successful?
- In relation to your story, what role did learning technology play in that learning, if applicable?
- How did you use the technology?
- How did your use of the technology in that situation help your learning?
- What are the different ways that technology helps you in your learning?
- Is it useful?
- If so, how is it useful?

In retrospect, Phase One of my generalised student interviews presented me with a number of challenges. All the students were willing informants, however being first year students who had just started their university studies, two or three of the informants were not completely comfortable with talking about their university learning. It was something they were not used to doing and at times found it difficult finding the words to adequately articulate their experiences. This frustrated them and meant that some of the interviews were shorter than anticipated. These informants appeared to display behaviour as if there was a right or wrong way to conduct a 'research' interview and provided responses to some questions that appeared less authentic or more what they thought I may want to hear.

The interviews were conducted around existing scheduled classes and I had made myself available to attend lectures and other workshops to make myself known to the students in the module.

The majority of these interviews were conducted in the Department of Chemistry boardroom however, with the aims of getting access to the students some interviews were conducted with the student's approval in a quiet, open public space at the university.

I successfully motivated the majority of the informants by putting in the necessary time and effort into organising and conducting semi-structured generalised student interviews in such a way that informants were able to express authentic thoughts and concerns and not merely plausible responses. In hindsight and in reviewing the interview transcripts, there are those two or three informants who felt challenged in providing authentic accounts, as mentioned previously.

I can confidently state that there were six informants who participated in the contextualised student interviews who provided authentic accounts (Cooper and McIntyre, 1996) due to my participation in their problem-based learning workshops over an extended time.

I conducted Phase Two of my fieldwork during Semester 2, 2014 – 2015. During this phase a further seven generalised student interviews were conducted with second year chemistry students studying *CH2013 – Science Communication & Career Skills*. These interviews were conducted either in the School of Chemistry Boardroom or elsewhere on campus in a private room. All of these interviews were audio recorded and were 30-minutes in duration. I worked very hard on trying to encourage participation from the original group of students who participated in Phase One. Four students from Phase One participated in Phase Two.

#### **3.5.4. Contextualised university teacher interviews**

Four contextualised university teacher interviews were conducted with Bryn during November and December of 2013 after the four PBL workshops I attended. The length of each interview was approximately 20 minutes in duration.

To create the optimum conditions in the contextualised in-depth post-lesson interviews, so that Bryn was able to provide richly textured and detailed accounts of his classroom experience, I conducted the interviews immediately after each of the problem-based learning workshops where possible or later on the same day of the workshop. All of the contextualised interviews were conducted in his office and audio recorded. Bryn had become relaxed and motivated with his participation in the research project and was comfortable with the interview process.

The four post-lesson contextualised university teacher interviews developed data to address the following subsidiary research questions:

- What thinking underpins how university teachers use educational technologies in their classroom teaching?
- What differences are there between university teachers and their students (as well as between students) in their approaches to incorporating educational technologies in their teaching and learning?

The following questions were asked in each of the four post-lesson contextualised university teacher interviews with Bryn:

- Can you tell me about the workshop?
- What were the learning objectives of the workshop?
- How successful do you think your workshop was in helping your students achieve the learning objectives?
- What did you do that you think helped your students learn those objectives?
- What did the students do that helped them learn those objectives?
- Tell me about your thinking behind the learning technology used?
- How do you think your use of learning technology helped your students to learn?
- How do you think the students were using the learning technology?
- How do you think the way the students were using learning technology was helping their learning during the workshop?
- What did you learn from this workshop?
- What did you learn, if anything, about using learning technology in this workshop?



### 3.5.5 Contextualised student interviews

During Semester 1, 2013 – 2014, 11 contextualised student interviews were conducted with six first year Chemistry students who were enrolled in the *CH1000 – Chemical Principles* module.

As a group, these six students explored four problem-based learning problems during their face-to-face workshop sessions. These problems were provided to them via the VLE before the workshop and related to topic areas and disciplinary knowledge they had previously explored in lectures and tutorials.

The 11 post problem-based learning workshop contextualised student interviews conducted garnered data to answer the following subsidiary research questions:

- What thinking underpins how students' approach educational technology use in classroom lessons to support their own learning and one another's learning?
- What differences are there between university teachers and their students (as well as between students) in their approaches to incorporating educational technologies in their teaching and learning?

The contextualised interviews conducted with students comprised seven questions:

- Can you tell me about the PBL workshop?
- What did you learn in the PBL workshop?
- What did you do that helped you learn?
- What did any of your peers' do that helped you learn?
- What did your teacher do that helped you learn?
- How did your learning technology use in the PBL workshop help you learn?
- How did you use the learning technology in the PBL workshop?

The interviews varied in length with the average length being between 10 and 15 minutes. At the time I conducted these interviews they did not appear to be insufficiently short (considering the contextualised university teacher interviews

were 20 minutes in length), as the opportunity to access informants as soon as possible after the problem-based learning workshop was not always ideal. Students though extremely helpful and flexible had other formal learning commitments to attend to. All interviews, though relatively short, were extremely productive. That they were first year undergraduate Chemistry students did not mean that they could not reflect on and verbally describe their craft knowledge about learning and learning in a group in a classroom. At times, two of the six students found it something of a challenge to share their thoughts with ease with a university staff member who was neither their class university teacher or a university teacher in the Department of Chemistry.

### 3.6 Probing strategy

During the data collection phase of my research, I sought to enhance the trustworthiness of my research through the use of a number of mechanisms, including the sustained involvement with both Bryn and the 15 Chemistry students, the incorporation of in-depth interviews that were semi-structured in nature, and seeking meaningful representation of differences within the informant group as well as seeking any common ground. Probes were an integral part of my interview strategy.

Using the interview schedules I had designed I was able to follow what informants has said through direct questioning. The probes I developed as outlined below were designed to elicit more detailed and elaborate responses to my key interview questions (Thomas, 2009; Flick, 2013).

During both my generalised university teacher and student interviews, and my contextualised university teacher and student interviews, I used a range of probing questions. I was interested in informants being able to express their thoughts and experiences clearly and be able to exemplify their accounts as fully as they felt comfortable. Each probing question developed had a specific purpose which is elaborated below (Dey, 1993; Rubin and Rubin, 2005).

<i>Probing question</i>	<i>Purpose of use</i>
<ul style="list-style-type: none"> <li>• Could you say that in a different way for me?</li> </ul>	<ul style="list-style-type: none"> <li>• Probing the meaning of specialist knowledge or vaguely expressed ideas.</li> </ul>
<ul style="list-style-type: none"> <li>• Could you explain that further?</li> </ul>	<ul style="list-style-type: none"> <li>• Probing for a more complete account.</li> </ul>
<ul style="list-style-type: none"> <li>• Could you give me an example?</li> </ul>	<ul style="list-style-type: none"> <li>• Probing for a more exemplified account of a more generally expressed point.</li> </ul>
<ul style="list-style-type: none"> <li>• Could you say more about that?</li> </ul>	<ul style="list-style-type: none"> <li>• Probing for contextual detail.</li> </ul>
<ul style="list-style-type: none"> <li>• What do you mean by that?</li> </ul>	<ul style="list-style-type: none"> <li>• Probing for clarity of meaning and understanding.</li> </ul>
<ul style="list-style-type: none"> <li>• How does what you have just said fit with what you were saying earlier/last time?</li> </ul>	<ul style="list-style-type: none"> <li>• Probing for congruence.</li> </ul>

The rationale for using these probes in all my interviews was also to support informants in the difficult and challenging task of reconstructing their thinking and perspectives regarding their educational technology use in relation to different aspects of their teaching and/or learning thinking and experiences.

I could have more confidence in the authenticity, credibility and hence the trustworthiness of my informants' accounts where their accounts were characterised by contextual detail, exemplification of general or vaguely expressed points, clarification of specialist or local terminology, a sense of their values, and congruence (Dey, 1993; Silverman, 2013).

### **3.7 Processes and procedures of data analysis**

The processes and procedures for analysing the interview data I developed entailed a close listening to the audio recordings, a detailed reading of all written transcripts, a collation of common questions and a further close reading and highlighting of key responses to questions (Ellis and Goodyear, 2010).

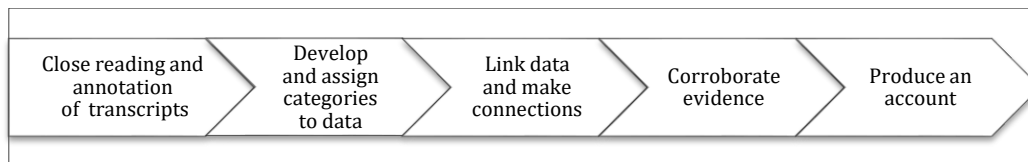
The process I used was iterative, with explicit decisions made at each stage so that my confidence in the authenticity, credibility and trustworthiness of accounts and of my interpretations of those accounts could be examined and tested.

My analysis of the interview transcripts used a combination of inductive and deductive approaches through successive repeated readings and sweeps through the data. This time-consuming process of repeated, close and slow reading of the transcripts allowed me to identify unanticipated themes and patterns and provide me with the opportunity to a recursively test my developing category system against the next transcript in the process (Silverman, 2013).

My approach to content analysis methods included word frequency analysis and thematic analysis (Franzosi, 2004) based on the constructs and meanings expressed by informants. I collated responses to specific questions, sought and identified categories and assigned these categories to the interview data. Using an inductive method of analysis, I assigned categories to segments of text defined by their semantic boundaries. I used sticky notes on large flip-chart paper sheets to link data from one section of the interview to another. I followed this process of self-correcting and adapting emergent categories as I progressed through successive transcripts. I then repeated the process, but this time working deductively with the data influenced by existing themes from previous research (Gosper et al, 2011; Gosper et al, 2013). Themes such as researching and searching information, accessing and sharing content, and collaborating and communicating were utilised.

Once I had completed this stage of the analysis process, I summarised the categories and documented them in a table using a spreadsheet software application as a way of thinking afresh about the categories and their relationships and organizing my data (McIntyre, 1998).

An overview of the qualitative approach I undertook (Dey, 1993), is outlined below in Figure 3.1. The aim of this staged process was to maintain a chain of evidence (Yin, 2009) throughout the analysis process as a means to increase the reliability of the evidence collected and my analysis procedure.



**Figure 3.1: Overview of qualitative data analysis approach taken**

I cannot claim that the categories I developed are exhaustive of all possible interpretive possibilities relevant to my research focus. However, I do want to assert that the categories I developed through my analytic processes capture the essence of the accounts developed by each informant in interview with me.

One of the challenges of using interviews as a data collection method in the type of study I conducted is around what my informants said in interviews about their practice and what they actually did. The selection of a differentiated interview strategy was one way to minimise the gap or inconsistencies in their discourse. I was able to merge the data from both the generalised and contextualised interviews as a result.

As there were numerous extracts that made the same or very similar point, the particular extracts I have chosen in my report attempt to be balanced and be representative of the range of ideas expressed across the group of informants.

### **3.8 Criteria for judging the quality of the research and findings**

To establish trustworthiness in the qualitative research I conducted and the findings I have developed from the data, I implemented a number of measures to assist me in this process (Creswell 2009, Silverman, 2013; Thomas, 2016). This section outlines the various criteria I have incorporated during my research project to ensure credibility and dependability of the research reported in this thesis (Shenton, 2004).

### **3.8.1 Triangulation**

The purpose of triangulation in my research was to optimise the quality of data by developing data through the use of different complementary methods. The purpose of combining the two different interview methods with Bryn and his students was to develop an empirical basis for representing and understanding different facets of the thinking governing their use of educational technology to support learning in the university classroom. I aimed to develop a methodologically coherent and pragmatic framework that did not privilege one set of data over another. I was open to different possibilities. There might be apparent inconsistencies between generalised and contextualised university interview accounts of Bryn and his students.

I viewed such possibilities as potential opportunities for advancing understandings either by raising new questions based on apparent inconsistencies and puzzles from the data or by proposing with caution new theoretical propositions about educational technology use based on a bridging of such inconsistencies, or apparent inconsistencies (Powney and Watts, 1987; Silverman 2013; Yin, 2009).

### **3.8.2 Member checking**

To ensure the accuracy of my interpretations of the interview data collected member checking (Creswell 2009; Silverman 2013) occurred with Bryn and four of the students who had engaged in both phases of the research project. Conversations with the five informants occurred during and after the data collection phase to seek clarification on specific points from their interview transcripts. Member checking was also done through the sharing of relevant sections of the initial data analysis section of my thesis and seeking their feedback and comments.

### **3.8.3 Thick description**

I have attempted to describe in detail the context of my research study and the events that occurred during this period. I have provided a thick description (Flyvbjerg, 2011; Lincoln and Guba, 1985) to help the reader identify with the research setting.

I believe that this thick description provides the voices, perspectives, actions and meanings of my informants (Ponterotto, 2006) and hopefully helps reveal any bias and as a result enhances the credibility of my account.

#### **3.8.4 Peer scrutiny**

I have had the opportunity to present my research internally to peers at the University of Leicester both in a formal way through a peer reviewed School of Education student conference and more informally as a presenter as a member of the school's technology-enhanced learning special interest group.

I have also presented externally at the Society for Research in Higher Education's (SRHE) peer reviewed Newer and Early Career Researchers Conference in 2013.

Also, I was invited to share my research with colleagues in the sector at the International Quality and Productivity Centre's (IQPC) *Next Generation Learning Spaces* conference in March 2016 and their *Blended Learning Forum* in October 2106. I was able to present my research at the Association for Learning Technology Conference in September 2017. This peer-reviewed conference was an instrumental opportunity to share my findings with peers and seek feedback.

It is through these opportunities for peer scrutiny that I have been able to challenge some of my assumptions, refine my research project and strengthen my lines of argument in light of the fresh perspectives, constructive feedback and comments I received from colleagues.

#### **3.8.5 Self-reflection**

Throughout my doctoral studies I have kept a detailed notebook. This has been where I have reflected on particular literature I have read and made notes of key points where relevant. I completed five notebooks, one for each academic year of study. These books also contain comments and observations from postgraduate research workshops and supervisory meetings I have attended.

I have attempted to promote an honesty in the narrative account of my study through my self-reflection and as part of this process I have been able to document my research experiences, insights and changing perspectives (Denscombe, 2010; Willig, 2013).

I turn in the following section to discuss ethical considerations

### 3.9 Ethical considerations

During the data collection phase of my research project, I reassured all informants about the confidentiality of their comments made during their interviews. It was made clear to all students who participated in the study that what information they revealed to me in the role of researcher, would not be disclosed with other participants in the study or with their university teacher, Bryn. It was made clear to them that Bryn's primary commitment was to them and his other students on the module.

It was also articulated that no private advantage would be made through their participation in the study. The relationship and interactions between students and their university teacher were framed as being professional and primarily about their learning on Chemistry modules they were enrolled on.

To ensure complete confidentiality, all informants identified in this thesis have been provided with a pseudonym which reflects their gender and cultural and/or linguistic heritage without compromising their anonymity.

Permission for research to be conducted with employees and students of the University of Leicester was sought from the Research Ethics Committee in the School of Education in the 2012 autumn term, using the required Ethics Review Form. I also sought permission from the Head of School and the Module convenor of the core first year module *CH1000* that informants were studying to ensure that all relevant parties were aware of the implications of the proposed research.



All participants were assured of confidentiality throughout their participation in the research and signed the participant consent form that provided background information on the research project, its purpose and details about their participation in the project. Participants were made aware that they were able to withdraw from the research project at any time, without giving any reason. Participants were clearly told that their names would not be used in any reporting of the research and were informed that no inadvertent disclosure of data would occur as result of their participation in the study.

The research I conducted adhered to the University of Leicester's 'Research Code of Conduct' (<http://www2.le.ac.uk/institution/committees/research-ethics/code-of-practice>) and was conducted in a responsible and ethical manner and operated to the required high ethical standards.

My supervisor and I discussed at some length the postgraduate regulations (Code of Practice for Research Degrees) to ensure that we had a shared understanding of our roles and responsibilities in regard to the expectations required for the research conducted; its design; the tools and techniques used to collect and analyse data; and the management of the research data.

All the research data collected was processed and stored with due regard to the provisions of the Data Protection Act and the University's Data Protection Code of Practice. All data will be retained intact for a period of at least six years and copies of all electronic data will be backed up. Particular concern to personal data in relation to the Code of Practice with respect to collection, processing, protection, retention and disposal has been adhered to. I am aware that the responsibility for compliance with all Information Compliance legislation rests with my supervisor.

I am aware of conflict of interest issues and have ensured that no financial involvement or direct financial interest, provision of benefits, provision of material or facilities has occurred.

Having summarised the research design I adopted and my attendant thinking and decision making, I turn in the next chapter to presentation of the findings that I developed through analysing the generalised university teacher interviews and contextualised university teacher interviews I conducted with Bryn and the generalised student interviews and contextualised student interviews I conducted with 15 of his undergraduate Chemistry students.

## Chapter 4: Findings and Analysis

### 4.1 Introduction

In this chapter I present findings developed through analysis of the transcripts of 36 interviews with one university teacher and 15 of his undergraduate Chemistry students. This included two generalised university teacher interviews and four contextualised university teacher interviews with Bryn, the university teacher, as well as 19 generalised student interviews with 15 students and 11 contextualised student interviews with 6 students.

My findings focus on key themes related to the informants' use of educational technologies to support two specific modules of their undergraduate university studies designed by Bryn. My findings address the main research question of how university teachers and students use educational technologies to optimise learning in classroom contexts and explores the three subsidiary research questions identified previously. Whilst analysing my data, a further research question arose, which examines how variations in task and social context influence changes in the mode of educational technology use by students.

In Section 4.2, I consider Bryn's dispositions and orientations towards teaching with educational technology, which addresses the first two of my research questions:

- How do university teachers and students use educational technologies to optimise learning in classroom contexts?
- What thinking underpins how university teachers approach educational technology use in their classroom teaching?).

In this section both generalised and contextualised university teacher interview data will be explored.

In Section 4.3, I consider students' dispositions and orientations towards learning with educational technology, which addresses research questions one and three:

- How do university teachers and students use educational technologies to optimise learning in classroom contexts?
- What thinking underpins how students' approach educational technology use in classroom lessons to support their own learning and one another's learning?

In this section both generalised and contextualised student interview data will be explored.

In Section 4.4, I elucidate different task contexts construed by students as important influences on their modes of educational technology use for both university teacher-designated tasks and student-initiated tasks, which addresses the research questions one, three and four:

- How do university teachers and students use educational technologies to optimise learning in classroom contexts?
- What thinking underpins how students' approach educational technology use in classroom lessons to support their own learning and one another's learning?
- What differences are there between university teachers and their students (as well as between students) in their approaches to incorporating educational technologies in their teaching and learning?).

In this section both generalised and contextualised student interview data will be explored.

In Section 4.5, I focus on how social contexts of learning are considered influential on how educational technology was used to support learning by students, which addresses the research questions one and three:

- How do university teachers and students use educational technologies to optimise learning in classroom contexts?

- What thinking underpins how students' approach educational technology use in classroom lessons to support their own learning and one another's learning?
- What differences are there between university teachers and their students (as well as between students) in their approaches to incorporating educational technologies in their teaching and learning?).

In this section both generalised and contextualised student interview data will be explored.

In Section 4.6, I conclude the chapter with a conceptualisation of the educational technology mediation of learning rooted in the data I analysed and which underpins the findings I present in this chapter.

Since 2013 the higher education learning and teaching context has changed remarkably with 'Generation Z' arriving in their first year of university studies with a range of mobile devices such as smart phones and tablets. The UK university campus has prepared itself for the influx of students bringing their own devices with the provision of both informal and formal learning spaces, free and reliable Wi-Fi, and spaces to recharge devices.

## **4.2 Bryn's disposition and orientation towards teaching with educational technology**

As discussed in Chapter 3, I purposively sought out an experienced university teacher committed to incorporating and fostering the use of educational technologies in their routine day-to-day teaching for my research project.

Bryn, a university teacher who had successfully completed the postgraduate certificate in academic practice (PGCAP) and been a participant on the module I convened on e-Learning had enthusiastically volunteered to participate in the research. Bryn's disposition and orientation towards teaching with educational technology was one that was much deeper and more sophisticated than the typical university teacher (González, 2009; Hunt and Chalmers, 2013).

He had a more robust understanding of the complexities of educational technology and curriculum design (Ashwin et al, 2015; Biggs, 2012; Biggs and Tang 2011; Blackmore and Kandiko, 2012) than many of his Chemistry colleagues.

He had been formally recognised for the high quality of his teaching through University teaching awards and successful in obtaining University learning and teaching research funding. Bryn was not a typical university teacher as reported in the literature, he did not belong to that group of university teachers who were engaging with educational technologies in a minimal way as described in the literature (Conole, 2004; Kennedy et al, 2011; Laurillard, 2007; Selwyn 2007, 2011).

Bryn has a cohesive conception of how to use educational technology effectively in his teaching (González, 2009; 2010; Ellis and Goodyear, 2010) and had been able to develop professionally and build new understandings through his participation and engagement in the PGCAPHE course.

Yeah. I think it's I can't imagine the job without it anymore to be honest with you. So I mean almost everything I do is either coordinated or directly implemented via use of the technology and that includes when I'm in the contact sessions a lot of the time. So I would never go into a PBL session without my iPad with me and it fulfils a number of roles. Some of them are quite trivial. It helps me remember the names of the students because I've got pictures on there [laughs], but a lot of the time it's excellent for me to be able to reflect or to marry up what we're talking about, what we're discussing in the group, with the resources that are being provided on Blackboard (Bryn, generalised university teacher interview 2, December 2014; transcript p.9, lines 21-31).

He has also been able to share his knowledge with colleagues and participate in the cultural change in educational technology use within his department, as he explains here:

What I've tried to lead since being a teaching fellow, is a change in culture within the department of seeing the VLE as something you can use in a much more engaging manner as a two-way resource. So it's not just something where we're transmitting information to the students, it's the way that the students are actually transmitting their understanding back and they can receive live feedback on it (Bryn, generalised university teacher interview 2, December 2014; transcript p.6, lines 32-37).

Bryn was fortunate enough to be employed by the institution specifically to develop blended learning resources, where he had sufficient time to develop them prior to teaching and had access to funding and pedagogical and technical experts during the development phase of the project.

During his two generalised and four contextualised interviews Bryn talked about the changes in the learning and teaching landscape brought about by a plethora of educational technologies available for use with optimism and enthusiasm. He could clearly see the learning benefits for his students, especially those students who exploited this new landscape and used the digital connectivity to their advantage for their learning. As he asserted in one of his contextualised interviews:

...bringing to class their mobile devices in particular their smart phones and tablets they are experiencing a truly multi-modal university learning experience...They're making the overlap between the physical and the virtual much clearer than any year group we've ever had before and I think they're doing that in a number of ways. One of the ways is how I see it in the contact session. So they're bringing their tablets. They're bringing their laptops and they're working on things collaboratively in the session. They do it between sessions as well because they still meet up as groups just to do things on their computers. They meet up in groups to use the tools on Blackboard rather than necessarily going away and doing this all individually in a different room in the halls of

residence which is what we always probably originally imagined that they were going away and doing it... (Bryn, contextualised university teacher interview, 4, December 2013; transcript p.4, lines 19-30).

Through his use of educational technology, Bryn wanted to be able to provide his students with the opportunity to feel engaged with the subject matter beyond the facts and challenge them in a positive way in preparation for the real world where they would need to work in teams and learn together and from each other.

#### **4.3 Students' dispositions and orientations towards learning with technology**

Three clear dispositions and orientations towards learning with educational technology were identified through analysis of the generalised and contextualised interviews with 15 students. All students adapted to their new learning context provided by their university teachers and found innovative and practical ways to incorporate educational technologies into different aspects of their university learning.

Three distinct approaches to educational technology use by students to support their university learning emerged through my analysis of the data. The first relatively small group of five students comprised genuine technology enthusiasts who voiced their discontent with the institution and their university teachers' efforts. They believed that there needed to be a greater use of educational technology in their studies and felt much of the educational technology use by university teachers on their degree programme was not sufficiently adequate for their learning and future professional needs.

These students over the 18-month period of the study built up an expertise and confidence in their educational technology use. The second group, the largest of the three, comprised eight students who expressed satisfaction with the educational technology options their teachers (and institution) had provided them and was overall content to work within that 'institutionally-endorsed' sphere.



The third and smallest group comprised two students who were reluctant users of educational technology and were openly critical about what they saw as a ‘forced’ use of educational technology by the institution. This group did not identify themselves as being incompetent educational technology users but were not convinced that they had been adequately supported by the institution on how best to use these educational technologies in their studies or were skeptical about particular applications and their usefulness to their university studies.

I will now discuss in further detail each of these three groupings of students based on their distinct dispositions and orientations to using educational technology in their learning.

#### **4.3.1 Group 1: Pioneer users of educational technology – ahead of the university teacher’s curve**

...Well apart from the PowerPoints I don’t see there’s enough use of technology... (Josh, generalised student interview 1, November 2013; transcript p.2, line 15).

Five students were identified as belonging to Group 1: Pioneer users of educational technology – ahead of the university teacher’s curve.

These students talked distinctively about how they were independently shaping their own learning experiences by employing a range of institutionally-endorsed and non-institutionally-endorsed educational technology applications. They were using a range of tools beyond what was required of them as part of their university studies. These students curated their own multi-modal revision resources, sought other multi-modal resources beyond what had been provided by their university teachers and were finding innovative ways of organising and managing their day-to-day study requirements using educational technology.

Sam, for example, talked about how he took ownership of his learning and developed his own personalised digital revision materials building on the resources his university teachers had provided him.

He was taking different multi-media resources and amalgamating them together in a way that made sense to him and helped him with his learning. This was something he developed and refined through trial and error over time.

I use (Microsoft) OneNote on my laptop which is great because you can pull all sorts of different bits together, stuff from ChemDraw that I might have needed to draw a mechanism for, or slides from PowerPoint, or images or recordings. Anything, you can pull it all together along with my typed up notes. So then when it then comes to revision, I have every single bit of information that I've gathered over the semester all in one place and then I can type up or I've occasionally made podcasts, you know, spoken it, because I sometimes find that I learn best when I'm explaining something, but it's all there in one place and I suppose yeah part of that is when watching those lectures again, I can either be scribbling them down, scribbling notes or typing them straight up (Sam, generalised student interview 2, February 2015; transcript p.3, lines 7-18).

While for Maggie, incorporating a number social media applications that were not supported by the university helped her better manage her study requirements and have a sense of being on top of her studies and be able to do this with some of her friends at the same time.

I use WhatsApp quite a lot to send pictures and things like that, but I mean I tend to not really use Facebook that much but I use FaceTime on my phone as well. So it's more about visually seeing someone and talking to them, but yeah. I would say that's kind of the main way I'd try and keep in contact with people that are outside of my course, well even with my course as well. There's a group of us that have a Dropbox account. So what we do it when we find information or documents, we just put it into the Dropbox account and then we've all got access to that. So it's actually really helpful, but there's just a small group of us that do that... (Maggie, generalised student interview, 2, May 2015; transcript p.7, lines 30-37).

For both Josh and Sophie, using educational technologies beyond the institutionally-endorsed ones became an integral part of their learning at university due to their specific learning disabilities. Josh revealed he had dysgraphia and Sophie revealed she had dyslexia. For Josh, writing lecture notes is an impossible task during the lecture. He needs to audio record the lectures and make his notes, very slowly, after the lecture. For Sophie, she needs to audio record all the lecture notes so that she can learn the disciplinary knowledge that way.

For Josh, he found ways to counteract his inability to take lecture notes and ensure that he was not missing out on key concepts:

I actually because hearing things for the first time, it doesn't always go in. So I like to go back and I actually play it over and over again. If there's a specific part that I didn't understand, I'll rewind it and I play it back until I understand it and I actually use Microsoft OneNote. I don't know if you know it. It's basically like note-taking software and I basically use the recordings. I also use a snip tool so that'll take pictures from the lectures. So I write down everything that they're saying in quite a large amount of detail and obviously include the pictures and important things from the slides. So I've developed quite extensive notes around the recordings because sometimes they say stuff that's important which isn't in the lecture slides. So yeah it's quite good for making decent notes. It's quite a lengthy procedure though because it can take more than an hour to take a detailed list of notes for one lecture (Josh, generalised student interview 2, February 2015; transcript p.5, lines 9-15).

While for Sophie, engaging with a specific educational technology application to help her with her dyslexia meant she was able to maximise her chances of learning success.

Yeah. So Anki, it's a flash-card system. So it's recommended by the Accessibility Centre and you have to create questions. So you create them from your workshops and lecture notes and like all different sort of like everything you use, like tutorials, everything. You create questions. The less well-known cards will show up more frequently than the cards that you know a lot better. So you go over information that you don't know so well more frequently than information you don't know so well. So it's kind of supposedly a much better revision technique.... I use it constantly. Every single day literally, for every sort of part, every part of my studies. And I've used it on both courses. And you can access it from the internet. So you can use it, synchronise it over different devices, and you can access it from a device which doesn't have Anki downloaded (Sophie, generalised student interview, November 2013; transcript p.2, lines 1-4; 14-17; 20-23).

These students talked about the different ways they were using a range of educational technologies to support their conceptual understanding and enhance their study practices. Sam, Josh, Maggie and Sophie thought that more lecturers, other than Bryn, needed to use educational technology more extensively in their teaching and use it in more creative ways. These students have embraced the digital world they live in and know that they will need strong and diverse digital skills in their future work careers. They also know that the multi-modal possibilities that educational technologies offer can only enhance their learning experiences and support them in understanding the new conceptual knowledge they are acquiring as part of their university studies.

These students were independent and autonomous learners who were not reliant on their university teachers to provide more technology use; they were self-starters and took the initiative themselves. They experimented with a wide range of educational technologies to support their university learning. They used the university-endorsed technologies extensively and also used non-institutionally-endorsed educational technologies to satisfy their interests and learning dispositions, preferences and needs.

This included curating digital images and diagrams, digital academic publications, audio recordings, video and animation to create their own digital study resources for both university teacher-designated tasks and student-initiated tasks.

#### **4.3.2 Group 2: Mastery-oriented but compliant approach to educational technology use**

Eight students were identified as belonging to Group 2: Mastery-oriented but compliant approach to educational technology use.

This group of students were open to the idea of using educational technologies as an integral part of their university studies. However, this group were also happy to use a combination of media, both traditional educational technologies such as paper and pen as well as digital technologies. They used and over time mastered the specific tools that their university teachers had made available to them. They were content to be guided by their university teachers and the university and reluctant to go beyond the institutional guidelines and suggestions provided. They incorporated educational technology into their day-to-day university learning as required.

Gulwant was an avid user of technology and interested in mastering the institutionally-endorsed educational technologies to manage her learning. As she states in her generalised student interview:

I have the Blackboard app. So that's a university app. So it gives me a notification every time a new lecture has gone up or if there's any like – because we have assessed labs every week. So our reports, like our grades, will go up on there. So I think that's really important. I check that every day, five times a day (Gulwant, generalised student interview, Phase 2, February 2015; transcript p.3, lines 9-12).

These students were actively engaged in using institutionally-endorsed educational technology to promote their learning.

However, they were interested in using a range of media both educational technologies and more traditional technologies to support their learning; this included pens to make hand-written notes as well as using hard copy paper handouts and books.

They were users of social media but were not completely convinced that these tools were useful for study purposes. They would use them if necessary but had their reservations about them being the first option they would choose. They looked to their teachers for guidance.

They were also happy to keep their personal lives separate to their study lives and found the merging of the two uncomfortable. For example, receiving notifications for both social and study purposes in Facebook or WhatsApp was challenging. For active users of these media found the increase in the number of notifications difficult to juggle and having the two spheres of their life on the one application became confusing.

Some students mentioned that they were not sure if they could fully rely on the student-driven initiatives using social media as a reliable revision option. They were unsure of the level of accuracy of the disciplinary knowledge discussed in these initiatives and were not fully convinced of their usefulness for their learning.

They felt more comfortable engaging with the university teacher-organised revision initiatives available on the virtual learning environment or information they found in the recommended Chemistry text books.

Students recounted how they used technology socially for gaming or organising group events via Facebook but they did not want see these social media technologies be integrated into their studies. This group of students were reliant on their university teachers to drive the educational technology use and were satisfied with what they were provided in this area.

They did not consistently voice an interest in taking educational technology initiatives themselves or discuss their experimentations with different educational technologies as those students in Group 1: Pioneer users of educational technology – ahead of the university teacher’s curve have done.

Duncan liked to separate his social life from his study life. He had no problem in using Facebook but did have reservations about its ability to seriously enhance his learning compared to the university teacher-monitored discussion board on the VLE. In his interview, Duncan elaborated:

The only thing I can see being a difference between the two other than the fact that obviously the discussion group is monitored by academics. So the answer might be more tailored to an exam style answer. I think the thing that Facebook would have over something like the discussion group is the quick and, I don’t want to say easy because actually getting to the discussion board is still easy. ... I mean Facebook’s very sort of informal I guess and you’re talking to people of your own age I suppose who wouldn’t feel the need to use full sentences or anything like that. You could just post something and just put a question mark I suppose and people would understand what you mean, whereas the discussion board you’d have to go into more detail of what you want as an answer, which I suppose in some respects might be more useful because you might get a better answer, but yeah (Duncan, generalised student interview, February 2015; transcript p.4 lines 17-21; 33-36; p.5 lines 1-3).

For Bronwyn using the lecture capture recordings complemented her hand-written lecture notes and helped her enhance her understanding of new and difficult concepts.

When I’ve done a lecture, I usually go home and I look through my notes again and then I look at the lecture notes that are put on Blackboard to make sure that I haven’t missed anything. And during revision actually, the lecture capture is really helpful.

So they do a lecture and I can get all my notes. Then I come back to revision, it doesn't make sense this bit of the notes, then I look at the lecture notes on Blackboard and that doesn't make sense, but then I look at the lecture capture and he's really explained it and I really understand it now (Bronwyn, generalised student interview, February 2015; transcript p.6, lines 28-34).

While Gulwant liked the way she could use the lecture recordings to augment her revision notes. She felt she had more control over her learning because she could review the lectures when she wanted to and could pace her learning by stopping, starting, rewinding and skipping forwards the recordings as she needed to. As she states in this interview:

So every lecture, like I make notes in the lecture, and then I'd go back and I'd look at the video session of the lecture and just add anything that I've missed or just to kind of understand it because if you're in a lecture because it's only for an hour, you end up spending a lot of your time just writing down everything because you don't want to miss anything, but then you've actually got to go over it and understand it. It's not just about repeating everything that they say. So it's a good opportunity for you to actually understand it and it's good that you can stop it and go at your own pace because sometimes you do feel in the lectures they do kind of move really quickly. So it's really useful to be able to just stop and pause and rewind and go over something that you don't understand and be able to research while you're looking at it as well other than it's just going really quickly (Gulwant, generalised student interview, February 2015; transcript p.3, lines 16-26).



#### 4.3.3 Group 3: Unconverted sceptics and somewhat frustrated by educational technology use

Two of the 15 students interviewed were identified as belonging to Group 3: Unconverted sceptics and somewhat frustrated by educational technology use.

These students found the regular reliance on educational technology as part of their university studies a real challenge and at times overwhelming. For them, they found using educational technologies for particular aspects of their studies a real hindrance.

They would comply with the minimum requirements asked of them by writing up their assignments using MS Word or submitting their work online but expressed their criticisms of other particular practices such as using Facebook for group work or the reliance by teaching staff of using the VLE to communicate over face-to-face interaction.

Stephen expressed a sense of bewilderment and clearly wanted more help. He was struggling with his studies and did not consider the guidance he had received from his university teachers as being adequate.

...and the Blackboard thing doesn't really help...it feels like I'm just – there's not really help with it. It's just information on the website and I just go on the website and I try to gather information, but there's no real guidance to an extent unless I go to say the lecturer and he can guide me (Stephen, generalised student interview, Phase 1, November 2013; transcript p.2, lines 3-8).

While Sebastian though satisfied with university teacher-directed tasks and resources made available on the virtual learning environment he was not interested in using social media to support his studies as he was dubious about their educational benefits for his learning.

Apart from research I'm not really too much of technology person anyway [laughs] ... I have the computer and I check my emails and stuff... I've got Facebook. Yeah...

I think Facebook is quite a big distraction for studies definitely [laughter] - doesn't help at all (Sebastian, generalised student interview, Phase 1, November 2013; transcript p.3, lines 6, 10, 12, 14-15).

#### 4.4 Task context of learning

So far in my analysis, the focus has been on how the students construed the influence of educational technologies on their learning. As my analysis developed, it became clear that for many of these students, the task context of learning was an important factor in influencing their use of particular educational technologies to support their learning.

Bryn, the university teacher, was very proud of his ability to create a real two-way communication channel with his students and them with each other through his iterative and thoughtful task design mediated by a range of educational technologies. He felt he was able to motivate and engage his students to learn to think and write like a chemist by creating authentic tasks that were supported by these educational technologies. He felt he could provide his students with opportunities to practice as well as support them with their learning struggles through the learning analytics he had at his disposal via the VLE to track their learning progress.

For Bryn, the rationale to thoughtfully integrate educational technologies into his tasks and activities was to amplify the learning and provide all learners take different paths both inside the classroom as well as outside to comprehend and apply the required disciplinary knowledge.

So everything we try to build in this blended approach into as much of our teaching as possible and it gives us the advantage that we can help expand the learning experience for the student perspective to outside of the contact time.

We're getting the students to focus on key aspects of the practical before they come into the lab and then we're getting them to reflect on the experience afterwards by setting up post-lab activities which they will submit on Blackboard (Bryn, generalised university teacher interview 1, Phase 1, November 2013; transcript p.3, lines 20-26).

A development in the analysis identified that there is more at play than students optimising their learning through educational technology use. Students tended to speak about technology use in relation to task contexts of their learning.

When students were talking about task contexts of learning as a factor influencing their use of technology they tended to distinguish between the following:

- University teacher-designated tasks (UTDT)
- Student-initiated tasks (SIT)

Students engaged with a range of both university teacher-designated tasks and student-initiated tasks and talked about how they enacted these tasks using different educational technologies.

Students demonstrated differences in the kinds of educational technologies they used for particular categories of tasks. Their choice varied (the kinds of educational technologies used, as well as the ways in which they may have used the technologies) depending on the degree of flexibility they perceived they had with both university teacher-designated tasks and student-initiated tasks.

Students overall expressed their enthusiasm for semi-structured tasks where they had some scope to adopt a different task engagement.

structured task	semi-structured task	open-ended task
<p>one preferred way, university teacher-designated instructions</p> <ul style="list-style-type: none"> <li>• VLE online quiz tool</li> </ul>	<p>some scope to adopt a different task engagement</p> <ul style="list-style-type: none"> <li>• VLE (Blackboard)</li> <li>• VLE group tool</li> <li>• Chemistry specialist software applications tools</li> </ul>	<p>plenty of scope for students to engage with tasks in different ways</p> <ul style="list-style-type: none"> <li>• university teacher designed online resources</li> <li>• open education online resources</li> <li>• internet search engines</li> </ul>

**Figure 4.1: Degrees of structure in students' task contexts of learning**

Figure 4.1 illustrates the degrees of structure in students' task contexts of learning and will further mentioned in Figure 4.3.

#### **4.4.1 Structured learning task context**

Bryn used the VLE in a number of ways to support his module task designs. One particular task design that students recounted enthusiastically was the implementation of weekly electronic assessments (online quizzes). Bryn had consciously decided on implementing these quizzes using the VLE online quiz tool to provide regular formative learning opportunities for his students where they received 'instantaneous' formative feedback. This task also prepared his students for their laboratory practicals.

The electronic assessments have been absolutely essential to us actually because on a purely practical term it's made it a lot easier for us to actually manage the assessments of all of our students when we've got quite a large cohort. It's also let us be quite creative in terms of how we run the assessment. So we can actually embed a much greater variety of types of assessment into our programme by using a virtual environment (Bryn, generalised university teacher interview 1, Phase 1, November 2013; transcript p.4, lines 1-6).

Seven of the 15 students interviewed expressed satisfaction with the use of online quizzes where they engaged with the VLE test tool designated by their university teacher, Bryn.

These quizzes were highly structured because they were required to complete all questions set, as well as use the educational technology provided by their university teacher.

For Sebastian the ease of being able to complete the task online and receive immediate feedback on his progress motivated him. He also saw the benefit of these weekly online tasks and how they helped him with his subsequent practicals and written reports.

Before every practical you do, you have to do a pre-lab which is like questions which you prepare you for the reports which you need to hand in by Friday five o'clock. So that's done via Blackboard which is obviously like online interactive software... It's like multiple-choice questions really and you need to like sometime do some calculations and submit your answers. That counts towards your grade as well (Sebastian, generalised student interview, November 2013; transcript p.1, lines 9-11; 13-14).

For Bronwyn she found the online quizzes helped her prepare for her weekly laboratory sessions. She was able to gauge what she knew and what she was having problems with through the online feedback she received when she completed the quiz. It meant that she could organise her study better and commit more time to those areas she didn't confidently understand before she entered the laboratory to perform the assigned experiment. There was an unintended benefit where this work then helped her with her revision.

He also put quizzes on as well. So every week we could do a quiz to see how well we knew what we were doing. That was really helpful with revision as well (Bronwyn, generalised student interview, February 2015; transcript p.8, lines 34-36).

#### 4.4.2 Semi-structured learning task context

The way Bryn had designed the *CH1000* module was to have the VLE at the centre of everything related to the module. He wanted students to heavily rely on the module site so all student work was coordinated via the VLE. He had consciously created a truly blended learning experience where the face-to-face on campus teaching sessions were thoughtfully integrated with the online tasks and resources students needed to engage with.

Of the 15 students interviewed, 14 expressed enthusiasm towards their access to the institutionally-supported virtual learning environment (VLE) Blackboard. The module site provided students with specific group work tasks which were either formative or summative assessment tasks. Bryn also provided supplementary resources for their lectures and laboratory sessions which he recommended them to interact with during the module. Students had the flexibility to access these resources whenever and wherever it suited them and could use them to prepare a variety of university teacher-directed assessment tasks and student-initiated tasks.

For Maggie and Susanna this option helped them make choices around which resources they would use in their studies, both for preparing for assessment tasks and revision. It provided them with a choice to explore the same new disciplinary concepts in different ways with different tools.

I'm using Blackboard a lot. All the lecture notes and things like that are always put straight onto Blackboard after. So I find that when I've done my own lecture notes, I'll rewrite them up but I will use the Blackboard to ensure that I'm actually getting exactly what I need out of it (Maggie, generalised student interview 1, November 2013; transcript p.3, lines 3-7).

Well the Blackboard site is obviously really useful because they can upload extra resources that you don't particularly have time to use in lectures which can contain programmes or internet files that help look at things in different ways (Susanna, generalised student interview, November 2013; transcript p.2, lines 19-21).

For Bryn, the VLE group tools were a particular feature of his module design as the problem-based learning problem tasks was an integral feature of its design and he wanted each problem-based learning group to work with each other both face-to-face and online.

So our PBL experiences completely harmonise between the classroom environment and the virtual environment. So all of the student work is coordinated by via our Blackboard system. So we create a series of groups for each of our PBL groups on Blackboard and each of those groups is given access to a number of different tools on the Blackboard system which includes a group discussion board and a group file-sharing tool which allows them to successfully exchange ideas and actual files. The output is submitted via the Group Wiki. So the assessment for the module takes the form of the construction of a Group Wiki (Bryn, generalised university teacher interview 1, Phase 1, November 2013; transcript p.3, lines 12-19).

Of the 15 students interviewed, 13 found the VLE group tools useful to complete the problem-based learning problems (university teacher-designated tasks) they were required to do as part of their module. Some students supplemented the university-endorsed technologies by using non-institutionally-endorsed educational technologies as well. This developed in an ad hoc fashion and was more circumstantial than pre-planned. For their university teacher, Bryn's design for the problem-based learning element of the module was structured but did give students some choice to incorporate other technologies to support their learning. This choice was never explicitly discussed but happened organically depending on the particular problem-based learning group.

So we create a series of groups for each of our PBL groups on Blackboard and each of those groups is given access to a number of different tools on the Blackboard system which includes a group discussion board a group file sharing tool which allows them to successfully exchange ideas and actual files. The output is submitted via the Group Wiki. So the assessment for the module takes the form of the construction of a Group Wiki. This is something that evolves during the semester. So we provide feedback to the students on the Wiki and the students go in and edit each other's work, correct each other's work, in order to get as good a final product as they possibly can (Bryn, generalised university teacher interview 1, November 2013; transcript p.2, lines 14-27).

Rebecca explained in one of her interviews how she liked using the VLE Group tools to contact her problem-based learning group. She could quickly and easily contact group members which helped her with her group task learning.

I use it for like keeping in contact with such as my PBL group. That's another way because then you can like study together without actually physically being together which I find it quite good, and the file exchange, I like that as well (Rebecca, generalised student interview, November 2013; transcript p.3, lines 16-20).

While Wan Azizah liked the ease of sharing files via the VLE and working together online with her group:

I think the good things that I've received from the uni is Blackboard. We can exchange like – we have PBL sessions. So we can exchange files instead of having to meet outside and all (Wan Azizah, generalised student interview 1, Phase 1, November 2013; transcript p.1, lines 6-8).



Others began to use other educational technologies to complete the university teacher-designated tasks. Seven of the 15 students interviewed talked about how they used Facebook to support their university learning when doing group work. These students were communicating and collaborating with their peers as part of their university teacher-designated group work tasks. They also shared draft files and useful resources with their group peers. They found Facebook was a more convenient technology to use for collaboration than using the VLE group tool. They expressed their preference of this educational technology due to its ease of use, and that they could more easily navigate around tool due to the user-friendly design of its interface.

As Maggie tells us about her unpremeditated selection of using Facebook for group work as it seemed easier than what had been provided by her university teacher as her group happened to all be on Facebook.

So we had to do a poster presentation and with that we actually did all of our research and everything separately and we all brought it together. That was actually by Facebook that we were messaging one another and we just found it was quite easy to do that and then we would sit or make sure that everyone's got it together and then actually in the PBL lesson, we'd put it together. So we found that by doing the separate bits of research and sending it together to each other over Facebook, it was really beneficial to then kind of get everyone involved as well (Maggie, generalised student interview 2, Phase 2, May 2015; transcript p.4, lines 30-36).

Wan-Azizah also talked about how her problem-based learning group had used Facebook for group communication, the sharing of useful links and getting feedback on their draft work. She found this easier to use than the VLE.

Oh because Facebook is easier because it's just direct. Like it's there. We just click the chat session. Whereas with Blackboard, okay we have to click and go the CH- I forgot which one it is. The module and there's the discussion board and then click to your group.

There is so many clickings, whereas Facebook is just click and it's there (Wan Azizah, generalised student interview 2, Phase 2, May 2015; transcript p.2, lines 15-19).

Bryn, their university teacher, became aware that some of his students began to use other software applications other than the ones provided to them within the VLE for specific elements of their university teacher-designated tasks. Their use of these other online tools provided them with flexibility which they felt were more appropriate for completing their designated task. This was not something that he was particularly happy about at first. Over time he adapted to the situation as he states in one of his contextualised interviews:

So one of the main things I learnt was not to worry so much when I don't see things on the Wiki because I was entirely expecting a couple of pages created by every group and I did panic I have to admit. If you look inside my notebook there's a lot of lines that says, 'No contribution from Group whatever'. I needn't have worried because in every case the groups had done something and in all but one of the six groups I look after they'd done quite a lot actually, but they'd adapted and they'd done it in slightly different ways. They'd done it using the file exchange more than anything or they had done it privately by exchanging emails rather than doing it over Blackboard. So one of the things that I can take out of this is that the students might not see the Wiki as the most convenient form of collaboration in every type of problem that we do and the students will adapt and evolve their approaches to meet the specific demands of the problem we present them with (Bryn, contextualised university teacher interview 2, 13<sup>th</sup> November 2013; transcript p.4, lines 2-13).

Those students who perceived that they had flexibility and choice in the educational technology they could use when working in a group would consider selecting other options. This was not something that all students perceived to be the case and not all group members agreed it was a good idea to move away from the tools within the VLE that their institution had provided them.

The fact that some students liked to choose a different tool as they perceived these other tools to be easier to use and had more sophisticated features resulted in them feeling more engaged and more independent in their group learning.

Bryn, their university teacher, talked about how many first year Chemistry students have difficulties translating two-dimensional representations of chemical structures into a three-dimensional mental model. This is because, according to Bryn, they wouldn't have seen the method used at university to represent chemical structures in their previous schooling. As he elaborated in his interview:

In order to get around that barrier or to overcome that barrier, we provide these interactive three-dimensional models that the students can actually manipulate or they can view from various perspectives. They can view it at their own time. They can view it at home. They can see it as many times as they like, and by doing that, it gives them the opportunity to see what we're trying to condense into a two-dimensional diagram in a faithful 3D reproduction. So they can compare the two formats of representation by doing this (Bryn, generalised university teacher interview 1, Phase 1, November 2013; transcript p.3, lines 35-41).

With Bryn's insistence, the school provided students with particular specialist Chemistry software applications. Students were requested to use the software for formative and summative assessment tasks. Of the 15 students interviewed, 10 found the software extremely helpful to complete specific assessment tasks that were both university teacher-designated tasks as well as student-initiated tasks. They also used the software to prepare for assessment tasks and create self-directed study resources for exam revision purposes.

Josh liked the way he could use the school supported Chemistry specialist software application to enhance his laboratory reports by drawing his chemical structures using the specialist software.

His diagrams appeared more professional and were easier to decipher than hand-drawn diagrams. As he stated in one of his interviews:

So the molecules I'm using within the lab, I draw the structures of those on ChemBioDraw and input them into my report and I hand that it because they like diagrams to be drawn in ChemDraw (Josh, generalised student interview 1, November 2013; transcript p.2, lines 7-10).

Duncan also found the software useful to enhance a number of his assignments, for him it was the sophistication of the output and the ease in which he could construct it, as he recalls in his interview:

Then we normally record spectra as well to get some data on the molecule and then interpretation of that which ChemDraw is also good for. ...The ChemDraw stuff, normally at the back of our sheet there's space to write your mechanism, whereas if you're going to do it on ChemDraw you'd make it and then you'd print it out... (Duncan, generalised student interview, February 2015; transcript p.6, lines 18-19; lines 28-29).

Susanna talked about how she found using the software aided her conceptual understanding of particular new and or difficult topic areas of Chemistry, which assisted her in her learning. As she discussed in one of her interviews:

...in biology lessons we've used some software that helps draw proteins and then you can play with what you're given. So you can have the structures given differently which really helps visualise what you're doing.... Well it was easier to see like the 3D perspective and specifically for proteins, how they fold around one another. So you could get more of a perspective on how it actually figures rather than just a picture on a 2D plane (Susanna, generalised student interview, November 2013; transcript p.2, lines 9-11; 14-16).

Rebecca talked about how useful she finds the software over a paper version to assist her comprehension of specific chemical concepts. She elaborated on this point in her generalised interview:

...that allows us to picture molecules in three dimensions and like such as in *CHI000* where we have to do close-back structures and they're really hard to view on paper. So it's easier to view them online where you can change them around. Though you don't physically have them in your hands, it helps you to picture them. So in that way you use it for visualisation... (Rebecca, generalised student interview, Phase 1, November 2013; transcript p.3, lines 9-11; 11-15).

Students expressed their enthusiasm to use the specialist Chemistry software applications for their university teacher-designated tasks. The focus was being able to submit professional looking and understandable diagrams and models as part of their assignments. Some students made connections with other work they were doing for other modules as well as other tasks within the modules taught by Bryn. These students began to use the software applications for their own student-initiated tasks that were not always being formally assessed. These tasks involved revision work and student-initiated exploration of key concepts. Those students from Group 1: Pioneer users of educational technology – ahead of the university teacher's curve, predominately featured here.

#### 4.4.3 Open-ended learning task context

In both of his generalised interviews Bryn reported making extensive use of educational technology in all the different elements of his teaching practice. He integrated a range of digital visual and audio-visual resources into his classroom teaching and provided these resources to his students via the VLE.

Of those complementary learning resources provided to students via the VLE, students would be able to complete optional university teacher-designated tasks at their own leisure.

These optional tasks provided students with flexibility with how and when they went about those tasks but did not necessarily give them choice in which educational technologies they could employ. Students engaged with particular digital resources to enhance their end of semester exam preparation and revision.

Sam and seven other students found it useful to use the lecture capture recordings that Bryn and other university teachers had provided. Sam incorporated the lecture capture recordings into his day-to-day revision and university teacher-designated task preparation.

One thing that I found particularly useful this year was two of our modules were lecture captured, recorded, and I know that there's a lot of controversy around it because there are academics and people that say that it stops people from going to lectures. I didn't miss a lecture. I went to every single lecture, and being able to review it again at a later stage, you often get a much better understanding hearing that lecturer explaining it than it would be just reading the slides which is what is normal. So if I was ever confused by something and the slides just weren't giving me that information, it was a great safety net being able to watch that lecture again or that clip from the lecture again, to ensure that what I was trying to understand was correct (Sam, generalised student interview 2, Phase 2, February 2015; transcript page 2, lines 40-45; transcript page 3, lines 1-4).

Maggie also found this option extremely helpful to help her prepare for her exam revision by reviewing the enormous amount of new information she received in her lectures.

She elaborates on how she uses the recordings to enhance her learning in her second generalised student interview:

I tend to watch the lectures back as I make my revision notes and things like that.

So when I've been making the revision notes I've been listening to it and there's been a couple of times where there's been a few like an intensive five minutes maybe where you get quite a lot of information thrown at you. So what I've done is I've just re-watched it and re-watched it until it starts to go in a little bit and I think that that's been really quite helpful because having the lectures there that you can then go and access, you know, if for example you can't make it into university one day and there is the lecture that goes up, it's so beneficial to be able to then actually watch it, because when you read through the screen you're not picking up on all of the little extra bits that they add in or the way that they might explain something. Actually it's so helpful to then just go back, watch it again and just listen to how they explain it again. And as you do that, it really-really kind of cements it in your knowledge to be able to apply that (Maggie, generalised student interview 2, Phase 2, May 2015; transcript page 8, lines 16-28).

And for Bronwyn, the fact that other university teachers from other modules started to record their lectures was helpful to her learning beyond what Bryn had provided her via the VLE within his modules. She felt that this option helped her manage her busy and stressful workload and saw it as a helpful back up when needed as she explains in her second generalised student interview.

Yeah. Definitely. I think one of the most useful is lecture capture and I think without it I think I'd struggle because I don't miss lectures but the other day I was ill. So it really helps to have lecture capture rather than just looking through the notes. And I think a lot of people would really struggle without lecture capture. We had a new lecturer the other day actually and he asked us whether we wanted him to do lecture capture and the whole lecture theatre just shouted, 'Yes', because it is so useful. The quizzes are an amazing revision source, revision material. Having workshops and the workshop answers are really useful as well. So it's having the feedback is really useful and having my phone.

So if I do go home for the weekend or I'm on the train going home, I can just have a quick look and just being able to do it wherever I am really (Bronwyn, generalised university teacher interview; Phase 2, February 2015, transcript p.10, lines 1-11).

Students were also using educational technologies outside of the VLE which were determined by what devices, platforms and other applications they had at their disposal. This was either directly related to university teacher-designated tasks as well as for student-initiated tasks.

As Nareem explains in his generalised student interview:

Yeah. If it's just searching for random scientific information, most of the time I use Google. I'll just type into Google and type in as many specific words as I can so the things that aren't related don't come up. Then I'll look at the short sections before clicking on something and I might go through three, four or even five, may even more links before I find something useful, but that's still a lot quicker than having to go home and find it in a book or something like that (Nareem, generalised student interview, Phase 1, December 2013; transcript p.2, lines 4-9).

For Wan Azizah the internet opened up many doors for her to find the correct information in a timely fashion beyond what she found in the prescribed module textbook:

Obviously I think every student, anyone would like if they don't use internet to research some questions, you know, for quick questions, because if we use the textbooks, we might need to look for the correct textbook and then is it sufficient. Because even some textbooks have insufficient information. So I think using the internet, this website may link to another website with more detail. So I think yeah, using the internet for research is much convenient than using textbook.



But yeah the disadvantage is of course the reliability of the information (Wan Azizah, generalised student interview 1, Phase 1, November 2013; transcript p.2, lines 30-36).

As students identified in their interviews, they liked the range of different educational technologies they were provided by their institution. They found particular educational technologies very helpful for their learning, in particular to help them complete university teacher-designated tasks. Some students, particularly those from Group 1: Pioneer users of educational technology – ahead of the university teacher’s curve, began to use other educational technologies that were not provided by their university teacher for some of these tasks. This change in educational technology use occurred when they were completing semi-structured and open tasks only.

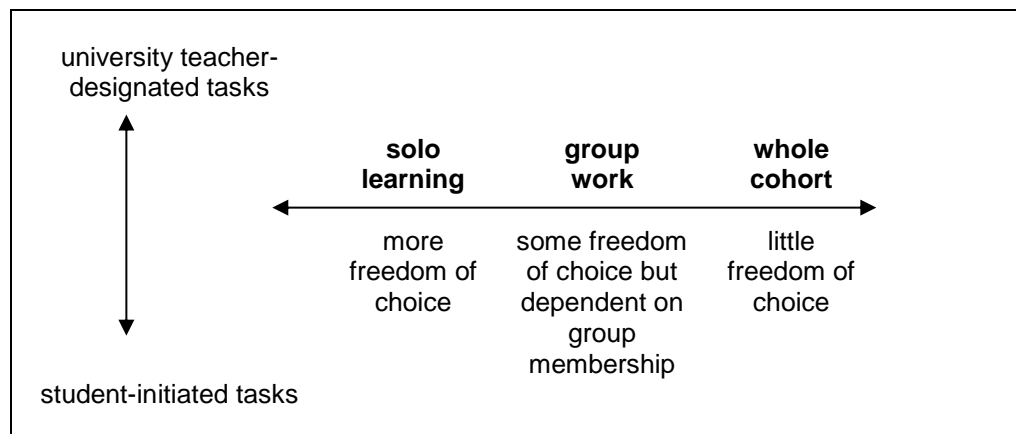
There was some variance in students’ educational technology use for semi-structured university teacher-designated tasks and open student-initiated tasks. Not all students used those educational technologies provided by the institution; instead they began to use other technologies for these tasks. Other students preferred to only use the educational technologies provided to them as part of their studies and would only consider using other technologies if prompted by other students. This is not something they would necessarily decide on their own.

It is difficult to state from the data collected if all students would approach open student-initiated tasks in the same way. One might perhaps assume that all the students interviewed used web browsers to search for information to support their studies, however, not all of them talked about this in their interviews. Some students, usually those in Group 1: Pioneer users of educational technology – ahead of the university teacher’s curve, talked about using a range of different educational technologies that were not provided to them by their university teacher or the institution for both semi-structured and open tasks.

## 4.5 Social context of learning

As analysis of student and university teacher interview accounts developed further it became clear that not only did university teachers and students consider task context to be an important influence on students' use of educational technology. They also spoke about the social context of learning as another important influence on their use of educational technology in relation to different facets of learning. In this section I elaborate on how students and teachers construed different social contexts as influential on how and what educational technology they used in support of their learning.

It was evident from the data collected that some students, particularly those identified as belonging to Group 1: Pioneer users of educational technology – ahead of the university teacher's curve, used different educational technologies in particular ways depending on who they were working with and what they were working on. Figure 4.2 summarises variation in educational technology use according to the social contexts of students' learning.



**Figure 4.2: Students' variation in educational technology use depending on social context**

### 4.5.1 Solo learning context

Students studying alone found innumerable ways to integrate educational technology into their learning. This was applicable for both university teacher-directed tasks as well as student-initiated tasks.

This was also relevant for both institutionally-endorsed and non-institutionally endorsed educational technologies. Students' engagement with educational technologies when working alone was contingent on their approaches to the usefulness of technology in their learning and what technologies they had at their disposal. Those students who were identified in Group 3: Unconverted sceptics and somewhat frustrated by educational technology use, revealed stories about how they found educational technology useful for their successful solo learning for university teacher-designated tasks only.

Nareem liked the way he could manage his own learning as well as keep up-to-date with announcements and developments in his course and within the institution as a whole. He explained this in his generalised student interview.

Well Blackboard is another thing which is the University's system, but getting information to students and for students to submit information and it gives a lot more flexibility with deadlines and things like that. Obviously, there's less paperwork involved and also information can be put straight on to that so every student within the course is kept up-to-date with things that they need to know and they can use that to help their studies (Nareem, generalised student interview, Phase 1 December 2013; transcript p.2, lines 4-9).

Sam liked to engage with a range of digital resources while taking notes in the lecture theatre. He felt this meant he could take richer lecture notes, check his conceptual understanding of new topics and have a sense of making progress with his university learning.

...So I have my iPad out on the table with me. So to support what the lecturer's talking about and the notes that he's giving me, I'm able to flick through the e-book of the textbook. I wouldn't bring the massive textbook with me. So it's of substantial use to me to have my iPad to just flick through so that I can build on what he's telling me (Sam, generalised student interview 1, Phase 1, December 2013; transcript p.1, lines 21-23; p.2 lines 1-2).

While for Wan Azizah she could use the video recording of her lectures in her own time to improve her understanding of specific concepts.

...there are some points that our lecturers mention during the lectures that are not in the notes because obviously they can't just spoon-feed everything to us. So yes. And some points are just okay, one sentence. Sometimes students, we're not an expert in that field. So we need more explanation. During class we don't have time to write and listen at the same time. So it was nice that with the video, I can, 'Okay. That's what he said. Okay. I'll jot it down', and while I am jotting I can pause the video and continue. So yeah (Wan Azizah, generalised student interview 2, Phase 2, May 2015; transcript p.3, lines 12-22).

Gulwant liked the scope for taking more control of her learning and pace it according to her ability to digest it comfortably. She was happy that she was able to access the video recordings and listen to them at a time and place that suited her. She also liked the fact that she was able to stop and start the recordings whenever she wanted to. This meant she could repeat a particular section numerous times because she wanted augment her own hand-written lecture notes.

So every lecture, like I make notes in the lecture, and then I'd go back and I'd look at the video sessions of the lecture and just add in anything that I've missed or just to kind of understand it because if you're in a lecture because it's only for an hour, you end up spending a lot of your time just writing down everything because you don't want to miss anything, but then you've actually got to go over it and understand it. It's not just repeating everything that they say. So it's a good opportunity for you to actually understand it and it's good that you can stop it and go at your own pace because sometimes you do feel in the lectures they do kind of mover really quickly.

So it's really useful to be able to just stop and pause and rewind and go over something that you don't understand and be able to research while you're looking at it as well other than it's just going really quickly (Gulwant, generalised student interview, Phase 2, February 2015; transcript page 3, lines 16-26).

Sophie is a mature student with two young children and revealed her learning and health difficulties during our interview. Her use of audio to support her learning of disciplinary knowledge for formal assessment tasks as well as revise for exams was how she adapted to her personal circumstances and made the best of her situation.

It's not always practical to be able to sit and revise as most students would. So being able to like listen to my notes and obviously I don't live on campus. So it would be nice to listen to my notes in the car. I can actually from, sounds really sad, but I can put my Dictaphone notes, convert them onto my iPad and play them through my stereo of the car, which is really sad [laughs], because my iPad connects up to my car stereo. So I can play them through the radio. So as it kind of gets nearer, because I spend an hour and twenty minutes a day just travelling to university and back (Sophie, generalised student interview, November 2013; transcript p.3, lines 20-27).

It was evident from the data collected that students from all three Groups found ways to use a range of educational technologies to help them with their solo learning. Those students identified as belonging to Group 3: Unconverted sceptics and somewhat frustrated by educational technology use, talked about their use of Microsoft Word to type up assignments in their interviews. They completed this university teacher-designated task as solo learners.

Those students identified as belonging to Group 1: Pioneer users of educational technology – ahead of the university teacher's curve and Group 2: Mastery-oriented but compliant approach to educational technology use, talked about their particular successful learning experiences as solo learners.

They were using a number of educational technologies provided by their university teacher to use for both university teacher-designated tasks and student-initiated tasks.

#### 4.5.2 Group work learning context

Bryn reflected on how he had found that over time the dynamics of the face-to-face problem-based learning workshops had changed as students started bringing their own mobile devices to the workshop sessions. For him, a more reliable and expansive Wi-Fi network in the Chemistry classrooms has modified the ways students engaged with their group work learning.

Students speeding up their productivity in the classroom in face-to-face classes have taken on a new dimension since a better Wi-Fi coverage in teaching rooms as well as other areas of the university. Students now do not need to wait they can go online and access information and resources without having to go to the library physically. I think it's I can't imagine the job without it anymore to be honest with you. So I mean almost everything I do is either coordinated or directly implemented via use of the technology and that includes when I'm in the contact sessions a lot of the time. So I would never go into a PBL session without my iPad with me and it fulfils a number of roles (Bryn, generalised university teacher interview 2, Phase 2, December 2014; transcript p.9, lines 21-25).

Bryn found the way particular students used a range of educational technologies in the classroom helped them create the particular outputs they needed to provide as part of their group work assignments.

So I was actually very impressed by the way – I spoke to them for five minutes, went off to speak to one of my other groups and by the time I'd come back to Team A, they had a diagram of their experimental design which was actually generated very quickly by Sam and it was a completely viable diagram and he did a very good job.

I could see he did a very good job in generating it (Bryn, contextualised university teacher interview 4; December 2013; p.2, lines 12-21).

Students reported on particular group work which involved university teacher-directed tasks in particular. However how students worked together as a group varied and the particular educational technologies they used to complete these tasks also varied. This variation was contingent on who they were working with and what technologies they had at their disposal. Students reported that their choices were not consistent across all group work university teacher-designated tasks.

For Bronwyn she found problem-based learning group work in particular and group work in general a challenging and unenjoyable experience because of the lack of group dynamics and unequal sharing of the work load.

... I didn't really enjoy PBL because I worked – Well one of the first tasks we had, you worked in a team and I worked so hard on my piece of work for the first task and I was really proud and it was amazing and I'd put hours and hours into the work and then when we all put it together, nobody else really did anything and I just felt- I don't know. It was a bit disheartening and I don't really enjoy working in a team when we're doing things like that. Like in assessments for different modules, we have to do posters and presentations and I just don't enjoy working in a group because people don't put the work in and they don't make the effort. Then I'm getting a bad grade because they're not putting the work in. So I didn't enjoy PBL (Bronwyn, generalised university teacher interview, Phase 2, February 2015; transcript p.4, lines 13-22).

For Nareem, educational technology provided him and his group with the opportunity to access relevant scientific information in a speedy manner which facilitated their problem-based learning group work.

By working in pairs, or with particular members tasked with specific roles, the group could work consistently during the one-hour face-to-face workshop and use this time together as efficiently as possible.

Well one of the main things that technology plays is fast access to information, especially in PBL when most of the time we're talking to each other and we're at a table and we need to get information to discuss very quickly, and with technology, that allows us to be able to do that (Nareem, generalised student interview, December 2013; transcript p.1, lines 19-22).

The six students working together as Team A in the problem-based learning workshops, used the reliable Wi-Fi access to their advantage when they met physically. Three of the group brought mobile devices to the face-to-face workshops. As a group they worked effectively using a range of educational technologies to prepare their problem-based learning group work problems.

I had my iPad out with me all the time. I was able to have the task up so that I could flick through that and then it's very easy to do a little bit of research in the task, you know, looking at this UV Vis. Getting up a Wikipedia article or whatever just to give us a little bit of background at the same stage, you know, while this wasn't me. Nareem was able to remotely book a library room for us to go and study in which is all done obviously online from there. We knew instantly in that session whether we'd go a room or not where we had to go, when we had to do, which was also particularly useful (Sam, contextualised student interview 2, November 2013; transcript p.2, lines 23-30).

For example, Sam, one of the six students, got out his laptop and begun to work directly with the specialist Chemistry software application in one of the problem-based learning workshops.



I was able to import the text for the second question into a word-processing app that I've got. So I was able to go through that and make some changes from there, highlight some differences. It's quite useful to have different tabs open with the different documents. So I'd got the problem open once. I was then able to open another tab and do a bit of research on this CAD laser system which obviously you'd really struggle to do with a piece of paper with a problem on. (Sam, contextualised student interview 1, November 2013; transcript p.2, lines 26-32).

It was evident from the data collected that not all students from each of the three groups found ways to use a range of educational technologies to help them with their learning while working with other students in a group. Those students identified as belonging to Group 3: Unconverted sceptics and somewhat frustrated by educational technology use, did not reveal any stories of successful learning while working with other students in a group. While those students identified as belonging to Group 1: Pioneer users of educational technology – ahead of the university teacher's curve, and Group 2: Mastery-oriented but compliant approach to educational technology use, talked about particular successful learning experiences using a number of educational technologies provided by their university teacher (institutionally-endorsed) to use for both university teacher-designated tasks and student-initiated tasks during group work. These students also revealed other educational technologies not provided by their university teacher (non-institutionally-endorsed) to use for both university teacher-designated tasks and student-initiated tasks during group work.

#### **4.5.3 Whole cohort learning context**

Bryn, the university teacher, found he could use the reporting functions in the VLE to provide him with learning analytics of the whole cohort to inform and improve his future teaching.

Using data collected he could tailor his teaching according to the results he found.

So I can actually have the Blackboard site open in front of me while I'm talking to the students about problem solving process and I think that's really, really important. I mean even when we're talking about lecture-based modules or practical-based modules, the learning environment gives me an opportunity to monitor engagement with my resources. So we've got questionnaires on there obviously measuring levels of feedback and collecting data on student satisfaction, but more importantly from my perspective, I can get a live measure of how many people have looked at the notes in advance, ... what kind of distribution in time did those views have. If there's a pre-session activity, what proportion of the students have done it? What proportion of the students remain to have done it? Of those that have done it, what is the average mark? What are the questions that they're frequently getting wrong? Can I do something in the lecture to address those issues? So it's providing some level of live feedback that informs the way I go out and perform in the lecture on any given day (Bryn, generalised university teacher interview 2, December 2014; transcript p.9, lines 29-42).

Bryn also used the VLE as a means of two-way communication with his students so that he can engage and monitor the whole cohort through this medium and provide students with a means to get just-in-time feedback on their learning progress.

From my perspective it gives me a useful way of monitoring what the students are doing at all times in terms of working on the problem. So it allows me to drop in and check the Wiki periodically. So I can do that throughout the course of the week and I can interact with the students. I can engage with the students. I can leave feedback. I can leave messages for them. I can interact with them via the discussion board as well.

So it gives me a means to communicate with the students when I'm not in direct physical contact with them and it allows me to keep up-to-date with their work all the way through the problem rather than just during the times I do physically see them (Bryn, generalised university teacher interview 1, November 2013; transcript p.2, lines 30-38).

On the other hand, students such as Gulwant felt her contributions to the whole cohort Facebook revision group enhanced her own learning, as if by sharing her knowledge she gained a confidence in what she knew and what she needed to get a better understanding of for her forthcoming exams.

We did have a revision group set up on Facebook for the January exams. I found that actually really useful. So people would put up a question that they found on a past paper or whatever they were struggling on. And it was just a way for other people to answer it. So you're learning like, you know, obviously getting the answer to whatever you're struggling on but that person's also learning by answering it because you remember it and it's easier if you're teaching someone. So it was really good and it was really useful. I feel like everyone kind of got involved and spoke on it. It was clearly just for work. So it was just straight to the point and it was really helpful (Gulwant, generalised student interview, February 2015; transcript page 7, lines 17-25).

Duncan also found this opportunity of using Facebook useful for his exam revision and found the whole cohort involvement helpful to his own learning.

Just being able to just organise groups where essentially we had, for the last lot of exams we had, everybody in our year in one group being able to talk and ask questions and sort of bounce ideas off each other, and if somebody didn't know the answer to a particular past paper question.

They could put it up and people would explain if they know the answer, which was a really good way to just to sort of get people thinking and get everyone involved (Duncan, generalised student interview, February 2015; transcript p.3, lines 25-33).

Other students reported that the success of the revision group was not something that was repeated in each study week period. The fact that there was a significant enough of a break from university over the Christmas period meant that there was sufficient enough time to be connected and use the revision time effectively.

It was evident from the data collected that not all students from each of the three dispositions found ways to use a range of educational technologies to help them with their learning. Those students identified as belonging to Group 3: Unconverted sceptics and somewhat frustrated by educational technology use, did not reveal any stories of successful learning while working with other students in a group.

While those students identified as belonging to Group 1: Pioneer users of educational technology – ahead of the university teacher’s curve and Group 2: Mastery-oriented but compliant approach to educational technology use, talked about particular successful learning experiences using a number of educational technologies provided by their university teacher (institutionally-endorsed) to use for both university teacher-designated tasks and student-initiated tasks during group work.

These students also revealed other educational technologies not provided by their university teacher (non-institutionally-endorsed) to use for both university teacher-designated tasks and student-initiated tasks during group work.

#### **4.6 Interactions between task and social contexts of learning**

One point that Bryn, noted in one of his contextualised interviews was that he needed to become more flexible with his students and the specific educational technology choices they may make in their problem-based learning group work.

He realised that they might deviate from what he recommended them to use and that he should not be concerned if they do.

So one of the things that I can take out of this is that the students might not see the Wiki as the most convenient form of collaboration in every type of problem we do and the students will adapt and evolve their approaches to meet the specific demands of the problem we present them with (Bryn, contextualised teacher interview 2; November 2013; transcript p.4, lines 10-13).

In this section I draw on extracts from students' and teachers' interview accounts to show how interactions between task and social contexts related to students' and the lecturer's mode of educational technology use in ways that influenced different facets of students' learning.

Students recounted the different ways they engaged with university teacher-designated and student-initiated tasks. All students who were identified as belonging to Group 1: Pioneer users of educational technology – ahead of the university teacher's curve and a few of those students who were identified as belonging to Group 2: Mastery-orientated but compliant approach to educational technology use moved beyond the institutionally-endorsed VLE and used a range of non-institutionally-endorsed educational technologies. However, it was surprising to note their choices and decisions around educational technology use were unique, were often opportunistic and contingent on the social contexts and tasks contexts they were faced with. This might be understood as pointing to a highly skilled and adaptive expertise cultivated by students in relation to ways they use educational technology and adapt their use of educational technology in different contexts in ways that enhance their learning experiences.

Students when solo learning talked about the VLE as the 'go-to' technology for the module they were studying with Bryn. As discussed previously, Bryn's module design assisted this process by giving them purpose to visit the site and in particular with the problem-based learning elements of their module.

Regardless of the flexibility in educational technology choice within the designated task, students were interested in what they could access, explore or reflect on that was found in the VLE module site and able to do at their own pace, where and when it was convenient for them.

For Susanna, it was the variety of resources on the VLE that she found useful, and that she could access outside the classroom in her own time. Having access to the module VLE site, influenced Susanna's learning as she accessed a range of multi-module study resources that helped her to conceptualise the required disciplinary knowledge in range of different ways as she explains below.

Well the Blackboard site is obviously really useful because they can upload extra resources that you don't particularly have time to use in lectures which can contain programmes or internet files that help look at things in different ways (Susanna, generalised student interview, November 2013; transcript p2, lines 19-21).

Rebecca appreciated the way her university teachers adapted complex disciplinary knowledge for first year chemistry university students and made this available via the VLE.

So on the website there's more broader knowledge and it's explained in different ways to where it is on the textbook. So you can relate them together and contrast them to get more of an overview of what you're talking about because in textbooks they're kind of straight to the point and they use of lot of language that as a first year you may not understand at first, but on the Blackboard site you get the teacher's rendition of it and how they think first years should understand it. So it's basic language but language that we need rather than the language used in the textbooks. (Rebecca, generalised student interview, November 2013; transcript p.2, lines 30-37).

Gulwant liked to manage her learning and keep on top of her different modules through her access to the VLE via the mobile app.

She talked about how she found her mobile phone and the apps she had on it to be an invaluable part of this process and was aware that her particular approach supported her university learning.

I have the Blackboard app. So that's a university app. So it gives me a notification every time a new lecture has gone up or if there's any like – because we have assessed labs every week. So our reports, like our grades, will go up on there. So I think that's really important. I check that every day, five times a day. Emails. So I have the university email. I've linked that to my phone as well just so I don't miss any deadlines because there's always reminders. Even simple things like room changes. So I think it's really important to have a way of it reaching you every day because I know that I'm always on my phone, if I link everything to my phone, there no way that I could ever miss anything, whereas some people are always on their laptop but I never really carry that around with me (Gulwant, generalised student interview, February 2015; transcript p.5, lines 9-18).

How students accessed the VLE varied depending on what devices they had available at their disposal. Most students talked about their mobile phone and some students happily accessed the VLE from their phone. Others used their laptops and computers usually at halls or their term-time accommodation and sometimes at university. Students did not always bring their laptop to class, though they found bringing devices to the problem-based learning workshop extremely useful. Some students had tablets and would alternate between their smart phone, tablet and laptop depending on the task at hand. Not all students had all three devices.

For the face-to-face problem-based learning workshops I observed many students, but not all 30 in the class, brought mobile devices. Each problem-based learning group comprised six students. In Team A, three students brought mobile devices to the four face-to-face problem-based learning workshops I attended.

These were tablets and laptops. Team A worked together using a range of technologies to support them to complete their problem-based learning problem tasks.

Nareem made a conscious choice to bring his iPad to the problem-based learning workshops to help keep a learning momentum going during the group work. He wanted to use the face-to-face time efficiently and tasks were allocated to different members. He noted in his interview that he did not take his iPad to all his classes.

Well the iPad is very useful because instead of having just sheets of paper, you can quickly get research. You can use the piece of paper that everyone else is using but on Blackboard, and if you need to research something, you can quickly research it using the iPad which is really useful and it's a quick way of getting through information and organising yourself because everything's in one place with an iPad and it's not sort of you're carrying a big bag full of data and you have to find it. You can find it straightaway. So that's one of the reasons I choose to bring my iPad. I don't really bring it to many things, but definitely for PBL... (Nareem, contextualised student interview 1, November 2013; transcript p.3, lines 9-16).

For Sam it was a similar situation, he wanted to bring iPad to his problem-based learning workshops and he found it useful to take his iPad to other classes. He found the flexibility of carrying around his iPad that had e-text books and other key digital documents meant that he was able to access these documents during his studies. He liked the notion that he did not have to wait until he returned home to access key information.

I love having the iPad with me. I have it all the time. Being able to log onto Blackboard there, I was able to pull up the problem from there. I didn't have to bother about printing off and remembering to bring a sheet in.



I was able to import the text for the second question into a word-processing app that I've got. So I was able to go through that and make some changes from there, highlight some differences. It's quite useful to have different tabs open with the different documents. So I'd got the problem open once. I was then able to open another tab and do a bit of research on this CAD laser system which obviously you'd really struggle to do with a piece of paper with a problem on. (Sam, contextualised student interview 1, November 2013; transcript p.2, lines 24-32).

A number of students recalled the January exam revision Facebook group as being beneficial for their learning. They were studying and preparing for the module exam and they liked that they were able to share conceptual misunderstandings and confusions with fellow students while away from campus during their holidays and study period. They were engaged with the revision process and the Facebook group enhance and complemented their exam revision preparation.

This activity was a student-initiated task and happened in an organic way. These students expressed that the revision Facebook group was not something that would necessarily work during all revision weeks but it happened to work for that particular revision week. How it became a Facebook whole cohort student-initiated task was really by chance. Those students who mentioned this felt the experience for a range of different reasons was a complementary yet beneficial learning experience.

It just kind of happened because everyone kind of was like, 'Oh we'll add you on Facebook'. That's kind of the first thing to do. It's quite easy. Rather than obviously with like telephone communication and things like that, it's quite difficult to do that as a group as such unless you do like group messages, whereas like with Facebook you can just have one group message. Everyone all interacts. Everyone can read everything and it's a lot more kind of easy to do. I think everyone kind of goes on Facebook and checks Facebook and things like that.

So you can also get notifications on your phone and things like that. So yeah I think that's kind of – It just happened really. I think probably someone was scrolling through Facebook and go, I'll make a Facebook message', and that's what happened because it's just quite natural to end up on Facebook (Maggie, generalised student interview 2, May 2015; transcript p.5, lines 13-19).

Students' engagement with educational technology to promote their learning did evolve over time. Of the four students I interviewed in both 2013 and 2015 they all talked about how they felt they were refining how they were using educational technologies to support their learning. They were experimenting with different educational technologies and were finding out what worked effectively for them. In the second year of his degree, Sam began to use OneNote much more consistently than when he first began his studies.

I suppose I've dabbled in it if you like for quite a few years ever since it sort of first came out. I hadn't really tapped into its full potential as a learning resource if you like. I mean I suppose the first time that I really started using it at uni was just doing the shopping list because I knew that I could write that up at home, and then when I get into the supermarket, I can pull it up on my phone. Just something as trivial as that, but it was certainly revising for exams probably the back end of last year that I started to again those booklets of scribbled notes, I started to type those up during revision time at the back end of last year. At the start of the first semester of the second year I started typing those up as soon as I could and certainly for this year I felt that I've refined that process again and I'm able to go through a lecture in just over an hour. So I can sort of plan my day and I know, 'Well I've done three lectures today. I'll do two of them today and then tomorrow I can do that third.' So I suppose it's been a gradual thing but certainly from the start of this year has been when things have started to kick in and I've found it most useful (Sam, generalised student interview 2, February 2015, transcript p.7, lines 34-44).

Students found the differences in educational technology use between university teachers as one of the key challenges for learning, be it who did or did not record their lectures using lecture capture to those that allowed them to submit their laboratory reports electronically or deliver them in person. Students expressed their frustrations with decisions that had perceived negative impacts on their learning. For example, Wan Azizah did not appreciate the inconvenience created when submitting her Synthetic Chemistry laboratory reports in person.

For physical, we can upload our report at home through Blackboard, but for the synthetic experiments, we have to hand in our report and for handing in our report, we have a specific day. So I can't submit on Monday. So even if I finish my report early, I have to come on Tuesday and hand it in, whereas if it's just through Blackboard, I can just do it. As soon as I finish it, I can upload it and I can just get over, you know, get it done and over with. So there is no problem with missing the deadline, whereas I have to hand it in and I have to get my lab coat, get my goggles from the locker and go to the lab and submit it, and you know, there's actually this week that I was scared that I would miss the deadline because we had lecture from nine until one straight, because the deadline for our synthetic report is 2pm. So yeah. That was kind of less convenient (laughter) than if we could upload it online. Yeah (Wan Azizah, generalised student interview 2, May 2015; transcript p.6, lines 23-34).

Bryn, the university teacher in his 'blended learning' module design thoughtfully considered which educational technologies to employ so his students could engage with the discipline of Chemistry and be challenged as learners. He intentionally wanted to employ technologies that were all accessed via the institutionally-endorsed VLE Blackboard. He emphasised its use so that he could gain a deeper understanding of his students' progress and in turn be able to better support their learning through the learning analytics he could gain from the VLE.

So our PBL experiences completely harmonise between the classroom environment and the virtual environment.

So all of the student work is coordinated by via our Blackboard system. So we create a series of groups for each of our PBL groups on Blackboard and each of those groups is given access to a number of different tools on the Blackboard system which includes a group discussion board a group file sharing tool which allows them to successfully exchange ideas and actual files. The output is submitted via the Group Wiki. So the assessment for the module takes the form of the construction of a Group Wiki. This is something that evolves during the semester. So we provide feedback to the students on the Wiki and the students go in and edit each other's work, correct each other's work, in order to get as good a final product as they possibly can. This meshes with the classroom-based discussion that we have during the contact time. So we focus our attention during that contact time on planning the problem-solving strategy. The groups are encouraged to analyse the problem, take away the essential elements of the problem and set some research targets and set some logistical targets for the group to achieve before the next session and that's where the virtual environment kicks in (Bryn, generalised university teacher interview 1, Phase 1, November 2013; transcript p.2, lines 12-27).

Bryn, the university teacher I investigated in this study, had designed 'real-world' like and engaging task for his students that had arose out of commissioned research and funded by the Royal Society of Chemistry. As a result of this funding, he had been provided with the time and space to design his *CH1000* module and reflect on his design and modify it accordingly. He also had access to his colleagues' expertise in problem-based learning methodology. He had spent a considerable amount of time thinking about how to use educational technology to support his learners in this first year Chemistry module.

All five students belonging to Group 1: Pioneer users of educational technology – ahead of the university teacher's curve, spoke across all types of tasks and social contexts in their interviews.

They talked about their learning in university teacher-designated tasks as a solo learner, when working in a group and as a member of the whole cohort. They talked about educational technology-mediated structured tasks, semi-structured tasks and open tasks that supported their learning.

This was not the case for all of the students belonging to Group 2: Mastery-orientated but complaint approach to educational technology use. Some of the eight students talked across a range of tasks and social contexts but not all students spoke across all of the range. They talked more about university-designated tasks than student-initiated tasks. The majority of students talked more about solo learning or whole cohort than group work.

It was evident from the data that those students who belonged to Group 3: Unconverted sceptics and somewhat frustrated by educational technology use tended to focus on university teacher-designated structured learning task contexts and solo learning contexts in their interviews. They did not discuss any semi-structured tasks working with other students in groups.

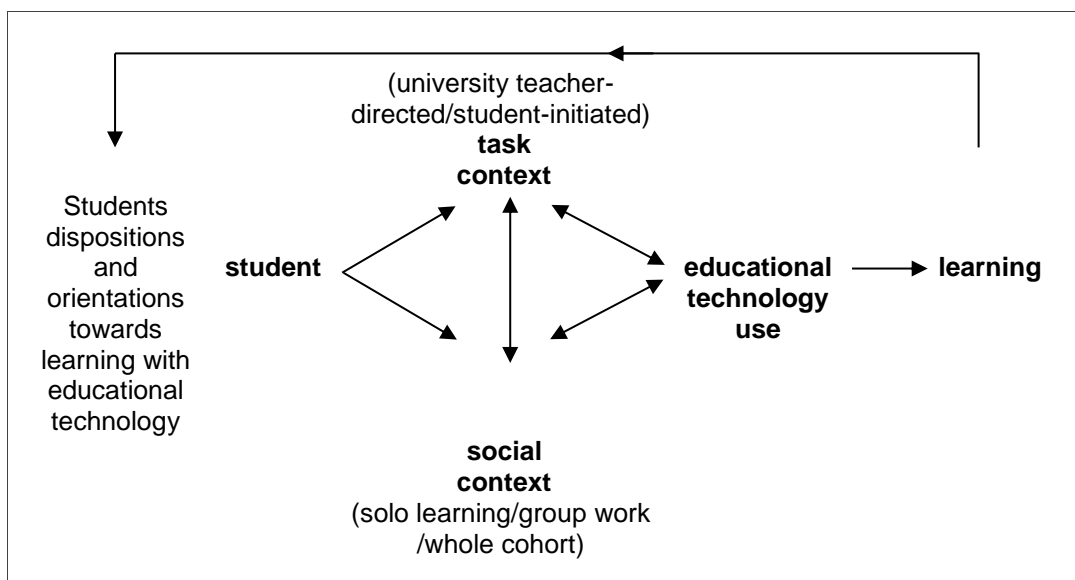
While the majority of students interviewed who were identified as belonging to Group 2: Mastery-orientated but compliant approach to educational technology use, appeared to be satisfied with the status quo of institutionally-endorsed educational technology options that their university teacher and the university provided.

They were not consistently compliant and some of the students interviewed were engaging with particular educational technology such as the Blackboard VLE app. Here they were using the notifications feature as a means to better manage their university learning.

## 4.7 Conclusion

The variety of ways Bryn and his students use educational technology to promote learning and the different kinds of educational technology they apply in a given learning context are shaped in interesting ways by the nature of tasks and the social contexts in which such tasks are undertaken. In other words, students' and teachers' use of educational technology to mediate learning is influenced by the task and social contexts of learning.

In light of my analysis of the data and the finding presented in this chapter, I have abstracted a conceptual model of how influences of educational technology on learning are mediated by student dispositions and the task and social contexts of learning as outlined in Figure 4.3 below. As outlined in detail in this chapter, three clear student dispositions and orientations towards learning were identified. It is evident from this analysis that students from these three groups were influenced by both task contexts of learning and social contexts of learning. Figure 3.4 provides a visual representation of the different variables at play when students were using educational technology to optimise their university learning.



**Figure 4.3: Factors influencing the mediation of learning by educational technology**

In this chapter I have presented the findings that I developed through analysing the interviews I conducted in my study. I have also presented a conceptual model

of how influences of educational technology on learning are mediated by students' dispositions and the task and social contexts of learning as outlined in Figure 4.3.

As discussed in this chapter, it was evident that how students approached the different social and task contexts of learning as part of their studies meant their educational technology use varied in light of these differences.

I turn in the next chapter to provide a summary of my research findings and discuss the links between my research findings and findings from the reviewed literature.

Then, I propose two conceptual frameworks of different modes of educational technology-mediated learning in university classrooms that have arisen out of Figure 4.3 and offer recommendations for policy and practice.

I also review the research design and process and conclude my study by suggesting how my study has made an original contribution to knowledge in the field of technology-mediated learning research.

## **Chapter 5: Discussion**

### **5.1 Introduction**

In this final chapter, I recapitulate the purpose of my study and provide a summary of my research findings before discussing the links between my research findings and propositions that arose from the reviewed literature discussed in Chapter 2. Then, I propose two conceptual frameworks to address the different modes of technology mediated learning in university classrooms which incorporates the findings, presented in the previous chapter. Next, I offer recommendations for policy and practice. Following this, I review the research design and process and reflect on the methodological limitations of my study. I conclude the chapter and thesis by suggesting how my study has made an original contribution to knowledge in the field of educational technology-mediated learning research.

### **5.2 Summary of research findings**

The purpose of my study was to investigate how university teachers and their students use educational technology to optimise learning in classroom contexts. It was also to develop understandings about and the thinking behind what kinds of educational technologies university teachers and their students consider the most useful and effective for optimising the quality of learning.

The following four research questions were formulated in light of my review of the educational technology-mediated learning literature and shaped the design of my study. Each of these questions will be addressed individually in relation to my research findings presented in Chapter 4.



### **Research question 1**

*How do university teachers and students use educational technologies to optimise learning in classroom contexts?*

As discussed in Chapter 4, the most frequently mentioned educational technologies by Bryn, the university teacher in his interviews were the VLE Wiki tool; the VLE Discussion tool (part of the VLE Group tools students talked about) and the VLE Test tool. He also talked about his use of visual media (including video and graphics) in his teaching. When he spoke of these tools he was talking about how was using the tools to mediate learning of specific disciplinary knowledge. Two of these tools were tools that students needed to use to communicate with other students and create and share Chemistry knowledge together.

The seven most frequently mentioned educational technologies that students felt helped them with their university learning were within the VLE itself where they could access study information and find out about key announcements. They also mentioned how they found specific tools within the VLE such as the file sharing and discussion tools extremely helpful for their learning. These two tools helped them prepare and complete the required problem-based learning problems that had been assigned and they needed to do in groups of six students.

An encouraging finding for the university teacher in this research is that the tools which he had planned for use were, by and large, used and found to be helpful by his students. Students found the VLE tools planned for use by the teacher extremely useful to their learning. Other tools that students mentioned as being helpful for their university learning was the web browser to use both at home and in class to complete university-designed tasks as well as student-initiated tasks. Students in their contextualised interviews mentioned that they found the web browser helped in maintaining the pace of group learning when they were at learning barrier or unsure of where to go next with their problem-based learning tasks.

Students also expressed how useful they found the Chemistry specialist software applications provided by the Department of Chemistry to support their learning. Student talked about the various ways they used the programmes to prepare and enhance their written assignments, explore difficult concepts by developing their own 3D diagrams and revise for exams.

Two educational technologies that students mentioned that were not discussed by the university teacher were Lecture Capture and Facebook. Students talked about how they found the lecture capture recordings of some of their lectures extremely helpful for consolidating their lecture notes and reviewing difficult concepts introduced in particular lectures. Facebook was mentioned by particular students as being a useful tool for managing group work and using it instead of the VLE Group tool that Bryn had set up for them. Not all students wanted to use it and some found it a distraction rather than a convenience. Facebook was used for exam revision, which was not received as being useful by all students.

### **Research question 2**

*What thinking underpins how university teachers approach educational technology use in their classroom teaching?*

Bryn spoke in his generalised interviews about how he saw his role as a university teacher was to prepare his Chemistry students for the 21<sup>st</sup> century workplace of the professional chemist. He designed 'real-world' scientific tasks that students accessed via the VLE and needed to work with each other via the VLE Group tool. The educational technology was a medium to support his students complete these required assessment tasks.

He wanted the VLE at the heart of all the learning and teaching that occurred in his modules. Bryn wanted to provide a two-way communication channel so that students could ask him questions and provide feedback as well as communicate and learn from each other. The task designs ensured that all students would be required to work collaboratively via the Wiki tool, to share files and work through an evolving problem over time in their problem-based learning tasks.

Bryn wanted students to see their progress through the submission of their group work via the Wiki tool. Some students preferred to use other tools to complete these tasks. From Bryn's point of view this at first created a challenge. He liked to be able to log in and see each group's progress by looking at their Wikis and this helped him to modify and adjust his future problem-based learning teaching in the problem-based learning workshops. The more students negotiated what educational technologies they thought suited the task then Bryn became more flexible in his thinking and approach.

Bryn liked the opportunity to use the VLE reporting tools to help him with his future teaching by monitoring his students' overall progress. He wanted to modify his lectures in a 'just-in-time' fashion to help those who were struggling. He could see the quiz results and seek out key concepts that students may not have fully understood. This helped him adjust his lecture slides and to set aside time to further explain concepts that he knew they were struggling with.

Bryn believed that multi-media resources could support his students with their comprehension of new chemistry concepts. As the students stated in their interviews, a 3D-animated chemical structure was easier to comprehend than a 2D-drawing in a text book. They were able to engage with the animation and move the structure around, zoom in and zoom out and see the structure from a range of perspectives. To support his students' conceptual understanding, Bryn provided them with a rich array of multi-media resources, with a focus on the visual which were all available via the VLE module sites.

### **Research question 3**

*What thinking underpins how students' approach educational technology use in classroom lessons to support their own learning and one another's learning?*

Students recounted in their interviews the numerous ways they navigated their university learning using educational technologies. Most students found educational technologies very useful in supporting them to get to grips with new and challenging concepts in their discipline and complete the required assessment tasks from their university teachers.

The majority of students interviewed enthusiastically engaged with the learning resources they were provided by their university teacher, Bryn, via the VLE. He used educational technologies to a sophisticated level which many of the students interviewed appreciated and could see that he was the exception to the rule. Students commented on the differences between university teachers and how some were using educational technologies less creative and useful ways.

Students were experimenting and finding new ways through their consistent engagement with the VLE in particular and appreciated the opportunities to manage their learning through educational technologies. This included the Blackboard VLE mobile application (App) which pushed through notifications directly to their smartphone or tablet. Not all students were using this app but those who were felt they could be in control of their busy study schedules and better manage their learning. Students when working together shared their educational technology knowledge. This is where students negotiated with each other on the various options they had at their disposal regarding educational technology use. Students talked about how they used a combination of university teacher designed and open educational resources to improve their lecture notes and prepare revision notes for their summative module examinations.

#### **Research question 4**

*What differences are there between university teachers and their students (as well as between students) in their approaches to incorporating educational technologies in their teaching and learning?*

There were discernible differences between Bryn, the university teacher and some of his students. Those who belonged to Group 3: Unconverted sceptics and somewhat frustrated by educational technology use were overwhelmed by the array of options and choices available to them in the VLE. Other students belonging to Group 2: Mastery-orientated but compliant approach to educational technology use may not have always accessed or consistently used what had been provided to them by their university teacher, Bryn.

As discussed in Chapter 4, each of the three student groupings identified reflected differences between students in their educational technology use. Students were required to complete specific university teacher-designated tasks using a range of VLE tools.

There are distinct differences in ways different students negotiated their use of educational technology, institutionally-endorsed or non-institutionally-endorsed. Other students were more compliant and tended to accept what had been provided to them by their university and remained within the boundary of institutionally-endorsed educational technology choice. This concept will be further discussed in Section 5.4 of this chapter, where I will present two frameworks of the different modes of educational technology-mediated learning in university classrooms contexts.

### 5.3 Links between my research findings and findings from the reviewed literature

I distinguished between four propositions of educational technology use for promoting learning from my review of research in Chapter 2. I will address each dimension individually in light of the findings outlined in Chapter 4.

#### ***Proposition 1***

*There is a distinct variation in university teachers' conceptions regarding the purpose, usefulness and benefit of using educational technologies to promote learning. These pedagogical beliefs were strong and influential.*

In the case of my research findings it can be said that there was a distinct variation in students' conceptions regarding the purpose, usefulness and beliefs of using educational technologies to promote learning as three distinct groups emerged from the analysed research data. They are:

- Group 1: Pioneer users of educational technology – ahead of the university teacher's curve
- Group 2: Mastery-oriented but compliant educational technology use
- Group 3: Unconverted sceptics and somewhat frustrated by educational technology use

I am unable to link my research findings to Proposition 1 as my study only involved the participation of one lecturer, Bryn. I have no grounds for claiming that the perspectives articulated by Bryn are somehow representative of a wider group of lecturers. It was evident from the research data that Bryn the university teacher's pedagogical beliefs evolved slowly over time especially once he participated in the Postgraduate Certificate in Academic Practice (PGCAP) and had time to reflect on his teaching practice and engage in scholarly endeavours as part of his formal assessments during the course.

### **Proposition 2**

*There is a gradual pedagogical evolution occurring, which is driven by the curriculum context and university policies. However, this is hindered by external constraints and significantly challenged through the velocity of change in technological innovation and tool design.*

Bryn, the university teacher, talked at length about his involvement in the curriculum redesign project on which he had been recruited to the University to work. This was a pedagogical innovation for the Department of Chemistry and has had a number of positive ramifications for both students and staff. Bryn has been able to experiment with different assessment types that reflect 'real-world' like tasks that professional chemists may be faced with as well as professionally develop colleagues through their involvement in his modules.

As stated previously, the curriculum redesign work had been supported by external funds obtained from the Royal Society of Chemistry which made the curriculum change possible as well as to a good quality due to resources directed to the project. The velocity of change (in relation to educational technologies) has been managed to some extent within the Department of Chemistry but this is not something that will be continually challenged.

### **Proposition 3**

*There are significant effects in the use of educational technologies in promoting learning for those students who are technically proficient and competent in using the technology; the frequency of their engagement with the educational technology driven activity and where the educational technology supports the instruction (university teacher led and directed) rather than providing direct instruction (students working alone with the technology).*

It is difficult to ascertain from the data analysed the technical proficiency and competency of all of the students interviewed. One can say that the five students belonging to Group 1: Pioneer users of educational technology – ahead of the university teacher’s curve had a range of devices and were able to talk at length about their use of educational technology. They all used educational technology often and were constantly finding ways to enhance their studies through educational technology use. All students talked about how they found the university teacher-directed tasks extremely helpful in their learning and were engaged with the variety of assessment tasks requested of them. Some students talked at length about working alone on student-directed tasks and these students were predominantly in Group 1: Pioneer users of educational technology – ahead of the university teacher’s curve.

### **Proposition 4**

*The contextual ‘uniqueness’ of each pedagogical challenge solved through the integration of educational technologies does not easily render the ability to generalise or make transferable the ‘pedagogical solution’ to other pedagogical contexts.*

In the interviews I conducted with Bryn, the university teacher, he articulated that the way he integrated educational technologies into each of his modules was not the same. He may have used the same particular tools in different modules however, he did not directly transfer what he has designed in one particular module directly into another module. He considered carefully a range of factors and may have experimented a bit before implementing a new initiative.

For him he was iteratively tweaking and enhancing his modules use of educational technologies and was not attempting to replicate the same design across all of his modules.

It can be stated that some students who were interviewed made conscious decisions around which educational technology they may use in one learning context but not repeat the same approach in another learning context. This was for both solo and group learning as well university teacher-directed tasks and student-initiated tasks.

### ***Contradictions and inconsistencies***

One inconsistent conclusion that arises out of the four propositions identified from the reviewed literature is around Proposition 2: There is a gradual pedagogical evolution occurring, which is driven by the curriculum context and university policies. However, this is hindered by external constraints and significantly challenged through the velocity of change.

As Bryn was not a typical university teacher we cannot be sure that other university teachers are part of that gradual pedagogical evolution which is occurring. It can be stated that higher education institutions are attempting to address this issue and support university teachers to participate in this evolution and make efforts to remove obstacles and barriers that might hinder university teachers from participating in this education technology use to optimise student learning evolution. Unfortunately, each institution will have specific and unique obstacles and barriers which means that strategies developed in one Department or context may not readily transfer to other contexts in other institutions. There may be similarities and common issues which for the purposes of this study will not be explored further.

Another inconsistency worth identifying relates to Proposition 3: There are significant effects in the use of educational technologies in promoting learning for those students who are technically proficient and competent in using the technology.



It is difficult to ascertain for the reviewed literature the link between students' conceptions of and approaches to learning and the link between this and their conceptions of and approaches to educational technology to optimise their learning. These two issues are not clear in the reviewed literature and the discussion around the 'digital literacy' of university students and their technical proficiency needs to equally apply to their 'academic literacy' when discussing the effects of educational technology on student learning gains.

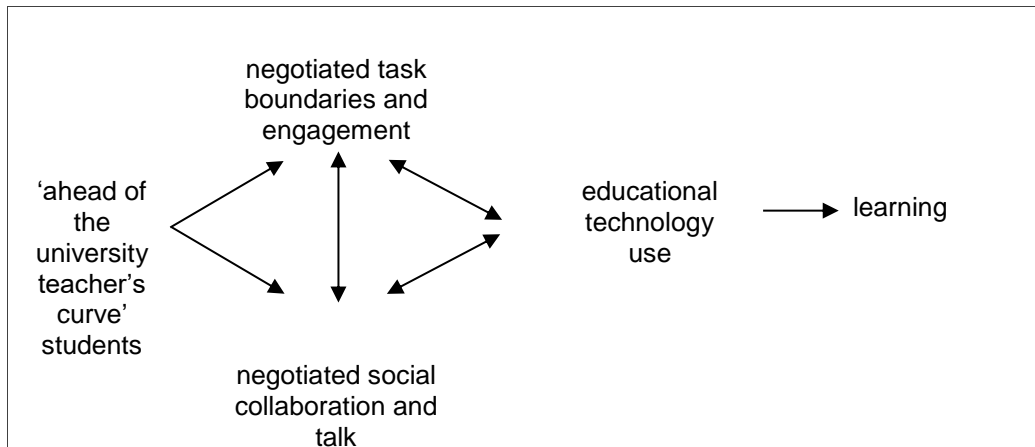
#### **5.4 Framework of different modes of educational technology-mediated learning in university classrooms**

From the data analysed it is apparent that the majority of students could be identified with one of the following frameworks. Those students who belonged to Group 1: Pioneer users of educational technology – ahead of the university teacher's curve would engage with Mode 1, an enthusiastic and agile engagement (see Figure 5.1), the majority of the time when engaging with educational technology in their university studies.

According to the interviews I conducted, those students who belonged to Group 2: Mastery-orientated but compliant approach to educational technology use tended to engage with Mode 2, an acquiescent and receptive engagement (see Figure 5.2), the majority of the time when engaging with educational technology in their university studies. It can be said that over time some students from Group 2: Mastery-orientated but compliant approach to educational technology use may have engaged with Mode 1 for specific tasks or specific social contexts. This was not necessarily consistent across all of the educational technology use at university.

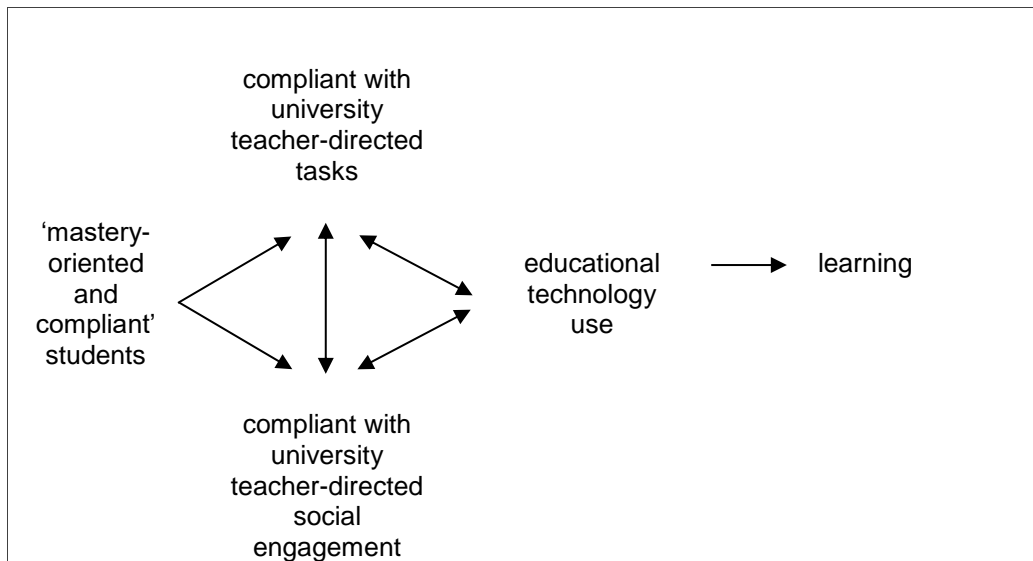
Students who were identified as belonging to Group 1: Pioneer users of educational technology – ahead of the university teacher's curve negotiated task boundaries and how they could engage with the task. They also negotiated with their peers in group work on educational technology use. Some students who were identified as belonging to Group 2: Mastery-orientated but compliant approach to educational technology use also negotiated task boundaries and how they could engage with the task.

They also negotiated with their peers in group work on educational technology use but this was not consistent. Some students recounted enthusiastic and agile engagement in their educational technology-mediated university learning experiences, but not all students. This engagement is represented in Figure 5.1 below.



**Figure 5.1: Mode 1: Enthusiastic and agile engagement in educational technology-mediated learning**

The majority of students who were identified as belonging to Group 2: Mastery-orientated but compliant approach to educational technology use and all of the students who were identified as belonging to Group 3: Unconverted sceptics and somewhat frustrated by educational technology use, were compliant with university teacher-directed tasks and university teacher-directed social engagement. Overall, the majority of students consistently recounted an acquiescent and receptive engagement in educational technology-mediated university learning experiences. This engagement is represented in Figure 5.2 overleaf.



**Figure 5.2: Mode 2: Acquiescent and receptive engagement in educational technology-mediated learning**

## 5.5 Policy and practice implications

The practical challenge is what can universities and university teachers do to support the practices, dispositions and perspectives for educational technology use and learning more broadly characterised by the successful group of students identified in this research as being ahead of the university teacher's curve. We can learn from these students and emulate them.

### **Implication 1**

University teachers have a great deal to learn from their students because students are pedagogically and technologically aware. This conclusion points to an important policy and practice implication. Universities need to establish regular staff-student forums for consultation, planning and evaluating experiences of learning and teaching in educational technology-mediated classrooms (learning spaces).

### **Implication 2**

Not all students are successful in their educational technology use for learning. My research suggests that these students are more dependent on direction from their university teacher for using educational technology to support their learning. And yet we also saw that their university teacher provided tasks that were carefully and thoughtfully designed.

There are limits to how much personal attention university teachers can give to such struggling students. In any case, the highest forms of pedagogic and technological sophistication are with the students I have identified as ahead of the university teacher's curve.

An important policy and practice implication that flows from this is for universities to identify students who are ahead of the curve and appoint them as learning coaches for their struggling peers.

### **Implication 3**

An important conclusion from my research is that educational technology cannot resolve on its own the learning and teaching challenges that university teachers and students face in university classrooms.

It was very clear from my data that educational technology use tends to have its most successful effects on learning and teaching in interaction with social and tasks contexts of that learning and teaching (see Section 5.3 above).

The implication of this is for universities to avoid unsophisticated and expensive investments in educational technology on the apparent and naïve expectation that educational technology will have direct independent benefits for learning.

University spending on educational technology needs to be informed by a more sophisticated analysis of educational technology-mediated pedagogy. Therefore, ahead of the university teacher's curve students and university teachers with cohesive conceptions of educational technology need to be involved in planning investments in educational technology as part of a fully integrated University policy and programme of planning for learning and teaching.

## 5.6 Methodological reflections

One of the biggest challenges for me was getting satisfactory access to undergraduate students. In my work role, I work with university teachers and postgraduate research students but not directly with undergraduate students. My experience with the 15 undergraduate students involved in my research project was innumerably valuable and has been incredibly enriching from a professional point of view.

However, during the data collection phase of my project I had to work extremely hard to maintain the connection and manage access to this group. I believe the efforts involved have been outweighed by the student voice developed and expressed through this research and the data generated. I would have liked to have shared more than I did on my findings with these students. This has not been the case.

If I had been able to participate in a larger research project, I would have liked to have been able to have access to two or three university teachers and access to different disciplines of students besides Chemistry. This would have helped me gather a wider range of data and explore absence or presence of subject differences in the practices and processes of technologically-mediated learning. I may have also been able to develop a more comprehensive, cross-subject department 'institutional' picture that may be more useful for senior staff in policy development. This ambition would have been impossible to pursue as a solo doctoral researcher.

I believe the differentiated interview strategy was an important strength of my research strategy and design. For both Bryn the university teacher and six of his students to be able to talk in both generalised and more specific ways about their successful learning experiences has opened up useful understandings about learning and teaching with educational technologies.

One of the limitations of my study relates to the two phases of data collection. It was evident from the interviews conducted with those four students who participated in both Phase 1 and Phase 2 of the generalised student interviews that their confidence in how to articulate their experiences of educational technology use to optimise their learning had increased. They have also gained a better knowledge of how to optimise their learning through educational technology use which came about through both experience and experimentation over the 18-month period between the two phases. This did not mean that they were all considered to belong to Group 1: Pioneer users of educational technology – ahead of the university teacher's curve, as that was not the case.

However, they were more comfortable in their roles as university students in their second year of their studies and were able to discuss their learning experiences with more ease and reflect back on their previous interview.

Students at times found it challenging to respond to some questions, they may have interpreted the questions in particular way that may have hindered their ability to talk about their educational technology use. Some students did not have the ability to easily articulate their thoughts on learning, while others were more confident and at ease about talking about their own learning journeys.

## 5.7 Summary: contribution to knowledge

The research design adopted in my study has enabled me to make an original contribution to the field of educational technology-mediated research in a number of important ways.

Firstly, unlike previous sociocultural studies as discussed in my literature review, the informants in my study were undergraduate students at university and a university teacher. Whereas the sociocultural research discussed in Chapter 2: Literature Review was conducted in primary and secondary schools in the UK with school students and school teachers (e.g. Deane, Ruthven and Hennessy, 2006; Hennessy and Deane, 2009; Hennessy, Deane and Ruthven, 2005; Hennessy, Ruthven and Brindley, 2005). Whilst there has been some previous higher education research which deals with students' and teachers' experiences and thinking about educational technology though not specifically sociocultural, much of this research was conducted prior to 2005 and subsequently excluded from my literature review (Jones, Asensio and Goodyear, 2000).

Importantly this study has also used a differentiated interview strategy in order to support articulation of the voice and draw out generalised and contextualised perspectives of undergraduate university students and their university teacher on their educational technology use for optimising learning. This strategy also enabled me to identify influential task and social factors on the mediation of learning by educational technology as represented in Figure 4.3 (see Chapter 4) and further explored in this chapter and conceptualised in Figure 5.1 and Figure 5.2.

One of the interesting and novel features of my study was the participation of both a university teacher and his university students. In examining the literature reviewed in Chapter 2: Literature Review, 11 of the studies dealt with research conducted with teachers or university teachers only (Hennessy, Ruthven and Brindley, 2005; Steel, 2009; Ellis, Steed and Applebee, 2006). Whilst, 15 of the studies reviewed, focused on students or university students only (Gynnild, Myrhaug and Petterson, 2007; Vilo, Seitamaa-Hakkarainen and Hakkarainen,

2011). However, only 4 of the studies in the reviewed literature, focused on teachers or university teachers and students and some of this research was conducted by the university teacher or teacher with their own students.

In my research context, I was not the students' teacher and while I had been the university teacher's teacher this was not the case during the conduct of the research. I think the participation of both a university teacher and his students meant that both the learning and the teaching were viewed by me as a neutral observer or third person with a more distanced outsider's perspective on the module and its design and was able to stand back from the learning and teaching and analyse the learning and teaching activities and experiences with a unique lens.



## Appendices

### Appendix A: Section of interview transcript of generalised university teacher interview#2: 16<sup>th</sup> December 2014, pp.6-7.

Interviewer: Okay. That's really interesting. Now the other thing is just coming back to the learning technology and the way that you've been using in particular the Blackboard and why you've made those choices. You could have used other tools. Can you talk about how you were using the technology or how was the technology driving the design of the programme?

Respondent: So the PBL part of the programme?

Interviewer: Well actually, you could talk about both.

Respondent: Okay. So I mean if you go back five years, the PBL was obviously making a lot of use of the technology primarily through the Wikis and discussion boards. The rest of the course is a lot of them were largely using the VLE as a repository of information. So it was largely just a case of I go in, I upload my PDF or my PowerPoint of my lectures. I've done my job and that's it. Nobody's going to complain. What I've tried to lead since being a Teaching Fellow is a change in culture within the department of seeing the VLE as something you can use in a much more engaging manner as a two-way resource. So it's not just something where we're transmitting information to the students; it's the way that the students are actually transmitting their understanding back and they can receive live feedback on it. So now we have courses that have weekly quizzes on the lectures the students have. So interactive quizzes that they can go in and they can repeat and they can get feedback on. We've effectively converted a lot of our mid-term continuous assessment, which in chemistry usually means a mid-term test, we've converted a lot of that into a VLE-based activity. So there's a lot of Blackboard multiple-choice, multiple-answer, fill-in-the-blank type tests that we do throughout the course of the term. We have discussion-boards on probably every module throughout the course, if not every module on the course, but almost every module on the course. The discussion boards fulfil a number of different purposes. So with some modules the discussion boards are integrated very closely to the assessment, like the PBL in first year. We have a PBL activity in second year which is entirely electronic actually. Has no contact time and it's largely driven by the discussion board conversation. We have discussion boards on conventional lecture-based modules which are there to support student understanding as the course goes on. So it's an opportunity for them to discuss the content that they've just learnt in the lectures. There's opportunity for them to discuss what's coming up in the lectures and also it's the place they can go during the revision period to reflect on their learning and challenge anything

that they don't quite understand. We started making quite heavy use of pre-event activities recently. So we've used pre-lab activities for quite a long time. So these are mostly electronic. I think in all but one module's case they're all electronic ... [unclear – 00:23:57] one module is still paper-based pre-labs. We have now got pre-PBL activities as well. So this is something very new. I've only introduced it this year. This was done in partnership with the students. So final year project student helped develop them and these are short quizzes that help the students structure their preparation for PBL contact time. So it gives them an opportunity to reflect on the reading they were meant to do in advance of the activity and it gives them a chance to gauge the level of understanding before they go to the contact session. Then once they've done the problem, we've started setting up post-PBL activities as well. So we do an analogous quiz afterwards which gives them in some cases an opportunity to measure the level of improvement in their understanding by doing the PBL problem. We also make quite a lot of use of PBL for self-reflection activities now as well. So we get the students to measure their level of confidence in different skills. We do this via questionnaires that go onto the VLE. So we've aligned that with the PBL in some cases. In other cases it might be aligned with practical modules, but we've started doing that throughout the degree from first year to fourth year.

Interviewer: So just kind of following on from that last bit when you were talking about particular sort of reflective opportunities that the students have, what's the level of engagement and first of all about the engagement of the students, how they're engaging, but also how is that fitted in with assessment?

Respondent: The level of engagement is typically near enough to a hundred per cent because we usually assess those activities [laughs]. So we normally do require the students to do them. So in the case of the later years, so year three and four, those activities are married to their final year project. So they have to come in and they have to discuss their responses with their supervisor. For a sub-set of the questions, they answer, supervisor is also asked to evaluate them and they discuss the differences in their evaluations.

**Appendix B: Section of interview transcript of generalised student interview:  
16<sup>th</sup> February 2015, pp.6-8.**

- Interviewer: Okay. Just generally over your studies, I'm going to just start talking a little bit about learning technology. How do you use technology in your studies at the moment?
- Respondent: When I've done a lecture, I usually go home and I look through my notes again and then I look at the lecture notes that are put on Blackboard to make sure that I haven't missed anything. And during revision actually, the lecture capture is really helpful. So they do a lecture and I can get all my notes. Then when I come back to revision, it doesn't make sense this bit of the notes, then I look at the lecture notes on Blackboard and that doesn't make sense, but then I look at the lecture capture and he's really explained it and I really understand it now.
- Interviewer: So when you're talking about the lecture capture, what is it about the difference between say just getting the PowerPoint slides that have been uploaded on Blackboard versus the lecture capture? What is it for you?
- Respondent: Because sometimes there'll just be a bullet-point but the lecturer could explain it for five or 10 minutes in real depth and when someone asks a question as well, because usually in a lecture when somebody asks a question, everybody is thinking it. So when they ask it and maybe goes a little bit off tangent to what the lecture notes say, but he's answering everyone's question and I think that's really helpful.
- Interviewer: So when you go to the lecture capture recording, what do you do then?
- Respondent: As he's talking I'll just look through my notes and then if he says anything that's not on my notes, I'll just add it in.
- Interviewer: Right. So you're adding to your notes and your notes are hand-written?
- Respondent: Yeah.
- Interviewer: Then what do you do? Like for example do you carry any technology around with you?
- Respondent: No.
- Interviewer: You're a bit of a pen and paper girl?
- Respondent: Yeah.

Interviewer: Okay. So when you're preparing for exams you'll go into Blackboard. So where are you accessing the Blackboard site? Like where are you? Are you in the library? Are you at home?

Respondent: Oh, at home. At home.

Interviewer: Are you in halls or are you in shared ...

Respondent: No. I'm in a shared house with my friends.

Interviewer: So you've got a shared house. So you have your own computer in your bedroom?

Respondent: Yeah.

Interviewer: Okay. What sort of internet access do you have?

Respondent: We've got Wi-Fi.

Interviewer: So you've got Wi-Fi and that's something you all put in together?

Respondent: Yeah.

Interviewer: And that's pretty strong and you can get access to stuff?

Respondent: Yeah.

Interviewer: Okay. So how much of the day would you spend on the computer for study purposes?

Respondent: If I was revising, probably about two hours.

Interviewer: And what sort of things would you be doing in those two hours for example?

Respondent: I'd be looking at the lecture capture and I might even watch the same lecture a couple of times just to ensure that I've got everything. Looking through lecture notes. Looking at workshops because they're on Blackboard as well.

Interviewer: Okay. What sort of stuff do they put on for the workshops? What sort of materials would there be on Blackboard?

Respondent: It'll be the workshop sheet that you've got in the actual workshop when you turned up and the answers are put on there about a week after. So that's really helpful. Even if you didn't complete your workshop or you did but you got it wrong, you can look at the answers.

**Appendix C: Section of interview transcript of contextualised university teacher interview 3: 13<sup>th</sup> November 2013, pp.1-2.**

Interviewer: So what were the learning objectives of the workshop?

Respondent: The primary learning objectives if we move it away from the science specific ones which I guess you don't want to focus on, were to construct or to modify an existing project plan based on the contributions that had already been made and the timescale of the problem. So what I essentially wanted students to go in today was to take their project plan they'd started and developed last week and to modify it based on what they've already done and learnt and what they still need to do between now and the end of the problem session at the end of this week. So that was my main learning outcome. As always I expect the students to develop their time management skills and their project management skills and I expect them to learn more about, or gain more experience in, interfacing between the virtual and the real environment.

Interviewer: How successful do you think the workshop was in helping the students achieve the learning objectives?

Respondent: For the vast majority of groups today, and certainly Team 15, it was a very successful workshop. I'm particularly impressed by the way that Team 15 brought in their tablets and their computers and they were actively working on the Wiki as they were discussing, as they were going through. I think this is something that I'll come back to in a second. It's something that's changed in the outlook of students certainly in the last two years and probably in the last year quite a lot. We never used to have students who brought any mobile devices of this type to PBL sessions. So PBL used to be all paper-based thinking and then they used to have to go outside into the back home or to the library or somewhere to start working on the Wiki. These days they can actually do quite a lot of the active planning then when they've all grouped together and then that makes it a lot easier for them to go away to break out and do their individual bit.

Interviewer: Okay. What did you do that you think helped your students learn those objectives?

Respondent: So in terms of in a very general sense the actual setting up of the spaces online for them to exchange ideas and to exchange some of their early drafts and the students are very good at that and they're making very good use of things like the file exchange on Blackboard for example. So many students I spoke to today had been swapping very, very early drafts of their letters on the file exchange. There were groups still using the discussion board to swap ideas usually at the very, very start of the problem-solving process before

they've started to draft their solutions to the problem. Sometimes later on when they're trying to book a group meeting between the two time-tabled meetings for example. So I think those online tools are really helping. Within the sessions, specifically in today's session, I think having the ability to go around and give group-by-group feedback is a very valuable process. I think the fact that we've built that into our PBL structure is very useful for students because it gives them a chance to appreciate how their solution to the problem is progressing before they formally submit their first draft of the work.

Interviewer: Right. Well following on from that, what did the students do that helped them learn those objectives of those that you could observe?

Respondent: Yeah. Absolutely. So in terms of what the students did, they came prepared. So they actually made use of the tools that I provided between the two sessions which I can ask no more from them really. I was a little concerned at the start of the day because I looked at the Wikis and I noticed that some groups didn't have much new content on their Wikis. There seems to be some kind of mental barrier. Students think as soon as it goes on the Wiki, it's there to be judged, it's there to be criticised or graded and they hold back and they use things like the file exchange more often rather than putting things on the Wiki. Every group had done at least some preparation for today's session. So we've at least a printout of something that they had done. Most groups came with a computer and a Word document on the computer which contained the files in them and I think that greatly assisted the productivity of today's session. It made it a useful session for them.

**Appendix D: Section of interview transcript of contextualised student interview 2: 27<sup>th</sup> November 2013, pp.1-2.**

Interviewer: What did any of your peers, you know in the team there's a number of people, what did they do that helped you learn?

Respondent: I think again it's constantly interacting. If we were working on an individual basis, you know, I do this part, they do that part, they do this part, and there's none of that interaction, I don't think that the task would come off anywhere near as good. I think certainly when you're placed in such an alien environment as this with something that we've not looked at before. Being able to sort of bash heads together and get as many ideas flowing as possible is very, very useful.

Interviewer: It's interesting. You just mentioned the word alien. What do you mean by that when you're using that word?

Respondent: The way that the task is set out is we're not given something that we necessarily know a lot about. So for instance with this UV spectroscopy, we've not covered that yet. So having to research and apply other things that we may know from lectures or previous knowledge or things that we've read to try and apply it to the situation is very interesting.

Interviewer: What did Dylan do that helped you learn in today's workshop?

Respondent: Again I think it's his input and the way that he talks to us and challenges us. He's not there to direct. He's there to have a bit of fun but at the same time he's there to gently ease us into the right direction. Obviously as I was saying, we don't know an awful lot about it and we may end up completely barking up the wrong tree and he's there to come in and say, 'Well actually have you thought about doing this a slightly different way?', which again keeps us going towards the correct answer at the end of the day.

Interviewer: How did your learning technology use in the workshop help you learn?

Respondent: I had my iPad out with me all the time. I was able to have the task up so that I could flick through that and then it's very easy to do a little bit of research in the task, you know, looking at this UV Vis. Getting up a Wikipedia article or whatever just to give us a little bit of background at the same stage, you know, while this wasn't me, Kish was able to remotely book a library room for us to go and study in which is all done obviously online from there. We knew instantly in that session whether we'd got a room or not, where we had to go, when we had to go, which was also particularly useful.

Interviewer: Was there anything anyone else was doing with learning technology in the lesson that helped you learn?

Respondent: Not that I'm aware of. I mean I was aware that Ben had got his laptop on and was obviously doing something that was assisting him though I wasn't necessarily involved with that.



**Appendix E: EdD Research Project 2013 - Participant Information Statement**

**DAVID PEDDER**  
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**University teachers and students use of learning technologies to optimise  
learning in classroom contexts**

**PARTICIPANT INFORMATION STATEMENT**

**1. What is the study about?**

You are invited to participate in the research project *EdD Research Project 2013*. The research focus is on university classroom contexts and how university teachers' and students' use of language and technology mediate learning in university classrooms. The central research question of my research project is 'How do university teachers and students use learning technologies to optimise learning in classroom contexts?'

I am particularly interested in the kinds of language that teachers and students use in technology-mediated task work phases of lessons. I am also interested in the thinking and perspectives that underpin students' and teachers' use of technology.

Your participation is part of the fieldwork phase of my doctoral studies research which will explore how university teachers and students use learning technologies in university classroom contexts to optimise the quality of teaching and learning: a study of purposes, principles, processes and perspectives.

**2. Who is carrying out the study?**

The study is conducted by Ms Denise Sweeney, Educational Designer, Academic Practice Service, University of Leicester and current Doctor of Education (EdD) candidate in the School of Education at the University of Leicester. The research will form the basis of Ms Denise Sweeney's doctoral research at the University of Leicester under the supervision of Professor David Pedder.

**3. Who can participate in the research?**

This case study will encompass, Dr Dylan Williams, Teaching Fellow, School of Chemistry and his group problem solving workshop Wednesdays, 10am – 11am during October and December 2013 enrolled in Module *CH1000 – Chemical Principles*.

**4. What does the study involve?**

The project involves three components. Firstly, you are invited to participate in a generalised 'informant style' interview for the purpose of gaining access to two communities of informants, a university teacher and his students and their particular thoughts and experiences of using learning technologies to support

learning and teaching that are non-contextualised. These interviews will help the principal investigator select the 'case' group which will participate in the learning technology-mediated peer-to-peer task work phases of observed workshops and in the contextualised in-depth post-workshop interviews.

#### Phase One

- Generalised Interviews with Dr Williams and each member of the group problem-solving workshop (Wednesdays 10am-11am) and the principal investigator. These 10 minute individual de-contextualised interviews will be conducted out of class hours, in private and audio-recorded for data analysis purposes.

#### Phase Two

- Audio-recording of naturally occurring talk on one identified group of university students during learning technology-mediated task-work phases of four classroom group problem solving workshops. The selected 'case' group will be identified from data gathered from the generalised interviews.

#### Phase Three

- Four contextualised in depth post-workshop interviews with Dr Williams and particular students from the designated 'case' group and the principal investigator. Each interview will occur as soon as feasible after the workshop and will be face-to-face individual interviews. Each interview will be audio-recorded for data analysis purposes. Each student from the 'case' group will be interviewed two times post-workshop.

### **5. Can I withdraw from the study?**

Participation in this research is entirely your choice. Whether or not you decide to participate, your decision will not disadvantage you in any way and will not affect your relationship with the department of Chemistry or the University of Leicester. Only individuals who give their informed consent will be included in the project.

### **6. Will anyone else know the results?**

The information recorded in the research study will be used only for the purpose of this project only and kept strictly confidential by the research team in accordance with the 1998 Data Protection Act. Your tutors or staff members from your academic department will not have access to your responses.

However, this research will form the basis for Denise Sweeney's Doctor of Education thesis and reports of the study may be submitted for publication, but individual participants will not be identified in such reports.

### **7. What if I require further information about the study or my involvement in it?**

Please read this Participant Information Statement and be sure you understand its contents before you consent to participate. If there is anything you do not understand, or you have questions, please contact the principal investigator at [dms38@le.ac.uk](mailto:dms38@le.ac.uk) or by telephoning 0116 252 2602.

### **8. What if I have a complaint or any concerns?**

Any person with concerns or complaints about the conduct of the research study can contact the Principal Investigator in the first instance. If you would like to pursue the matter further you can contact the School of Education's Ethics Officer, Dr Hugh Busher on [hcb5@le.ac.uk](mailto:hcb5@le.ac.uk). Information on the University of Leicester's Ethics Code of Practice is outlined here: <http://www2.le.ac.uk/institution/committees/research-ethics/code-of-practice>.

## Appendix F: EdD Research Project 2013 - Participant Research Consent Form

### Participant Research Consent Form

I agree to take part in the *EdD Research Project 2013* (Ethical Application Ref: dms34-c118) which aims to explore how university teachers and students use learning technologies to optimise learning in classroom contexts.

I have had the research project explained to me and I have read the *Participant Information Statement* about the project which I may keep for my records.

I understand that this research project will be carried out in accordance with the University of Leicester's Code of Research Ethics which can be viewed at <http://www2.le.ac.uk/institution/committees/research-ethics/code-of-practice>

Material gathered as part of this research project will be treated as confidential and securely stored in accordance with the Data Protection Act 1998.

I have read and understand the *Participant Information Statement* about the research project and agree to participate. Yes ☐ No ☐

I have been given the opportunity to ask questions about the research project and they were answered to my satisfaction. Yes ☐ No ☐

I understand that my participation is voluntary and that I am free to withdraw from the research project at any time, without giving reason. Yes ☐ No ☐

I agree to any interview or group work I am involved in being audio-recorded and my words being used for research purposes. Yes ☐ No ☐

I agree that my answers and informal comments via emails might be used for research purposes. Yes ☐ No ☐

I request that my comments are presented anonymously but give permission to connect my institutional affiliation with my comments. Yes ☐ No ☐

Name [PRINT]

Signature

Date

Tick this box if you would like to receive a summary of the results of this study (no personal results) by e-mail. ☐

E-mail: \_\_\_\_\_ Date: \_\_\_\_\_

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