Guided Learning and Technology Enhanced Learning – an evaluation of the impact upon students' learning experiences at a UK HEI

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December 2019.

(On the final bound thesis this is the month/year your thesis was submitted for examination)

This thesis is submitted in partial fulfilment of the requirements for the degree of

Doctor of Philosophy.

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This thesis results entirely from my own work and has not been offered previously for any other degree or diploma.

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Word count: 52408

Abstract

Blended Learning, Technology Enhanced Learning and technology are three key components of many HEI's approaches to teaching and learning. The language used to describe such approaches varies but is often framed in terms of enhancement, or improvement. However, the advent of the TEF (Teaching Excellence Framework) presented a potentially difficult problem for the implementers of technology. Instead of being front and centre stage in claims for enhancement, institutional TEF exercises indicate that institutions' conception of technological enhancement is limited to the capture of lectures. This does not reflect claims from the literature which can be generally summarised as technology delivers enhancement, and improvements in students' learning experiences and outcomes. Furthermore, the literature suggests that standardisation of resources within Virtual Learning Environments or removing interactions such as lectures and moving online will yield improvements in outcomes like the NSS (National Student Survey). Whilst the NSS data drives part of the TEF exercises, it is too distant from the point of technology implementation, and I argue a new approach is needed to form the evidence base to support technology implementations. Within this thesis I perform an investigation into an existing technology implementation strategy (an analogue of Blended Learning) to demonstrate how changes to approaches of technology implementation can improve the evidence-base for demonstrating improvement and enhancement: the approaches technology implementers utilise to justify success in BL (Blended Learning) implementations, examining the implications of a BL-style implementations upon students' experiences via a case study of computing students, identifying the benefits and drawbacks of technology standardisation, and examine methods to

evaluate students' priorities. The outcome of this investigation is a new framework which focuses upon iterative evidence generation to manage technological implementations – which use data to look backwards, and think forwards. The analysis and approach can be tested and adopted by practitioners who want to show a constructive alignment between their own technology implementations and to work towards support the outcomes of TEF subject-level narratives.

The data underlying the suggested framework is drawn from the School of CST (Computer Science and Technology) at the University which has difficulties with attainment, retention and poor NSS outcomes. I use a combination of iterative implementation utilising DBR (Design Based Research) and TA (Thematic Analysis) combined with supporting statistical analyses. The use of DBR is intended to allow fellow practitioners to adopt, test and adapt the framework to test implementation in their own context. The framework provides a departure from the existing blended learning computing literature which focuses upon claiming success from single point implementations or utilise control and experimental group approaches. My findings indicate that the intentions and utility of blended learning fails to algin with the requirements of students and the rhetoric does not provide sufficient pedagogic utility to academic staff, I finish by providing a framework for other practitioners to develop and test the utility of combining narrative and quantitative data. It is this framework which will provide the implementers and managers of technology a standardised approach to planning, assessing and iteratively developing technology to support learning.

Acknowledgements

I would like to thank my supervisor Dr Jan McArthur for her advice and reminders to keep going. To my now wife, who I have promised to get this thesis finished as quickly as possible. Finally, my dear friend Dr Peter Norrington for his indispensable advice – I now know what PhD stands for.

Table of Contents

List of Figures and Tables

1. Introduction

a. Setting the scene – an overview of this body of work

Before the advent of the TEF (Teaching Excellence Framework) UK HEIs could treat the NSS (National Student Survey) as an aspirational opportunity to improve rather than operating under the threat of reduced fee structures (Office for Students, 2018). This change has focused the efforts of institutions, and demonstrations of 'enhancement', 'value-added' and 'improvement' are the focus of strategic efforts. For the implementers of technology (or Learning Technologists) this presents an interesting problem. Claims of technological enhancement are difficult to justify and depend upon your relative position (Kirkwood and Price, 2014; Gordon, 2014) and for the purposes of the TEF partly upon an ability to demonstrate evidence-based impacts utilising narrative and data (primarily the NSS). Existing technology-focused responses to the NSS include standardising approaches in the VLE (Varga-Atkins, 2016) which can reflect BL (Blended Learning) approaches (Kerres and De Witt, 2003; Osguthorpe and Graham, 2003; Picciano, 2009; Graham et al., 2013), or for the TEF – utilising lecture capture (Eales-Reynolds et al., 2018; Flavin and Quintero, 2018). The general claims are that standardisation can influence NSS outcomes – via structure, and lecture capture via repetition. I disagree, as there is a great distance between technology implementation for first years and the assumed resultant outcome in the NSS and the TEF. The NSS results do not lend themselves to an exploration of the journey from induction to academic staff receiving the NSS results. I argue that this is a serious issue for technology implementers as their approaches and evidence of impact will very likely be called into question (Selwyn, 2015; Henderson et al., 2017).

The high-level question I explore in this thesis is how the implementers of technology can improve their approaches to aligning to and responding to students and I direct this towards a longer-term strategy for improving the evidence to support TEF outcomes. In developing my argument I consider five factors: the approaches the implementers of technology (the term used in the UK is Learning Technologist) utilise to justify success in BL (Blended Learning) implementations, examining the outcomes and impact of a BL style implementations upon students' experiences, identifying the benefits and drawbacks of technology standardisation approaches, and examining methods to evaluate students' priorities and how technology might influence them.

To develop my case I utilise primary data collected from first year Computing Science and Technology (CST) students' experiences of GL (Guided Learning – the University's specific implementation of Blended Learning) in an approach combining TA (Thematic Analysis, Braun and Clarke, 2006) and DBR (Design Based Research – following Ameil and Reeve's 2008) model. There are three reasons for focusing upon computing (I deal with the methodological choices in chapter 3): firstly, the University's CST students perform badly in assessment outcomes; secondly, the University's poor CST continuance levels (retention rates); and finally, these students respond with low levels of satisfaction in the NSS[1] and localised surveys. I concentrate specifically upon students, rather than the staff experience, as much of the strategic-level literature places great emphasis upon what academics must do, rather than using the students' behaviours as the starting point to support academics; finally, my position is that there is little point in using technology to

[1] The most recent NSS results for the University's Computer Science course in 2019 show an overall satisfaction of 68% - Sourced from the Unistats website - https://unistats.direct.gov.uk/Institutions/Details/10007152/CoursesByLetter/C

intervene with students when they reach the second or third year – it is vital that the effective implementation of technology occurs in the first year and sets a precedent for students' experiences. I should also indicate that these issues are not specific to CST students at the University of Bedfordshire, the issues I have advanced are sectorial (Shadbolt, 2016, Gordon, 2016, Woodfield, 2014), but with the lowering of the UCAS (University Colleges Admissions Service) entry tariff for the year group in this study they are more acutely felt.

b. Making an original contribution to knowledge

My contribution to knowledge takes on the following forms:

1) In contrast to the computing BL literature, I find that students find little utility in the approach to deliver online content and the intention to move lectures online would not align with the expectations of students. This position does not algin with the literature because I examine the problem in much more detail which reveals the impact of BL upon students' approaches and because the mechanisms in the specific area my data is drawn from (computing) utilise success criteria which are not strictly reliable or scalable approaches. I detail the reasons for this claim within chapters 2, 5 and 6.
2) Data from computing students within this study reveals that the conception that teaching is the most important driver of students' satisfaction is not Universally held by the groups in the study. The survey utilised to collect this data is an institutional standard, and reflects the questions asked in the NSS. Examples can be found in Chapter 5 section N.
3) I provide a framework to help target claims around the use of technology in the context of BL/TEL which require a stronger evidence base, and I argue for an

iterative and Design Based Research style approach (see Chapter 6 sections c through e). This is not something found in the literature. This is a technology specific extension of Ameil and Reeves's (2008) model of DBR. The DBR model applies as a more general approach to investigating a domain, my suggested approach is highly specific to technology implementations and evidencing. This can be seen in Chapter 6 – sections d to f.

4) I explore the question posed by Henderson et al. (2017, p.1568) and explain first year computing students' approaches to digital practice (See Chapter 5 sections k and l – along with Chapter 6 – sections b and c):

> *"More attention therefore needs to be paid towards the reasons why students engage with specific forms of digital technologies during their studies. This raises questions about the roles that these technologies are playing in student learning, the meanings that are being attached to different digital practices, and the outcomes and consequences of any use."*

The rationale for my claims are fourfold.

Firstly, there is comparatively little literature surrounding the use of BL in computing. Often the approaches favour the movement of content online, and the complete replacement of lectures. The students in this study would be highly resistive to such a move as they seemed quite consistent in their approach to describing the importance of the lecture sessions.

Secondly, in some cases separate tools are used to provide support and teaching (see chapter 2 – section H) and students experience which provide a finite amount activity which students can learn and become familiar with. Students' learning in these circumstances are limited to a very small and finite set of skills, rather than producing students who exhibit versatile skills. This feeds into the evaluation mechanisms in the literature for computing students. Though approaches are valid for local implementations, they do not take into account institutional or student priorities and so it becomes very difficult to make claims about success wider than a narrow implementation. Evaluative techniques for BL tend towards single point measurements of success or control experiments, and very few utilise qualitative data to conduct detailed analyses of students' experiences.

Thirdly, at a more general level beyond computing the literature does not deal with BL or TEL as it relates to the TEF (Office for Students, 2018)[2], the very limited exceptions being very brief mentions of lecture capture as a method of enhancing learning (Eales-Reynolds et al., 2018; Flavin and Quintero, 2018).

Finally, this research is useful for managers in other institutions who want to explore complementary forms of analysis for technology implementations and working towards evidence for a TEF subject-level submission that demonstrates a clear implementation and impact of technology, or for fellow implementers of technology to better evidence their interventions.

In summary, it is the last of my points that is important from the view of what must be understood or realised in educational circles. In my opinion managers often look to the staff to ask 'what should be done about this NSS score' or 'what should be done

[2] The OfS (Office for Students) is the policy setting and evaluative authority for the TEF

about students' feedback' rather than joining this with a review of students' behaviour and approaches to students' use of technology. Higher education is about learning to think, analyse and engage, but I am concerned that the implementers of technology have lost this objectivity and instead concentrate on outcomes rather than on a harmony of learning, long-term strategies and students' learning development.

c. The University's approach to BL – Guided Learning (GL)

The University of Bedfordshire's implementation of BL is called GL (Guided Learning) and is intended to improve students' learning experiences. GL is also an attempt to standardise VLE-based technology practice at the University. The University also uses the term TEL (Technology Enhanced Learning) to indicate that technology is being utilised in a way which enhances learning. The specifics of GL are explained in section H in this chapter. There is a synergy between BL and GL, and I explain this in more detail in Chapter 2 section L – where I draw a distinction between the two concepts. In this section I provide a brief overview of the University's intentions which will help explain the research questions in the next section.

University management-level assumptions are that both GL and TEL are effective techniques for promoting improvements of students' performance and outcomes, specifically: in student retention, assessment outcomes and increased satisfaction in student-focused surveys at a local level, and eventually in the National Student Survey (NSS). Delivering GL has become standard practice, but only a minority of units (approximately 5%) deliver GL as the University mandates. This means either: academic colleagues are not using GL because it is not fit for purpose, or that GL

may not deliver what it promises and so staff comply with the spirit of institutional guidance.

In my current position as the University's Head of Digital Learning Systems I will be making significant changes to the University's VLE in the form of a move to BlackBoard Ultra. My longer-term intentions are to use the data, conclusions, and recommendations from this thesis to inform a strategic review of University's strategy for technology use (GL and TEL). I also intend it to provide a way for the development of University's VLE to align with the strategic intention of improving TEF outcomes, and this also reflects a still forming area for sector-wide technology I want provide fellow practitioners a way of addressing the gap between their practice and the development of the TEF outcomes.

d. Research questions

I use the term GL within this section and the thesis more generally as I am comparing and contrasting the approach with BL for which there is literature. This is reflected in my research questions, where the first two are designed to explore and evaluate the first year CST students' experiences of GL, TEL, and the remaining question provides this body of work with an enhanced external significance by delivering a framework for other practitioners to test and extend (this is an outcome of a DBR approach -Amiel and Reeves, 2008). I test the University's assumptions that GL and TEL can complement and enhance computing students' experiences in four ways: firstly, by implementing GL according to the University's rules; secondly, by capturing and analysing students' interactions with GL and TEL; thirdly, by exploring the experiences of first year students as they prepare for their

assessments and to determine the role GL plays; finally, by contrasting my qualitative analysis with data from department-level surveys to examine the difference between the use of GL and the drivers of students' satisfaction. I reflect upon these issues by comparing the outcomes of GL to BL as the two approaches are conceptually aligned.

RQ1 – In what ways does Guided Learning (GL) and Technology Enhanced Learning (TEL) practice impact the first-year computing students' learning experience?

I explore this question by implementing GL according to the University's rules, and evaluate the impact before and after implementation, and then with a second group of students to compare the results between the first and second groups.

RQ2 – What are the benefits and drawbacks of adopting the GL model?

This question is intended to allow an evaluation of the existing GL model the University uses, and to reflect upon the approaches utilised by BL practitioners.

RQ3 – What changes to existing policy and practice around GL and TEL would provide a suitable evidence base for the ongoing development of TEF outcomes?

This question provides a new perspective for the implementers of technology. I present a data-focused approach to focus technology-implementers considerations for their implementations of technology as a three-year cycle. The intention is to focus efforts upon working towards a TEF subject-level

submission, by generating evidence to demonstrate alignment and response to both the students and institutions' priorities.

e. Study organisation

Within this body of work, I utilise an approach called DBR – Design Based Research (Collins et al., 2004; Wang and Hannafin, 2005; Amiel and Reeves, 2008; Anderson and Shattuck, 2012) which provides an overarching structure to this thesis. I explain the DBR approach in more detail in the section Introduction Design-Based Research. This work is broken into five phases: analysis, solution development, testing, refining and finally, reflection (Ameil and Reeves, 2008). This manifests as a split methodology where I first explore the problems GL presents, devise a method to evaluate GL and then put this into practice. In doing so I attempt to address the imbalance highlighted by Oliver and Trigwell (2006) where practitioners are highlighted as lacking a theoretical basis for blended learning implementations. I show that there is space for experimentation, consideration and development, but that this needs to be tempered with some realism about both the students and the data from students we attempt to interpret.

The primary source of data I utilise in this study is semi-structured interviews which are analysed using Thematic Analysis (TA), an approach described by Braun and Clarke (2006) and Vasmordia et al. (2013). Data was collected from a total of 24 students where I implemented GL as per the University's policy and guidance, and from 8 students with no changes made to materials. I also discuss data the University collects to evaluate a department's student satisfaction in the form of a Spearman's rank-order correlation analysis (Gautheir, 2001; Hauke and Kossowski, 2011), and Cronbach's Alpha analysis (Cho and Kim, 2014; Taber, 2018).

Additionally, I refer to data collected as part of the NSS for the University, which is publicly available via the Unistats website.

f. What is outside the scope of this study?

There are two areas beyond the scope of this study: firstly, this body of work does not concern itself with the act of learning to program, nor does it perform a deep analysis of staff experiences of GL. There are three reasons for this approach. The process of programming has been covered within the literature to some extent, and as a programmer myself I consider that I would introduce a profound bias into the approach of any existing pedagogy; secondly, this is not an evaluation of blended learning as the University has implemented its own unique scheme (i.e. GL). I acknowledge there are many other terms that might pass as GL, for example: flipped classrooms, e-learning, online-learning. I address this problem in the literature review. However, the basis for GL was blended learning and so my investigation has to anchor itself to the origins of GL to ensure a reliable comparison; finally, my position is that there is much administrative influence over what staff could and should do – rather than concentrating on making students more responsible for their own learning and skill development.

g. Key terminology and definitions

In the following sections I introduce the key terminology which is used throughout the rest of this thesis.

h. University policy - What is Guided Learning?

In this section I explain the practicalities of GL, beginning with a definition and then the requirements of GL.

For the purposes of this study, I have utilised the definition which was made available to staff at the time leading up to and after the data collection for this body of work.

> *"Guided Learning refers to learning activities which prepare for and support Scheduled Learning [timetabled] sessions. It should be clearly defined ('Guided') and time-constrained and – if the material is preparatory – it should be clear to students that it is an expectation that students will complete their Guided Learning tasks in time for the Scheduled session.* ***It is important to note that simply uploading PowerPoint slides before a session would not be adequate as Guided Learning."*** (my emphasis)
>
> (CLE, 2014)

Efforts to introduce GL came from an institutional perception that students spent too much time in lectures, and that such activities are didactic and have little emphasis upon students' skill development. Content delivered in the VLE was perceived as involving 'knowledge transmission' and the strategic view was that didactic learning activities be delivered online. Once this transformation was complete, more time could be spent encouraging the development of socio-constructive approaches to learning – thus enhancing students' experiences. Lecturers are expected to prepare, create and evaluate online materials as part of their preparation time. The amount of time that students spend working with GL is specified in Unit Information Forms (UIFs), and so staff must specify how much independent or guided study students should undertake. It is important to note this is different from scheduled time spent with students in lectures and seminars.

The uniqueness for GL is in the method of delivery – which is presented to staff in the following way:

> *When you establish and maintain a model of providing Guided Learning in structured packages, providing students with access to content before their session and then using the face-to-face session for learning activities leading into active, dialogic face-to-face sessions, students learn the importance of coming to classes prepared to use information, ideas and ask searching questions*.
>
> (UoB LearnTech Blog, 2015)

The delivery mechanism intends that students should be provided with material before taught sessions – this is something most academic staff can relate to, but the difficulty is with 'structured packages' of content. To be compliant with the requirements of GL a content organisation tool in BREO called a learning module (known as a 'book' in Moodle) must be used and specific items must be delivered:

1. *instruction on how to go about the task,*
2. *the associated time requirements,*
3. *content in a variety of formats to maintain interest, enthusiasm and meet the needs of our diverse student body and*
4. *sequential activity which consolidates the learning through, for example, a discussion or blog post or a quick quiz or lead into an assignment.*

(UoB LearnTech Blog, 2015)

Immediately after the above list, another list is presented which appears to repeat the initial listing, but adds slightly more detail:

1. *Introduction about the task including rationale, alignment with learning outcome, relevance to assessment, information about time to be spent.*
2. *Introductory learning content, in the form of your own writing on the page, images, quotations (properly referenced), etc.*
3. *Further learning content on subsequent pages, with embedded audio or video or other Open Educational Resources (OERs).*
4. *Link to activity, such as a discussion, a personal journal for reflection, a wiki, a quiz or survey, etc.*
5. *Closing content, springboarding the outcome of that activity into the next part of the unit.*

(UoB LearnTech Blog, 2015)

Note here that there are no evaluation mechanisms, standards or pedagogical rationale discussed – it is left to the lecturers to decide what is appropriate provided they follow the outline. I return to this problem in the literature review.

i. Defining blended learning

GL and blended learning (BL) share some common ground – further details are in Chapter 2 section L. In this section I explain the definition of BL I use in this thesis, how it compares to GL and finally, a brief overview of how I arrived at the definition. In the literature review I have to rely on BL as a closest analogue I can find for GL.

The definition of BL that I adopt is: a process of delivering teaching activities which are before or after class times; the replacement of time spent in the classroom with a more 'efficient' delivery mechanism. Conceptually, GL and BL are linked by a shared desire to move activities to the online environment.

GL differs from BL in five ways: firstly, the mechanism of delivery; secondly, the need to ensure assessment is considered; thirdly, that BL is an augmented support mechanism that both prepares and supports students before or after class; fourthly, that it does not count as teaching time; finally, that BL also contains links and elements of TEL.

In arriving at my definition of BL, I relied upon three authors cited when discussing BL:

Kerres and De Witt (2003, p. 101):

> …traditional education can be enriched with the use of technology and learning with technology can profit from [face-to-face] meetings.

Osguthorpe and Graham (2003, p. 228)

> *…the aim of those using blended learning approaches is to find a harmonious balance between online access to knowledge and face-to-face human interaction.*

Garrison and Hanuka (2004) suggest blended learning is a continuum – on one end technology enhances learning, and at the other interactions are totally online; the middle ground is BL.

The commonalities between the three sets of authors are threefold: firstly, the claim that blended learning has the potential to transform students' learning experiences; secondly, the use of technology which enables delivery online delivery which replaces and supports classroom activities; finally, that students should be able to experience content in a range of delivery styles through different media types.

An overview of the difficulties associated with BL

The difficulty with these approaches is that they do not lead to a standardised approach or understanding, but rather a loose collection of practices (Oliver and Trigwell, 2006). Blended learning, as Oliver and Trigwell suggest, is practitioner led as opposed to deriving from some form of learning theory. Later definitions and models of blended learning do little to resolve the practitioner-theory dilemma presented by Oliver and Trigwell, rather they follow on from Garrison and Hanuka's original model, but with one important addition: the use of VLEs. For example, Picciano's (2009) model utilises four dimensions: face-to-face verses fully online and minimal technology/media verses technology/media infused. Graham et al.'s (2013, p. 5) model utilises a single dimension presented as a linear scale with delivery falling into one of three regions: "Technology Enhanced" or "Mostly Online" with blended learning sitting in the middle of these termini.

In summary the definition of BL has three segments: firstly, blended learning is a mix of in-person and online activity; secondly, time for face-to-face interaction is replaced with some form of online interaction; finally, that there is the inclusion of some mechanism for delivery – in this case the VLE.

j. Introducing Design-Based Research

In this section I provide a definition of Design Based Research (DBR), explain how I arrived at this definition, and finally, explain the process and rationale for the use of DBR in this thesis.

I draw my definition of DBR from the four sets of authors in the paragraphs following this: firstly, a DBR research effort is iterative; secondly, there should be a degree of collaboration between practitioners and researchers; thirdly, a thick description of the

context is vital; fourthly, the research results in the partial or full development of theories which can be tested iteratively and developed by the current researcher or others; finally, DBR does not align with a particular epistemological or ontological position – and I provide details of my approach in the methodology section.

In arriving at my definition of DBR, I make reference to the following authors.

Collins et al. (2004, p. 16) who define DBR as:

- The need to address theoretical questions about the nature of learning in context
- The need for approaches to the study of learning phenomena in the real world
- The need to go beyond narrow measures of learning
- The need to derive research findings from formative evaluation.

Wang and Hannafin (2005, p. 6) describe DBR as:

> … a systematic but flexible methodology aimed to improve education practices through iterative analysis, design, development and implementation, based on collaboration among researchers and practitioners in real-world settings which leads to contextually-sensitive design principles and theories.

Anderson and Shattuck (2012, p. 16) offer a summary from their systematic review of DBR literature[3]:

> … a methodology designed by and for educators that seeks to increase the impact, transfer, and translation of education research into improved practice.

[3] The use of the term 'methodology' is not meant to imply a particular epistemological or ontological approach but rather is used as a structuring framework

> In addition, it stresses the need for theory building and the development of design principles that guide, inform, and improve both practice and research.

Barab and Squire (2004, p. 2) frame a DBR approach as:

> the need to improve and generate evidence-based claims about learning.

Why is DBR important to this thesis?

The origins of DBR can be traced to Brown's (1992) and Collins's (1992)[4] initial efforts to improve the quality of educational research. Classical approaches to research often involved single interventions which focused upon a small number of variables (often one or two) which researchers sought to tightly control and evaluate. As I reveal in the literature review there is emphasis upon proving the value of BL and TEL approaches. The approach implies that complex phenomena such as learning and human behaviour are easily reducible and can be reduced to a theory (Kelly, 2004; Ameil and Reeves, 2008). However, from a purely positivistic (or deterministic) viewpoint – no two groups of students are the same, and once an intervention is made it inherently changes a group of students – making the standard of proof impossible by positivistic standards. This presents a Wheeler-esque[5] paradox for the implementers of technology, as it difficult to systematically demonstrate impact because researchers have already worked with a student group and they cannot be certain of the effect of an intervention upon another group or the same group (Kirkwood and Price, 2014). In the complex domain of human behaviour and educational practice a compromise is needed, and this is what DBR represents.

[4] In this original literature both authors use the term "design experiments", but this terminology evolved with later work and researchers, and researchers eventually settled on the term Design Based Research.

[5] I refer to the thought experiment of the physicist Wheeler who suggested that particles act differently when under observation. Repeated observation of the same students presents a similar issue.

It assumes that practice and understanding improve with iteration (Ameil and Reeves, 2008). Emphasis in this thesis is upon mechanisms to develop an ongoing body of evidence, which might lead to specific theories of implementation (McKenny and Reeves, 2013).

Structurally, the DBR approach in this thesis utilises the following pattern: (Ameil and Reeves, 2008):

Analysis of practical problems (Chapters 2 and 4)

Development of solutions (Chapter 4)

Iterative cycles of testing (Chapter 4 and 5)

Reflection to produce design principles (Chapter 5)

Iteration to the analysis phase (Chapter 4 and 5)

k. Introducing thematic analysis

The use of DBR in this work provides an overarching framework for conducting the progress of this thesis, but DBR has no standard data collection method. For this reason I utilise a technique called Thematic Analysis (TA) to analyse the data collected from student interviews. There are many different approaches to TA, and there is no generally agreed standard, but I follow Braun and Clarke's (2006) combined with Guest et al.'s (2012).[6] This allows me to draw on secondary data sources.

[6] Guest et al.'s (2012) approach is called Applied Thematic Analysis, but it shares many commonalities with Thematic Analysis, though with a specific emphasis upon obtaining secondary supporting data.

Following Braun and Clarke's paper I use an inductive approach to generating themes, where the data dictates what themes I found. This was a deliberate effort on my part to ensure the students' responses drove the emerging themes rather than my trying to enforce a structure driven by the literature. This has the advantage of allowing me to compare the differences between the experience of students and the assumptions inherent to GL, BL and TEL. The themes I identify are built into a structure which reflects the data collection, and the different aspects of students' experiences as they progressed through their first-year learning and assessment experiences.

Guest et al. and Braun and Clarke indicate there is a great deal of flexibility in range of epistemological and ontological perspectives for TA approaches. I have taken advantage of this in two ways: firstly, I utilise Braun and Clarke's definition of an interpretive approach to analysis where I provide both a rich description and an ongoing analysis of the data I collect. Additionally, I utilise category D of Guest et al.'s approach where I utilise quantitative data to provide a statistical analysis of my participant groups' experiences – specifically: Spearman's Ranking Coefficient and Cronbach Alpha testing.

I. Technology Enhanced Learning

The concept of TEL is not concisely defined, but rather it is a collection of connected concepts that might involve anything from the provision of wifi to a VLE (Gordon, 2014). I have elected to address the three different pillars of TEL – Technology, Enhancement and Learning as individual components to indicate the definitions I utilise in this work.

Technology – The VLE as the focus

The sets of UCISA[7] surveys (a survey exploring the use of Learning Technology) which ran during 2008 through to 2012 give a definition of technology as being an

> …online facility or system that directly supports learning and teaching.

Henderson et al. (2015) consider VLEs and their related components (e.g. portfolio tools, similarity checking services) as part of the routine of current university life and I acknowledge that VLEs act as a container supporting other functions vital to students' learning experiences (Bayne, 2015)

For the purposes of this thesis, I define technology as an aspect of the students' experience that stems from the VLE. For the University the VLE takes the form of a customised version of Blackboard Learn 9.1.

Enhancing, enhanced and enhancement

Enhancement presents a conceptual and definitional problem in technology research, and the conceptions differ greatly depending upon your position within an organisation. To start I present a dictionary definition for clarity:

> *to improve the quality, amount, or strength of something*
>
> (Cambridge University Press, 2019)

Owing to the difficulties I am going to outline in the following section I adopt the position that enhancement derives firstly from enabling learning or teaching, from which evidential claims can be constructed to justify enhancement.

[7] "the member-led professional body for digital practitioners within education" https://www.ucisa.ac.uk/about

In the context of the use of technology, a consistent definition of enhancement is not easily accessible from the literature. For example, Price and Kirkwood's (2014) survey the definitions and conceptions of enhancement, but the authors find that the concept of enhancement requires specific categorisation. Oliver and Trigwell (2006) had previously addressed the notion that practitioners have led implementations rather than a coalescence around theory. This explains the variances Price and Kirkwood have found, and specific issues of non-pedagogical driven 'enhancement'. For example, Walker et al. (2016) discuss the findings from the UCISA survey, a key and consistent focus (from 2003 to 2016) is on TEL being used to enhance teaching. The examples Walker et al. highlight include Newland and Martin (2016) who explore enhancement through the use of 'EMA' (Electronic Management of Assessments). The justification is not necessarily strong (p. 5): *"Academic staff have positive attitudes to eMarking (74%) and eFeedback (86%) when taking Positive and* ***Neutral*** *responses together".* There are two problems with this approach: firstly, the use of neutral responses does not provide a confident evidence base to suggest teaching staff find utility in the EMA approach; secondly, enhancement in this context is focused upon a managerial or standard-levying role. 'EMA' (the University uses the same term) is quite simply put: submitting assignments online. In one sense it does make little sense to store vast quantities of paper and then to pass these artefacts around to external and internal examiners. A different perspective is that EMA allows for the quantisation, cataloguing, standardisation and the management of the assessment process by administrators, and the implementation is not necessarily pedagogically driven. There is still the claim of enhancement where Bayne (2015) suggests that 'enhanced' means the likes of 'good' or 'improved' – which are highly subjective measures. In this sense Bayne is asking the question – good or improved

compared to what? This is the challenge the TEF brings for enhancement: approaches using technology must demonstrate value is being added to students' outcomes and experiences. It stands to reason that enhancement is something an institution would want to define very closely, replicate and develop.

Learning

In exploring the last part of the TEL acronym – learning – I concentrate on defining how the learning aspect of TEL is enacted. Depending upon the perspective (student, lecturer, administrator or manager), learning can be conceived as measurable in different ways. For example, through an exploration of the assessment grades or evaluations or the quality of the assessments produced.

I am operating in the context of exploring students' learning experiences. I am attempting to measure the ways in which GL upon students' learning experiences, how students use resources, and their rationales for resource use.

However, it is not sensible to directly ascribe the influence of the technology I implement to be the only factor which impacts learning. Clarke's (1994) paper *"Media will never influence learning"* discussed this issue. Clarke's position is that the use of media and instructional methods (I interpret this as teaching approaches that impact learning) require different considerations, and that the case for improvement comes not merely from the implementation of media, but is a result of the delivery mechanism. Furthermore (p. 27) Clark states:

> …my claim is that media research is a triumph of enthusiasm over substantive examination of structural processes in learning an instruction.

Structure, according to Clarke, is the prominent feature of learning: in what way do technology and enhancement impact learning. I return to this issue in my conclusion.

Separating out the action and resources within the VLE, there may be other instances where learning might take place in other environments; for example Henderson et al. (2017, p. 1576) describe students' learning processes as:

> Watching and re-watching video lectures, and preferring to look at diagrams, animations and images as opposed to engaging with the written or spoken word are perhaps not particularly advanced forms of digitally enhanced learning.

Henderson et al. are referring in rather general terms to the plethora of resources available from the internet. Note the synergies with blended learning: the use of multiple media types and approach which provides a superficial approach to learning. There is some evidence to suggest that students also look to other areas such as YouTube[8] to explore curriculum-supporting content, but the scope of the study prevents a detailed review of students' approaches. In terms of wider significance for this study Henderson et al. (2017, p. 1568) raise a very pertinent point about technology and learning:

> More attention therefore needs to be paid towards the reasons why students engage with specific forms of digital technologies during their studies. This raises questions about the roles that these technologies are playing in student learning, the meanings that are being attached to different digital practices, and the outcomes and consequences of any use.

[8] This is a particular approach used by students in this study.

In summary, for the purposes of this work I concentrate my efforts upon Henderson et al.'s point, as it is unclear how students engage with GL and TEL, what their motivations are, and how they use such tools for learning.

m. The University and wider strategic context for enhancement

In this section I explain the issues surrounding the TEF which is an area of focus of my own institution and the wider sector. Within this explanation I also address: the nature of the TEF and why it is important, an overview of the stages leading to the TEF's implementation, and the data sources which inform the TEF that are relevant to research question 3 in this thesis. The TEF and its data-providing companion the NSS influence UK HE institutions' (HEIs) strategic efforts.

The TEF is being implemented as a UK-wide strategy with the intention of improving students' understanding of HE institutions' profiles and to enable the comparison of 'quality' of different HEIs. The most recent TEF (Office for Students, 2018, p. 6) documentation indicates the TEF has four intended outcomes:

- Better inform students' choices about what and where to study
- Raise esteem for teaching
- Recognise and reward better teaching
- Better meet the needs of employers, business, industry and professions.

Originally, the TEF was intended to operate at an institution-level with a single submission encompassing the four elements above. Institutions could gain one of three award levels – bronze, silver or gold. It was possible for institutions to argue their way from one level to another (e.g. bronze to silver). Awards are based on performance over three years, with the production of an accompanying narrative – with a classification being based upon comparison to the sector, and year on year.

Poor performance in the NSS categories or the other elements I have identified may prevent the award of a silver or gold, but this can be influenced by the narrative an institution must provide. An initial analysis provides a flag which relies upon z-scores which provide an indication of how far an institution's outcome is from the norm. This data is provided at a general level and for specific categories of student demographic (gender, ethnicity and deprivation are three examples). The z-score approach is a cause of much critique (WonkHE, 2017; Royal Society for Statistics, 2019), as it tends to push the benchmark values higher, making it difficult for an institution to make significant improvements.

After an initial institution-level effort, TEF analyses are taking place at a subject level. Subjects, relevant to this thesis, are grouped by a marker called CAH2 – this allows for high-level aggregation of similar subjects, e.g. computer science, computer science and AI, software engineering. It is this subject level which I focus upon. It is likely that future TEF developments will utilise a view at subject level, which feed into an institution-level review. Subject groups are reasonably similar to how university departments are organised.

n. What is driving the TEF's implementation?

The UK government wanted to increase competition between providers, with the intention of improving students' choice in the UK HEI market (Department for Business, Innovation and Skills, 2016). A key driver for change is the Office for National Statistics (OFS, 2018) report which forecasted only 30% of full-time undergraduates would fully repay their loans. There is a range of reasons why this could be the case, but the ONS indicates one problem of the current student loan system is that it:

> Does not recognise expected losses at inception and shifts the associated government expenditure decades into the future. (OFS, 2018, p. 4)

There is a government need to predict how likely a student is to pay a loan back. A highly employable graduate presents a greater likelihood a student will earn over the repayment threshold. Universities that do not produce highly skilled and employable graduates are liable to suffer. Hence there is pressure to ensure that students are earning beyond the threshold limit to make repayments once they enter employment. HEIs that fail to demonstrate good TEF outcomes could find their funding is capped below £9,250 (the standard fee in 2019). TEF outcomes are judged upon data from a three-year cycle and compare institutions to outcomes from the wider HEI sector.

o. Data which forms the subject-level TEF and areas of interest

The NSS has an important role for the University, with the institutional strategy setting a target of being in the NSS's top quartile indicators for:

> *"teaching quality, academic support, assessment and feedback, overall satisfaction)"*
>
> (University institutional strategy, 2017, p. 3).

Since 2005 (HE Academy, 2012), the NSS has provided data about final year university students' learning experiences. University managers, policy makers and prospective students can review and compare institutions based on their NSS results. The survey consists of a series quantitative questions, with a limited number of qualitative questions. HEFCE had been responsible for monitoring the retention rate of students in UK HEIs (HEFCE, 2013), but this work has now been taken over by the Office for Students. Selected parts of NSS and HEFCE data have been

subsumed into a new framework called TEF (Office for Students, 2018) which also includes data relating to students' highly skilled employment upon leaving university.

Table 1 contains details of the last five years of NSS scores for Computer Science as an example of the difficulties faced by the University's CST department.

Year	Overall Satisfaction / %
2015	69
2016	83
2017	80
2018	58
2019	68

Table 1– Overall satisfaction levels for Computer Science students at the University of Bedfordshire

The exact arrangements for the TEF at a subject level are still subject to improvement and final confirmation, but they adopt the same metrics as the higher provider level. Subject-level TEF utilises the same awarding structure (bronze, silver and gold). The intention is that the different subject-level analysis will be combined to form an overall evaluation of an institution. This means that individual subjects have the potential to directly affect the institution's overall award. A key part of this award, or an appeal against an award, is the presentation of a narrative report which references data collected through: the NSS, local interventions and details, highly skilled employment surveys and retention. Three NSS elements are considered: teaching on the course, assessment and feedback, academic support. Continuation data (retention) is collected and concerns the movement of students from one academic year to the next. The subject-level TEF considers outcomes over two years (Office for Students, 2018) meaning that performance must be sustained.

Why are all these sources of data relevant to a thesis about GL and TEL? There are four reasons: firstly, the assumption that the GL (or a variant of blended learning) impacts students' experiences in a way which would enhance them – if we consider that the implementation of technology is a causal factor in increasing students' satisfaction we should be able to identify it; secondly, the problem of evidencing outcomes of technology implementations which may influence the NSS or TEF; thirdly, if the first two assumptions are correct then a consistent approach to implementation is vital; finally, exploring how we might harness technology to help deliver improvements in students' experiences.

p. Introduction summary

In this chapter I have discussed the differing aspects of the study and I have laid out the key definitions which are part of this thesis. I have given examples of the strategy of the University in the form of GL and of TEL. The other key parts of this chapter which relate to my overall argument around the use of technology concern the TEF and the NSS. I view these elements as an eventual trajectory of students who I include in this study, in the sense that I wish to provide students with an effective starting point. This problem is made more pressing because the TEF addresses more than just students' satisfaction.

2. Literature review

a. Chapter introduction

Within the literature review I concentrate on eleven areas, ranging from the strategic considerations of blended learning, through to the practical aspects of delivery in the area of computing. My intention with this structure is to begin at a macro and move towards the complexities of BL use in computing. I identify a strategic disconnect between the intentions of BL and the method of implementation, specifically in computing. The evidence base utilised by practitioners is presented as effective, but the methodologies employed are fixed towards control experiments, which do not reveal a deeper understanding of the domain studied.

The literature review supports my research questions in the following way. For RQ1 I begin with a high-level exploration of the intentions of BL (as a comparator to GL/TEL), I then use this to demonstrate how practitioners evaluate BL. I draw in arguments around TEL and explore the approaches of practitioners in implementing technology. To support the exploration of the BL computing literature I examine the literature surrounding students' satisfaction which is a key to improving TEF outcomes in the longer term. In exploring the approaches of practitioners, I draw upon the literature to determine the benefits and drawbacks which assists with the analysis of RQ2. It is my final research question (RQ3) which holds the significance for this thesis in and beyond the University. RQ3 concerns itself with a relative untouched area of the literature, and so to support my later framework and claims I include sections on CBL (Computer Based Learning), literature conceptions of GL and I discuss the problem with the concept of 'enhancement'. I use the evidence from RQs 1 and 2 to help me use the literature to argue a case for improving the

evaluation mechanisms used for implementations such as GL within the University. I use the review to support the development of RQ3 in the conclusion section of this work, because there is very little literature linking technology and the TEF.

Within the review I uncover six key issues: firstly, that the strategies for implementing BL are tied to the 'enhancement' of students' experiences, increases in efficiency and with the aim of replacing lectures with online interactions – but that the methods to assess 'enhancement' suffer from validity and reliability issues; secondly, there is a lack of qualitative literature covering BL approaches in computing; thirdly, approaches to BL implementation amalgamate both BL and wider curriculum changes, making it difficult to identify specific impact; fourthly, that computing literature does not address the challenges posed by the NSS, technology and the TEF; finally, that there is a lack of literature which qualitatively explores HEI students' experiences of BL approaches in computing.

b. Strategic considerations around blended learning

In this section I explore the strategic considerations that result from BL approaches. The amount of academic papers which directly address the strategic implementation of blended learning is limited, but this could be because the discourse is limited to the production of literature directed at practical concerns amongst practitioners and developers (Oliver and Trigwell, 2006; Drysdale et al., 2013).

The strategy of BL implementation depends upon the university involved, and one such way to visualise this are two extremes – teaching intensive or research intensive (White, 2007) – with control being centrally focused or devolved to faculties. A teaching led environment may have centrally generated requirements and initiatives which attempt to standardise practice, and achieve institutional

homogeneity (this is the case at the University). BL practitioners concentrate upon potential outcomes from standard practice. For example, Garrison and Kanuka (2004) categorise blended learning as: a mechanism to provide a more in-depth learning experience, improving the quality of learning experiences and the opportunities for students to engage in communities of enquiry or practice. In a similar fashion, Osguthorpe and Graham's (2003, p. 231) work suggests six ways in which blended learning could be developed to support an organisation: pedagogical richness, access to knowledge, social interaction, the development of personal agency, cost effectiveness and ease of revision or maintenance. The difficulty is, they represent themes which are attractive to managers or administrators within organisations (Porter et al., 2014; Graham et al., 2013), but may not be pedagogically viable (Lisewski, 2004) – this is a theme I will return to in the discussion and conclusion. This has not stopped later claims in the literature, for example "increased interaction" and "improved learning effectiveness" (Niemiec and Otte, 2010, p. 23). Porter et al. (2016) realise interaction and effectiveness as: students spending less time physically attending the institution, and expectations of improved student learning outcomes and an increase in students' satisfaction with their studies.

Garrison and Vaughan (2013, p. 27) quantify the change:

> *Blended learning courses combine the best features of classroom-based teaching and learning with the best features of online learning in order to enhance the education experience and give students added scheduling flexibility. A key feature of blended delivery courses is the reduction in scheduled classroom or lab time usually by 25 to 50%.*

The argument reads more along economic lines and presents a very risky proposition for the computing students within this study as they already exhibit poor attainment and attendance (I discuss this in the methodology section). Principally, the difficulty of a movement online, presents a problem of equivalence (Taylor and Newton, 2013). How can the experiences of online and in-person students be equal in outcome and experience? This is especially the case when we consider that the speed at which students would integrate into a physical learning environment, where they have easily accessible peers and questions may be answered faster. Learning faster is not really the answer, but learning about learning is likely a better link to success (Draffin and Rainger, 2006; Broadbent, 2017). Something more than a non-academic focused transition to 'being online' is essential to the development of students' outcomes and institutional success.

There are three issues I have identified within the opening section of the literature review: firstly, that the drivers for the implementation of BL tend to derive from economic and managerial needs rather than from purely pedagogical elements; secondly, that there is an equivalence problem for those students who are studying in a blended format; finally, I indicate that these two problems do not consider the experience of students, but rather drive students' experiences.

c. The impact of Bended Learning upon academics and pedagogy

Having considered the strategic intentions of BL, I turn to examine the impact upon pedagogy and the impact upon academic staff. Though I focus upon the student experience, I use this section to acknowledge the impact of the top-down approach to BL implementation has upon academic staff and in consequence, pedagogy. I

begin this section with a quote from Torrisi-Steele and Drew (2013, p. 379) who suggest:

> Blended learning increasingly brings the role of education designer to the skill set of academics.

I will return to this quote in the conclusion, but I intend it to set the tone for this section. I argue that it sets a precedent for the expectations of academic staff involved in BL, and for the pedagogy which results from it. Selwyn (2015) is critical of the type linguistic turn delivered by Torrisi-Steel and Drew, in the sense that the invention and invocation of technologically related term is a source of improvement. This presents as doing to, rather than acting in concert with academic staff is often who is to undertake the work of building blended learning. For example, Niemiec and Otte (2010, pp. 95–96) suggest there are five potential advantages for academics who adopt blended learning – I include some counterpoints to each: increased access to instruction for students (but it not clear who writes the materials), increased enrolments (which implies an increased geographical catchment), improved time to degree (compared to part-time study), enhanced teaching and learning (students do not have any standard to judge by, and so it is an administrative evaluation), and improved retention (observing and determining what students are doing online). In support, Garrison and Vaughan (2013) introduce five metrics for analysis, all of which are related to their institution's equivalent of the NSS, but the first three are considered in the context of evaluating blended learning approaches (p. 27):

> "…active and collaborative learning, student interactions with faculty members, level of academic challenge, enriching educational experiences and supportive campus environment."

Niemiec and Otte's design suggests that classroom time should be used for discussion and Garrison and Vaughan express the replacement of lectures as an opportunity to promote active and collaborative learning in class. The assumption is that active and collaborative learning derives significantly from the use of technology, and equally, the 'enrichment' aspect. These approaches are presented as being 'innovative', but the innovation is being directed from higher management (Carbonell et al., 2013; Porter et al., 2014; Reed, 2014). From a pedagogical perspective, there are three general factors at play in this situation (Benson et al., 2011; Poon, 2013; McGill, 2014; Scott, 2014): firstly, that there is a need for human resources to be available to complete a transition to a blended learning approach; secondly, that there is need for suitable information technology resources to be available; thirdly, that there is some acknowledgement that the change will require constant development, evaluation and improvement. Consider my earlier citation of Garrison and Vaughan where they suggested a 25–50% reduction in class time. Who pays for the change, and who pays for the time it takes to be implemented? This is not something that can be easily answered as it relies upon knowing the context of the development and it assumes that there is a regular and simple path from conception of blended learning to implementation. This creates a situation which I described earlier via the citation of Porter et al.'s (2016) work – academic staff would not see the benefit of the change and they would be at the mercy of it. The learning experience might in these circumstances be influenced by market forces, and this means we focus on specific modes of learning to attract more distant students.

It is unclear from the literature and papers dealing with reviews of the literature (Boelens et al., 2017; Halverston et al., 2014) where the cost of change and the development of new skills is factored in. McGill et al. (2014) and Benson et al. (2014)

suggest the problem might be one of sustainability: once the goal of delivery has been reached, how can we continue to push the blended learning agenda? The answer for the two groups of authors is the utilisation of resources for academic staff both physical and monetary, but there is no real effort towards quantisation of blended learning. It is likely a difficulty of specificity and I could only find efforts to identify costs at a much lower (course) level: Lothridge et al. (2013) who explores the movement of a forensic science course to a blended learning model and Taplin et al. (2013) who consider the value in selling lectures as an outcome of BL. These authors attempt to show blended learning reducing the costs of students and more generally. However, what these two examples do not reveal is the overall cost of adopting blended learning and ongoing maintenance – they are at best estimates.

There are three points to draw from this section that I later rely upon: firstly, at a strategic level considerations around the use of blended learning operate in an a priori fashion – they tend to be untested or are described at a level where it is difficult to determine tangible impact; secondly, there is a problem of ownership of blended learning – does the matter, quality and delivery reside with individual academics or is it something that an institution ultimately understands the costs of; finally, being clear about process and outcomes – who provides the expertise and guidance to produce blended learning and how it be maintained after it is created?

d. Evaluating blended learning approaches

Papers that mention blended learning offered a form of evaluation which they believe justified their work and I found three typical types: student evaluation, staff evaluation, and approaches that are comparative in nature (e.g. pre- and post-

intervention). In the case of student and staff evaluations the primary method appears to be survey-based analysis or interview (focus group) analysis.

In exploring contributory factors to satisfaction, a common method is to use statistical means (Lim et al., 2007; Ginns and Ellis, 2007; So and Brush, 2008; Ginns and Ellis, 2010; Paechter et al., 2010; Wu et al., 2010; Lopez-Perez et al., 2011). Evaluating students' satisfaction is one example and there are different alignments for the term 'satisfaction'. So and Brush (2008) and Moskal er al. (2013) suggest students' satisfaction derives from intra-class collaboration (BL approaches reduce classroom activities), and the development of authentic learning experiences. However, the problem of separating out the impact of BL activities from face-to-face teaching activities is difficult to resolve (Ginns and Ellis, 2009; Paechter and Mairer, 2010) for three reasons: firstly, the action of adopting or developing blended learning may not have a direct influence on students' experiences (Lopez-Perez et al., 2011). Secondly, it is the context of implementation which should be used to inform how we define blended learning (Moskal et al., 2013) as there is a spectrum of definitions. Thirdly, the separation of blended learning influence is probably impossible unless students are asked specifically what makes their experiences different, and this is quite difficult to uniformly quantify between institutions (Paechter and Maier, 2010).

The alternative evaluation methods also prove difficult. Lopez-Perez et al. (2011) and Paechter et al. (2010) link students' experiences and expectations to outcomes. The emphasis for both sets of authors is the desire to link blended learning initiatives to improved learning outcomes as a demonstration of improvement. In the case of Lopez-Perez et al. the initial wave of the intervention seems to improve student pass rates, but further iterations of the same development plateau and provide little improvement. Exploring Lim et al.'s (2007) and Demirer and Sahin's (2013) research

also reveals a similar issue, namely that when students are exposed to greater amounts of online learning, they feel less supported that those students who experience a greater amount of blended learning. This may be for two reasons: firstly, the intervention or interventions are implemented part way through students' studies; secondly, it is difficult to determine if the effects of change are limited just to blended learning (Ginns and Ellis, 2009; Paechter et al., 2010; Diep et al., 2017) or if it is just different groups of students.

In reflecting upon the implementation of blended learning I identify four lessons from the literature: firstly, that the difficulty of defining blended learning pervades into policy-making choices – meaning that there is a lack of clarity around the aims and objectives of blended learning implementations; secondly, the evaluation of blended learning is difficult because without a clear policy and subsequent approach to course-level evaluation, it becomes difficult to see how impact can be ascribed to blended learning; thirdly, there is a problem when we consider how we implement blended learning and less thought is given to the human; finally, there is a danger that in the enthusiasm to implement blended learning we might not fully consider the needs of lower performing students, or the lowest common denominator. It is the last point which is of the most concern: I suggest it is quite likely that non-engaging students will engage with evaluation – worse still if we consider that they may not have a useful internalised concept of what academics are trying to achieve with blended learning.

e. Technology Enhanced Learning

Where BL as a concept brings a spectrum of activity ranging from partly online to fully online, TEL has a clearer scope for UK HEIs. However, it suffers from the same

issues as blended learning, specifically: standards of proof, evidencing enhancement and the ability to compare common conceptions of TEL across institutions.

The starting point for many TEL approaches is the VLE: conceptually, the literature sees this as a container for ancillary services. Early reviews of VLE-based activity, such as Browne et al. (2006), see usage of the VLE being directed at providing opportunities to share course material with students as a primary driver of usage. The intention was that technology would act in a transformative way, but much like the approach in blended learning, emphasis was placed upon policy to enforce change (Jenkins et al., 2011). Fundamentally, this is a form of enforcement not driven by academic staff, but rather by requirements developed by the sector or management at institutions.

Walker et al.'s (2016) analysis of TEL development suggests that institutions' strategies for teaching learning and assessment have been the focus of informing and developing the wider TEL agenda. However, Walker et al. note that specific strategies for TEL use (separate from learning and teaching) have seen a decline in recent years. As an example, I cite my own institution's strategy (UoB Strategic Plan, 2017), which does not have any specific mention of technology or VLE. There may be two reasons: firstly, the strategy has moved away from simply increasing the use of a VLE; secondly, practitioners have moved to specific implementations of technologies which are expected to be implemented. In the first case it is easy to identify an improvement – people can adopt a VLE and use it, but the latter case is fraught with difficulty in terms of standards of proof both theoretically, and in more practical terms such as realising enhancement (Gunn and Steel, 2012; Kirkwood and Price, 2014).

The UCISA (2016) survey indicates what types of technology are being used and considered as enhancements. It identifies common themes as: the ability to make assignment submissions online; the ability to communicate asynchronously, blogging tools; e-portfolio tools; and lecture capture tools. It is unclear when these implementations are considered against the ideas and themes described by Kirkwood and Price (2014) and from the theoretical basis Gunn and Steel (2012) describe. Effects of online submission or access to a VLE are not forms of enhancement if they are an expected norm of students' learning experiences. The same issue pervades into what little information is available from institutional strategies and TEF responses (Eales-Reynolds et al., 2018; Flavin and Quintero, 2018) where little can be found in the way of specific and institutional-level approaches to technology use, other than a brief reference to a VLE. TEF responses do weakly refer to Panopto (a lecture capture tool) as the basis for claiming enhancement.

As Brown (2013) suggests, the problem is that while there exists the letter of the policy, members of an institution find ways to implement change to achieve a form of compliance they think is appropriate. I refer to an earlier reference to White (2007) where I described my own institution as being teaching intensive. It is more likely that such institutions would have strategies (because of centralised management) that will detect such efforts. The institutions Brown describes are more research intensive and so more prone to localised development. It is entirely possible the reason for unofficial adoption is that strategies are seen as too far away from their purpose to make sense, or the sense of the requirements is lost in a greater strategy.

In summary, TEL has either become part of the fabric of university life, an expectation, something too broad to define succinctly for evaluation, or is not

something which is seen as an essential part of strategy. The questions then are: what is technology being used for? and what do students see as a priority as part of their university journey? Some high-level evidence about usefulness is available from Henderson et al. (2015) and Henderson et al. (2017). Students' primary concerns circulate around the logistics of university life, specifically knowing what they need to do and when, and gaining access to information necessary for studying. Similar to the problems of evaluating blended learning, efforts to work with TEL suffer from the same evaluative problems. There are parallel problems of what constitutes enhancement and what specific type of technology is useful. The sector has yet to fully react to the TEF and TEL problem, and to determine strategy to respond to it.

f. Students' satisfaction and learning experiences

I use the term 'satisfaction' to refer to students' responses to survey instruments, and specifically the NSS. Literature in this domain tends to refer to correlation values which are on a scale of -1 to 1, where the extremes indicate negative or positive relationship between the two values. Questions from the different subtopics, e.g. Teaching, or Assessment and Feedback, are combined and compared to the overall level of satisfaction to determine potential correlations. This may be performed at an institution- or course-level for surveys like the NSS.

The evaluation of students' experiences is not a new effort and there are examples (Ramsden, 1991[9]) which have attempted to assess course-level quality. I have used an aged reference deliberately as it indicates that 'good teaching' (0.60) is most

[9] Both Ramsden (1991) and Bell and Brooks (2018) use a statistical method that correlates data, with a scale of -1 to 1 with either value indicating a very strong effect (negatively or positively).

strongly correlated with a good perception of the course, and followed by clear goals and standards (0.47). Bell and Brooks (2018) exploration of the NSS reveals there is a strong correlation between the *Teaching on my course* (0.83 – rounded from 3 d.p.) category and overall satisfaction with a course, and *Academic support* (0.80 – rounded from 3 d.p.). These two examples set an important precedent for a snapshot of understanding of what drives final year students' satisfaction. The correlations suggest a high score for *Teaching on my course* will usually be reflected by a high score for overall satisfaction.

The pressure to ensure students' satisfaction has been brought into focus by the TEF. However, the issue of students desiring increased support is not new – Rolfe (2002) noted increased demands for more support from students. Furthermore, Bunce et al. (2017) ascribe the problem of students' desires for support stem partly from students' lacking robust academic skills. There is also a desire by students to ensure they obtain the highest degree classification possible, regardless of academic improvement or development. The desire for high grades and ensuring high quality outcomes feeds students' belief that both will improve their employment prospects (Raaper, 2018). However, the data for students at the University suggest regardless of outcomes the students still perform badly. In a wider context, institutions are then left with two diverging problems: firstly, err on the side of attempting to satisfy students' needs; or, secondly, ensure students' employability prospects are enhanced upon leaving the institution. The TEF brings both aspects sharply into focus as it utilises data that form judgements based upon both elements.

Does this make satisfaction a valid measure of students' experiences? The NSS approach certainly does assess valid aspects of students' experiences, but it certainly does not generate consistent results – a good example is the table I

provided in the introduction for Computer Science students' overall satisfaction level with their course. Could this mean the survey is an unreliable instrument? There are three ways to assess this: firstly, can we assume that students make sense of questions they are asked (for example, about teaching quality) in the same way that an institution interprets them (Bennett and Kane, 2014); secondly, that the measurement of satisfaction is valid and reliable – the former can be assessed more easily, but the latter requires further tests (e.g. Cronbach's Alpha – Cho and Kim, 2014; Taber, 2018); thirdly, we use an instrument like a local survey as a learning tool to determine what is driving satisfaction as students progress. There are two approaches that will not work: firstly, an approach to test the validity of the NSS such as Cronbach's Alpha (Cho and Kim, 2014; Taber, 2018) is not possible as there is no access to raw NSS data. It is difficult to claim the instrument is reliable (as there is no way to test it), but it is the only comparable measure HEIs and evaluating bodies have access to standardised data for; secondly, unlike positivistic levels of proof with experiments, one student group is not the same as another making a direct comparison between two sets of NSS results difficult. Institutions must then invest significant efforts to ensure that the trend of NSS results remains as positive as possible.

None of the examples in this section have explored the role technology may have, or explored potential influences. Within the higher level TEF submissions there is very limited reference to technology. The scope is quite narrow, most submissions make at least a passing reference to VLEs, but do expound the VLE's importance in any great detail; there is also a reference to enhancement via the mechanism of lecture capture, but it is quite unclear why or how this enhances students' experiences (Eales-Reynolds and Westwood, 2018). Reed and Watmough (2015) and Varga-

Atkins (2016) present two different methods to look at VLE minimum standards: the former by using a survey and the latter by exploring students' requirements by utilising focus groups. The highest priority amongst students (and therefore the institution) was access to information such as lecture notes, specifications and where to find lecturers.

There two issues I have detailed in this section: firstly, they really only address the needs of final year students; secondly, there seems to be an absence of effective strategy for explaining the role of technology in the TEF and satisfaction. These will be examined in detail as part of RQ3.

g. The use of blended learning approaches in computing subjects

During the course of working on this section of the literature review, it became apparent the key form of delivery mechanism in computing uses of blended learning focus upon pushing 'teaching' content online. The difficulty is filtering out those papers where blended learning has been implemented at a University level. Several articles stated they used a blended learning approach; it was often a term used in passing. I considered this could be for two reasons: firstly, that the term 'blended learning' is being used in a way which reflects the nebulous definition of the term; secondly, that the approach for teaching programming and other computing subjects does not lend itself well to blended learning environments.

In computing, similar to the literature identified in sections b and c, have embraced the need to drive to remove lectures (Jonsson, 2015; Chen et al., 2015; Hauswirth and Adamoli, 2017), and in some cases to place much greater emphasis upon lab sessions (this is where students work on problems). This presents as a method to avoid the possibility of a transmission approach by the lecturer, and as a shift to a

more ‘efficient’ forms of transmission. Where smaller groups existed, this prompted a change in approach where there was a shift to running support online with interactions focused upon group teaching (Cakiroglu, 2012). There are variants of within the approach: lectures are replaced by practical sessions, and lectures are moved online (Dawson et al., 2018); videos made available online replacing lectures (Impelluso, 2009); reading and short videos being available online with lab sessions providing support to students (Davenport, 2018).

There are very few examples of a large-scale shift to BL, and it is sometimes difficult to determine the exact nature of the changes made. For example, Jacobs et al. (2016) – viewing lectures online which are broken into small chunked tasks and Dawson et al. (2018), describe adopting blended learning, but this seems to be limited to students undertaking tasks partly online (no more details are provided). The language used also speaks as to be related to BL, but the authors tend to use the term in passing. Of the large-scale examples I could find - Boyle et al.’s (2003) was the most significant. The authors refreshed a course with approximately 600 students, resetting the primary delivery mechanism to utilise a blended learning approach. Though it may be linked back to the time of the change (2003), there is no appetite to remove lectures, as Boyle et al, consider them a useful medium for the transfer of theoretical knowledge (which is in contrast to Jonsson, 2015; Chen et al., 2015; Hauswirth and Adamoli’s, 2017 collective approaches). Though Boyle et al. claim success in temporarily uplifted grades, it is unclear if the effect was simply due to refreshing the curriculum or because of enhanced blended pedagogy. A methodology closer to this thesis was tested by Hadjerrouit’s (2008) BL efforts which took the form of packages consisting of: examples of code for students to follow, the

presentation of solutions by the lecturer, multi-purposed representation of learning materials and links to other programming resources. The author, like Boyle et al., allowed students to repeat and replicate activities from the class, and to create instructions and methods which provided students with fast feedback on progress. Though Hadjerrouit's model appears effective, the group within the study is less than ten students, and this is where care must be taken when generalising success.

There are other examples of practice, which push the boundaries of the definition of BL. For example, Kose and Deperlioglu's (2012), Djenic and Krneta (2010) and Djenic and Mitic (2017) studies combined uses of an online tool as part of their practice which provided students with feedback and evaluation on their programming efforts. Students could test out code and feedback directed them to make changes where needed. In the case of Galvez et al. (2009) and in an effort comparable to Kose and Deperlioglu's, the primary focus of efforts is around the use of a programming teaching tool. In the case of Galvez et al. this ended in increased failure rates, primarily because the tutors allowed students to operate the tool in an unsupervised manner without specific and directed feedback. Both Matthews et al. (2009) and Bati et al. (2014) systematised the provision of materials in a blended learning environment. Students are exposed to pedagogy which included: working in groups in a laboratory, large class lectures and then 'e-learning' based activities. The use of the term e-learning is problematic in this context as the authors position it to consist of no more than lecture notes and external links. These are simply information-focused resources. This is especially a problem for Matthews et al.'s (2009) students. The authors identified that students had difficulty processing the relevant elements from packages of materials.

h. Computer Based Learning (CBL), and BL

There are synergies between CBL and BL. CBL focuses upon replacing methods of teaching, and it shares a synergy with BL in that it may replace events like lectures (Dalgrano, 2001; Sharma, 2017). Emphasis is upon students utilising a computer to undertake some of the activities usually delivered by the lecturer. Commonly CBL is used to produce representations of learning environments such as online text, or simulations (Ifenthaler, 2012). Authors I identified the last two sections approached this problem in different ways: Kose and Deperlioglu (2012), Djenic and Krneta (2010) and Djenic and Mitic (2017) utilise a form of simulated programming environment. These types of tool present a finite and highly deterministic approach to programming. Mistakes can only be made in a limited number of ways because there is a need to provide highly specific feedback in each case. There is little room for the development of wider contextual expertise on the part of the students. Furthermore, if the final assessment is based upon prior learning actions within the programming tool, then students may achieve a higher grade. If we compare this to Boyle et al. (2003) or Hadderjout's (2008) – though they replace the lectures with supporting materials, students are still exposed to a deterministic system, but it is significantly more complex and easy to make mistakes (and I would argue learn more). I would suggest this makes the students' understanding more versatile, but easier for less able students to fail. In these conditions it is much harder to claim success when students' assessment outcomes improve (Alhazbi, 2016; Breimer et al., 2016; Dawson et al., 2018) and unless students' satisfaction is specifically tested very difficult to claim improvements derive from any implementation. This goes some way to explaining the arguments Ifenthaler (2012) indicates are in support of CBL where simulation is the basis for an enhancement of experiences – two are relevant:

"The learners themselves are placed in control of what and how they learn." and *"The learners can receive immediate feedback on their activities."*. I disagree with the first point, as the students are learning from a pre-determined list of content and a pre-determined process – a more open approach to learning would force students to research and explore; the second point is correct, but the feedback is focused upon the very narrow activity presented. It does have the distinction of meaning that learning can be quantised, which fits the definition of enhancement I presented earlier:

> *to improve the quality, amount, or strength of something*
>
> (Cambridge University Press, 2019)

This approach is epistemologically short sighted, as students become experts in demonstrating competence within a highly deterministic system which will likely not exist outside of their studies. Though it may convince students of their expertise in a given subject area such approaches do not allow for appropriate levels of improvisation and problem solving associated with graduate skills -which explains the poor long-term outcomes in computing (Shadbolt, 2016). Whilst it is correct to make a claim that 'enhancement' is taking place when scope of assessment is limited to a simulation the validity of such claims need to be examined against the long-term expected behaviours of graduates.

i. Methods of evaluation in computing Blended Learning literature

Evaluation amongst the authors in the previous section falls into three categories: the use of data exploring pass and failure rates of students, measuring student satisfaction, and exploring students' perceptions of blended learning practice. The former category is an attempt at an empirical justification, the second a way of

justifying an implementation, but the third is a view of how students experience the use of blended learning. Sometimes two or more of the methods are tied together. For example, Boyle et al.'s (2003) study indicates pass rates increased for those students who had access to the blended learning materials, and increased levels of satisfaction. With some caution, they suggested there is a causal link between their redevelopment and the improved outcomes. There are two considerations which are thematic to the other authors' approach: firstly, the studies involve humans and so their behaviour will vary greatly for each group (Kelly, 2004; Ameil and Reeves, 2008) – a principle which I established when discussing DBR in the introduction; secondly, a questionnaire provides a very thin (though useful) evaluation of the students' experiences. Hadjerrouit (2008), like Boyle et al. (2003), finds student satisfaction improves with iterative developments of blended learning. However, Hadjerrouit admitted wider applicability is an issue, because the student group in the study consisted of only 11 students. Authors also focus on evaluation in quite narrow constructs. In determining students' satisfaction questions tend to focus upon the authors' model in terms of a perception of effectiveness or elucidate much in the way of external variables. For example, focusing upon satisfaction as the only question asked (Bautu et al. 2018); focusing upon students' emotional states (happiness with material) (Tritrakan et al. 2016); focusing upon compliance with watching online content (Tyler and Adbrakhmanova, 2016); satisfaction focusing upon the VLE itself rather than pedagogic concerns (Bi and Shi, 2019).The use of control and experimental groups are utilised and the focus orbits claims of improved assessment outcomes (Alhazbi, 2016; Breimer et al., 2016; Dawson et al., 2018). Unless a practitioner is able to determine the controls and methodology in place it is difficult to

replicate studies, and this is before we begin to take into account the issues DBR approaches to education research imply (namely the control of complex variables).

Using a specific example, Kose and Deperlioglu's (2012) approach utilises a survey instrument to form a judgement of students' perceptions of blended learning. The authors utilise questions such as "This learning model is more effective than traditional approaches" and "I can learn faster by using the intelligent tools". In these cases there may be an impact as Brew (2008) and Law's (2010) research suggests: students might see completing a survey as part of an ongoing compliance which is extended from their existing interaction with blended learning approaches in a unit. When considering improved grades Owston et al. (2013) concur with Law et al.'s position suggesting that higher grades drive students' satisfaction upwards.

The control experiment approach is common to many practitioners (Alhazbi, 2016; Breimer et al., 2016; Dawson et al., 2018) and is a common justification after the implementation of BL. For example, Caberra et al. and Zeuch et al. (2019) utilise an approach which involved moving lectures online, and providing activities coupled with students working online worked online. In these examples the claim is made because post-implementation an improvement in exam results was seen amongst students who had BL applied to their units.

These examples are associated by being a snapshot in time and they do not consider the trajectory of students over the longer term. In the computing literature I cannot find any links between BL and areas like the NSS. This could be because practitioners are focused upon improving students' assessment outcomes, or that BL does not present specific utility. The approach of control experiments is also problematic. In the introduction I DBR, and the need to develop beyond single effort

implementations. The key to development in DBR is forming a better understanding of the domain in the study, and to develop and test solutions iteratively (Amiel and Reeves, 2008). The literature presents the solution that once implemented BL changes students learning experiences, but this is only tested once, and does not consider the opportunities for the strategic alignment of technology or BL.

j. Example qualitative studies in computing

As I was conducting a study which involved the collection of qualitative data I decided it would prove useful to examine the qualitative approaches of Computing researchers. Originally, I had intended to utilise phenomenograpical approach for my methodology, but opted for thematic analysis (I will explain the reasons methodology section). I have utilised examples from phenomenographic research to represent qualitative studies in computing for three reasons: firstly, that the range and types of research in computing making it hard to identify comprehensive qualitative research as it related to blended learning; secondly, to find examples of where computing research had addressed problems where an approach which focused upon students' experiences was prescient rather than just a statistical analysis; finally, I wanted to explore any existing strategies for learning that students possessed that had already been described in the literature.

Thune and Eckeral (2009) discuss the difficulties that students have understanding in the execution of a program. Unless there is an understanding of the mechanics of a program, it becomes difficult for students to adapt to new situations. For example, when the standard of proof required is mathematical in nature then students experience severe difficulty (Smith and McCartney, 2014). The problems students have to solve in their first year are important, but relatively speaking trivial. This

seems to present a problem for the students as they do not see the practical application of problems, or their wider context. Further to the problem of a wider context, Stamouli and Huggard (2007) and Bucks and Oakes (2011) both demonstrate the problem of specific programming goals students attempt to learn. The students struggle when they are faced with problems outside of the limited scope of a programming solutions they have developed. Students are generally not equipped to deal with variance. Bruce et al. (2003) identifies students' need for constant feedback and input from staff (p. 16): *"Input from 'expert programmers' is sought and intensive direction from teaching staff is expected."* In an earlier section of this review I pointed out the risk of poorly performing students and their abilities to engage with learning. The same argument would appear to apply in this case, whereby removing the expert would cause problems for the students. Such a problem is also identified by Boustead (2009) who tested students' skills with a timed exercise. In this example, students continuously re-wrote and tested code in the hope of getting the right answer. There was not much nuance to their approach and no underlying logic. Berglund and Eckerdal (2006) examine the motivatiors for students, identifying: academic achievement, development of project and team-working capacities, and social competence. None of these are necessarily related to the strict logical approach required by computing subjects but may be useful in a wider employment context. Compare this with the expectations of subject lecturers. In Carbone et al.'s (2007) study the lecturers indicated that successful teaching focuses on making changes to the way students think and upon students being able to generalise beyond what they are taught. The authors also discuss the problem of unsuccessful teaching, pinpointing five factors: a lack of teaching skill, inadequate organisational support, students not taking responsibility for learning, complexity in

the domain, and students failing to perform within assessments. The longer-term trajectory of students who do not fully understand the nature of programming means there may be problems when they seek employment, and this is a key issue if we consider that this aspect is tested by the TEF. A related approach is provided Thompson (2011) which indicated that there is a need for lecturers to regularise and pattern learning, and teaching by using concepts which do not immediately involve writing code. This, Thompson claims, is the method by which students will better grasp programming concepts. To an extent I agree with this position, but I refer back to Smith and McCartney (2014) – could we be fully confident students understand what they are writing about? There is an attractiveness to the instant feedback delivered by programming, and to re-quote Bruce et al. "…*intensive direction from teaching staff is expected"* – students must hold an increasing degree of responsibility for their own learning.

Within these examples, there is a common theme – some students are happier performing in a declarative manner. By using this phrase I mean to imply that a student may be able to tell you what an array[10] is, but the application of an array in theoretical or real-world situations is not something declarative students would embrace as a solution.

Lecturers teaching students must either pander to satisfaction or produce versatile students who can cope in a variety of new and challenging situations. The issue with the findings from the literature require me to look back at the implementation of technology for computing students, and there are three issues: firstly, the literature does not specify a particular approach as being effective or ineffective; secondly, the

[10] Arrays are a data structure which contain a series of elements, for example a series of words (strings) or numbers

problems for computing students do not seem to be easily resolved by providing 'online' teaching: quite the opposite would appear to be true – an expert in the vicinity of students appears to have more potential; finally, I consider the problem of 'enhancement' and what that means in the context of students' studies in programming. The gap in the literature I have exposed relates more to with what, by whom and how students are provided support. When I consider Bruce et al's point about of "intensive direction", I think there is a gap to consider if TEL, particularly the act of enhancement, could assist students in their learning journey.

k. Literature conceptions of GL and how they compare to the University's conception

In the literature the use of the term GL varies greatly, but it is difficult to find it utilised as the singular term 'Guided Learning'. The following examples are different from the University's conception of GL.

Where it is singularly in use, the meaning varies greatly: in FE (Further Education) (Hughes, 2013), in relation to functional skills training (Ofqual, 2019), within the ambit of cognitive load theory (Herman and Gomez, 2009) and related to limitations of memory, and in schools (DfES, 2004). It is the latter of these which bears some synergy with the University's definition of GL. Specifically (DfES, 2004, p. 15):

> *"Learning is structured into distinct episodes that follow a clear sequence which increases in cognitive demand."*

and

> *"'Scaffolding' provides support and focus through a gradual shifting of responsibility and control to the pupil"*

A more recent definition from Billet (2012) follows a similar line:

"close interpersonal interactions with more informed partners (e.g., experts, teachers, parents)"

And

"indirect guidance from observing and interacting with others, artifacts and social forms and norms"

There are variants of GL including: inquiry based (IB-GL) – (Levey, 2012; Lee, 2012; Jenkins and Healy, 2012; Kuhlthau et al., 2015), Process Oriented Guided Enquiry Learning (POGIL – Rodriguez et al, 2020), web-based and student-guided (Katuk,2013, Baker, 2016), and a Guided Learner Journey (Hudson and Barefoot, 2018). For the sake of convenience, I will refer to these examples as GL. Common to all the approaches is the notion that students should be develop skills as independent learners. Furthermore, Griffiths et al. (2010) indicate that the aim for institutional adoption is for students to become creators and authors of content, and to direct enquiry and learning. The path to this point is described by Kuhlthau et al. (2015), though using a school focus, and Baker (2016) with both methods indicating this requires the development of students' skills, and handing some control to students (Levey, 2009). In one case level IB-GL has formed the basis for institutional learning and teaching strategy (Jenkins and Healy, 2012). The summary of these points is that GL is a constructivist approach, the aim is for students to be able to build disciplinary knowledge and become experts in finding new areas for development with less input from staff and for students to frame disciplinary enquiry.

How do the advocates for GL approaches suggest this change is undertaken? If I return to Billet's (2012) definitions, there is synergy with BL approaches. In wanting to encourage different types of interaction there is a move to diminish the lecture as

a form of interaction. Avoiding information transmission in this context allows for more visual forms of learning (content in different formats) and to promote conversation (Levy, 2012). Roberts (2017) indicates that it is very difficult to move away from lecturing as it is difficult to replace this form of interaction with something else – there is not a suitable direct replacement. This is despite earlier authors (Jones and Wright, 1999) desiring a move to a model where interaction is delivered on a smaller scale. Lectures do at least have some opportunity for interaction rather than simply delivering a lecture as a video where interaction is not immediate, or at best another step for students to take. Lee (2012) suggests this is a vital step in ensuring students are equipped for the new ways of working. Given Baker (2016) indicates students need to work on their skills, can we entirely trust students to make appropriate decisions about learning? On the point that Levey (2012) makes I cite the more recent work of Halverston et al. (2017) who question the approaches of students when it comes to their digital practices. Viewing information in different formats and repeatedly viewing content as forms of practice. Furthermore, as Stamouli and Huggard (2007) and Bucks and Oakes (2011) demonstrate the approach of students when faced with unknown programming problems is not always sensible and well formed.

In conclusion, though the term GL is used elsewhere like the concept of BL it contains many different flavours and forms. The examples of GL in this section shared a commonality with BL in the sense that the act of the lecture is seen as something to be replaced. The involvement or incorporation of technology takes the form used within BL, technology can be utilised to promote provide a mechanism to deliver content.

I. Using the computing literature to compare GL and BL

Within the literature review I have focussed upon BL, and this section I compare it directly with the University's conception of GL drawing out the commonalities and the differences between the two approaches. To provide a basis to draw distinctions I have summarised the key aims of GL and have compared these to BL where examples exist. The examples on the GL side are drawn from the literature I have already utilised. Owing the highly specific nature of GL some elements are not directly comparable. The key differences between GL and BL come from the mechanism of delivery and assumptions about the core rationale for implementation. In the case of GL all activity must be delivered via the VLE – this is set by the University's standards. In the case of computing BL approaches there is more emphasis upon using a CBL approach with specific tools to support students' learning rather than packages of contents. This is summarised in table 2.

Focus of requirement	Guided Learning (CLE, 2014)	Examples of Blended Learning practice and differences
Delivery mechanism	Primary delivery mechanism is the VLE	Delivery mechanism varies by style of implementation. May be via video (Tyler and Adbrakhmanova, 2016), online, or via a specialist software tool (Djenic and Krneta, 2010 and Djenic and Mitic, 2017).
	Does not replace lectures, but augments existing activities with specified timescales	BL generally replaces lectures (Jonsson, 2015; Chen et al., 2015; Hauswirth and Adamoli, 2017) with pre-recorded content. In some efforts lectures are retained (Boyle et al., (2003)

Content delivery	Content must be delivered in the form of a learning module (a type of content container). Only providing PowerPoint material not appropriate.	No standard method employed, but involves a range of delivery mediums. May include online work, video content (Jonsson, 2015; Djenic and Mitic, 2017; Tyler and Adbrakhmanova, 2016), CD/DVD (Djernic et al, 2010) or via a structured programming tools
	Comprises sections detailing Rationale / Learning Outcomes / Assessment and Timing	Examples are difficult to determine, but some evidence suggests that this is designed in (Boyle et al., 2003, Hadderjout, 2008).
	Requires the use of internal tools within the VLE: Link to activity, such as a discussion, a personal journal for reflection, a wiki, a quiz or survey, etc.	May bypass the VLE entirely depending upon the delivery mechanism, but may be contained within an environment.

	Learning content with embedded audio or video or other Open Educational Resources (OERs). Resources are intended to support students' progress	Video content may already be pre-created, and additional content focuses upon students' use of predetermined tools or prior generated content. (Matthews et al., 2009; Bati et al., 2014).
Standards and evaluation	Content complies with minimum VLE standards	In the computing literature reviewed there was not a standardised institutional approach discussed. The implementations in the prior literature review sections with the exception of Boyle et al. (2003) are localised implementations.
	No direct mechanisms of evaluation, but a standard mechanism across the whole institution exists for evaluating students' experiences. Separate	Mechanisms focus upon satisfaction in a limited way, and include reviews which focus upon students' assessment outcomes often highlighting an improvement (Kose and

	processes evaluate the outcomes of assessments, but these are not related directly to GL.	Deperlioglu, 2012; Alhazbi, 2016; Breimer et al. 2016; Dawson et al. 2018)
	Implementation tracked by active Learning Modules	Implementation detection and tracking determined by method of implementation.

Table 2 – A comparison of the University's GL approach verses examples of the computing BL literature

m. Literature review summary

In the literature review I have identified three strategic issues related to the use of blended learning: firstly, that blended learning efforts tend to be driven from the top level of organisations the result of which efforts to introduce blended learning are not necessarily sympathetic to pedagogy; secondly, blended learning is viewed as having great transformative potential, but the rhetoric does not match the outcomes and detecting the outcomes is difficult; finally, the evidence base for effectiveness is not based around an even starting point – if students' only experience of learning is a blended learning model it is easy to claim that it is enhanced or different. The students have no basis for comparison, and it is then easy to claim success from an experience that could not otherwise be delivered – this is different from enhancing an experience.

It is at this point that I recall Clarke's (1994) point about the influence of media upon learning. The concentration is upon 'doing' something. This reflects Oliver and Trigwell's (2006) position about those who implement technological solutions. Little thought is given to the underlying premise of why the action of implementing TEL or GL is important. Like any bureaucracy the implementation of blended learning appears to exist more for the sake of justifying the existence of learning technologists and systems rather than spending that resource upon influencing students' learning. I am not alone in making this observation, as Selwyn's (2016) quite frank observations of technologies' influence upon education as being full of "bold assertions and confident claims". I would argue that the claims made for GL, and the assumption of Enhancement in TEL fall under the same description.

When I turn to the problems with the TEF and the NSS there is not much evidence about the TEF, but this is to some extent to be expected as it is a new relatively new initiative brought in by the UK government. However, this also identifies a gap for me to consider in my analysis of students' experiences. This presents three issues: firstly, it demonstrates that there is an opportunity to think about how the TEF will change the approach of HEIs; secondly, it opens up an opportunity to consider and think about how technology can play a role in impacting students' experiences; finally, that the strategic ground for the use of technology might be best not concentrating upon enhancement (which appears to be a fickle goal), but rather it could play a role in ensuring learning takes place.

In terms of the standards of proof for the enhancement made by the implementation of technology efforts are mostly directed at statistical proof. In some ways this is quite a comfortable way of demonstrating impact – numbers have a tangible and cross-discipline meaning when viewed from a strategic position. However, much like the considerations of the use of blended learning, the advantages can be better understood by engaging in capturing a narrative. Statistics do not provide a very rich view of the human element of the learning experience and I suggest this makes it harder for the implementers of learning technologies to understand the results of their implementations. The purely numerical methods do not adequately describe the process of getting from implementation to results. We therefore are probably trusting enhancement to luck, or an unreliable claim.

The subject area of computing does not really engage with blended learning, but I think this is understandable as it is a subject which has many resources online, and it necessarily involves the use of technology. In the cases of the units I explore within this study it is the case that students spend most of their time interacting with

technology. It seems then that the implementation of blended learning makes the assumption that other forms of technology require augmentation. Realistically, blended learning is better placed to help students make sense of problems they face; but equally, this might prevent students from forming their own competent strategies to develop as it provides them with answers to problems they need to apply effort to develop their understanding.

3. Methodology

a. Chapter introduction

It is at this point that I address the DBR stage of solution development. In this chapter I explain my methodological choices. The practicalities of handling data is addressed in chapter 4. As DBR does not have a prescribed method of data collection and analysis I use this chapter to explain and justify the approaches I use. This chapter is structured into six sections:

- TA (Thematic Analysis) and the use of qualitative data
- The links between TA and DBR (Design Based Research)
- Primary qualitative data - demonstrating validity and reliability
- Secondary data – quantitative departmental survey data
- Ethical procedures and considerations
- A method for examining the existing GL provision

b. A qualitative approach involving TA (Thematic Analysis)

In this section I explain how TA (Thematic Analysis) is the primary tool for the analysis of data in this thesis, and I explain the combination of TA and DBR.

In selecting a qualitative approach I had three primary considerations: firstly, I wanted to make a detailed exploration of students' experiences with GL (and TEL); secondly, on the basis of my first point the most convenient method of collecting data was via an interview – but the sampling would have to be purposeful; thirdly, I would be able to sample students' experiences with GL as they moved through a range of different assessment points – using interviews would mean I had some control over my sampling.

Thematic Analysis (TA) presented me with the greatest amount of flexibility for this thesis. It is not strictly tied to an epistemological or theoretical perspective, leaving a researcher to define and decide at an overall level what form the analysis should take. For example, Braun and Clarke (2006) present two methods to analyse data collected during a study: semantic – which treats the data descriptively, meaning I would only need to specify what participants had said, and latent, where some degree of analysis is conducted. These two positions relate to realist or constructionist philosophical perspectives (Namey et al., 2011; Vaismoradi et al., 2013). When studying human behaviour, it is very difficult to arrive at a totally objective view or to take a realist view of a domain, and so I have taken the view that a constructivist-interpretivist approach is more useful in this research environment, as it provides ample room for exploration and explanation. In this study I have opted, by dint of my research questions, to be exploratory in nature. Namey et al. (2011) indicate an exploratory approach implies a purposeful sampling method, and I use the definition from Cohen et al. (2007) who describe a form of purposeful sampling which provides an opportunity to collect quite rich data; but it also assumes that the researchers resources are limited (which they are in my case).

From the perspective of this research there are three main advantages to TA: firstly, it is not tied to an epistemological approach; secondly, it provides an accessible method for a large dataset; finally, the themes generated are supported by data and examples. In contrast I can identify two main drawbacks of using TA: firstly, there is a lack of substantial literature discussing TA – although there is a clear process to follow; secondly, the flexibility of TA might lead to incoherence in the analysis and outcomes.

I use Braun and Clarke's (2006) steps to develop a TA of my dataset. I list them here with a short contextual explanation: familiarisation – after collection the process of reviewing and obtaining an overall picture of the data; generating initial codes – a list of ideas or headings that describe high-level features of the data which can derive from the research question; searching for themes – collating codes into sets of meaning (diagrams or mind maps to visualise data); reviewing themes – a refinement of the initial themes; defining and naming themes – this is the final step of setting themes; finally, the write-up report.

c. The links between TA and DBR (Design-Based Research)

The reasons for combining the approach of using TA within a DBR approach come from the complexity of the domain. It might be possible to investigate the domain by methods such as a survey, or I may claim that a quantitative approach might yield enough evidence to claim success (ala the approaches in the computing literature Tritraken et al., 2016, Bautu et al. 2018, Dawson et al., 2018) . However, as Brown (1992), Collins (1992) indicated this approach might work in a strictly controlled environment, but the domain I am exploring is quite complex. Utilising a quantitative approach implies that complex phenomena such as learning and human behaviour are easily reducible and can be explained with a theory, or single interventions or change which focuses upon a small number of variables (often one or two) lead to a theory of implementation (Kelly, 2004; Ameil and Reeves, 2008). Though DBR is focused upon the aim of improving evidence-based outcomes in educational

research it is not tied to a specific epistemological or ontological position, and it provides an opportunity for a flexible investigation.

The DBR approach makes a contribution in the following ways: analysis (in conjunction with practitioners – in this case the staff participants); development of solutions (GL interventions) informed by existing practice and development with practitioners (the literature review provides existing practice, and working with staff to make implementations); iterative testing of solutions (I use two groups; reflection to produce principles and a return to analysis for further iteration. Performing more than one iteration of the DBR process I should be able to demonstrate an outcome, or some way of improving the understanding of my target domain which can be interpreted by other researchers (Wang and Hannafin, 2005; Anderson and Shattuck 2012). The problem is, alone, DBR does not have a standard approach to enable conception, collecting, analysing, and handling data. However, TA provides a set structure, and it can be linked to positive outcomes of validity and reliability (I deal with this in the following section). TA plays three roles, punctuating the DBR phases: as the basis for how I approach the qualitative data collection and analysis; secondly, to provide feedback for the mechanisms of iteration for which there are two groups which are included in the analysis; finally, I utilise the combined data set to generate an outcome for other practitioners to follow. In this way I can implement GL according to the University's requirements, collect data from students about their experiences and combine these with quantitative data as a point of comparison with the qualitative data. Furthermore, with the form of TA I am utilising (Braun and Clarke, 2006; Guest et al., 2012), and with DBR I have the opportunity to introduce additional contextual evidence; this takes the form of quantitative secondary data

which I explain in the section Secondary Supporting Data. I combine this with the data from the TA-focused investigation as a way of providing additional context.

d. Demonstrating validity and reliability for the main qualitative portion of this work

In this section I detail the approaches I used in this research to ensure validity and reliability. I have kept a discussion of these issues separate from the discussion of research methodology as I wanted to focus upon how I would achieve this with TA.

Considerations of validity

A valid measurement in the context of this study is the identification of approaches and activities that students undertake with GL. Though it is impractical I can use a comparative positivistic definition of validity which can be summarised as: to what extent a research instrument actually measures what the researcher purports it to measure (Cohen, 2007). Cohen's definition sits more comfortably with a deterministic ontology, but for qualitative research it is not possible to focus on such easily defined variables – and I needed a more pragmatic approach. I explored three different perspectives: firstly, Lincoln and Guba (1985) who described validity as credibility, transferability and dependability; secondly, Creswell and Miller (2000) who suggest that the researcher is the source of validity – they can decide how much data to collect, and the participants themselves – how accurately their realities are described; thirdly, Morse et al. (2002) see the investigator as taking the opportunity to evaluate data and determine if there are new avenues of exploration which can be utilised which provides validity; finally I had explored Cresswell's (2014) definition of research, and these encompass the prior authors' positions I have identified above

into a more pragmatic form. I use each of Cresswell's general headings and demonstrate how I ensured my activities aligned to a valid outcome.

Triangulation and member checking

For this thesis triangulation takes in the form of providing a balanced view of a domain of study, and to provide a deeper understanding of the environment this study operates within Cohen's (2007) and Turner and Turner (2009) approaches, where both sets of authors suggest that triangulation can take the form of obtaining data at different times and in difference places. Hence I collected data from two main cohorts, and a pair of test cohorts. As I interviewed students, I completed field note summaries of data, and created spider charts to help me to explore emerging themes and ideas. I used these for four other purposes at the analysis stage: firstly, to check my understanding of the domain; secondly, to sense check the emerging ideas from students; thirdly, to ensure I had captured as much of the domain as possible; finally, to ensure the validity of my own interpretations when conducting further interviews. I was also able to steer the questions in open ended interviews to explore other aspects of the domain in the study and to decide when I had reached a saturation point (Hopepfl, 1997). I also discussed my ongoing observations with my two main staff participants. I had two purposes in mind: firstly, to ensure that my observations reflected the pedagogical issues they had highlighted to me; secondly, to ensure I had fully understood the domain and the motivations of the students. In addition I utilised quantitative data to provide a backdrop to explore the drivers of students' satisfaction. This data and the approaches are later used to explore a new framework.

Repeated observations

To add to what I have indicated in the previous section the observations for the first and second main groups was spread across the second academic term to capture data as students completed their assessments – meaning I captured how students' approaches differed as their assessments proceeded. I captured data from the comparative groups after they had completed their first assessments and right up to their final assessment. In totality the data was captured from February through to September 2016.

A rich description of the environment

As I am utilising a DBR approach in this thesis, a requirement of this is to produce a rich description of the context I am working in. In the introduction section I have provided examples of the wider context that this thesis operates within and the literature review I have explained the wider-context the University is influences by, and the effect of the TEF on UK HEIs. In the results section I describe and provide analysis of students' experiences, which is a very rich description of the students' learning environment. In addition, I provide data collected by the University as part of its normal business processes (BUS – Bedfordshire Unit Survey). This provides supporting information of students' opinions about their learning experiences.

Clarifying the bias of the researcher

In any investigation there is a risk of researcher bias. Norris (1997), Onwuegbuzie and Leech (2007) and Roulston and Shelton (2015) suggest that the bias may derive from the researcher, the sampling methodology, the researcher's' predisposition for certain approaches or designs, and external and internal factors influencing the researcher. Cresswell and Miller (2000, p. 127) suggest bracketing as a way of

researchers "*self-disclosing their assumptions, beliefs and biases*". Both Tufford and Newman (2010) and Onwuegbuzie and Leech (2007) suggest an iterative approach to considering biases and for the researcher to continually reflect upon the assumptions they hold. In addressing the issues of bias I took three approaches: firstly, I have explained my involvement around the implementation and development of GL – I have proceeded on the assumption that the implementations will achieve something detectable; secondly, I utilised a form of "disconfirming evidence" (Cresswell and Miller, 2010, p. 127) when I collected data from test groups where I made no interventions, and the quantitative data generated by the University's business processes; thirdly, I have framed my interpretations of students' experiences from both my own perspective and what they meant in the wider context of the University. In the results section I have used material directly from students, and have contrasted this with my own interpretations; finally, I have addressed my own involvement in the development and delivery of GL.

e. Secondary supporting data

I explored the possibility of using quantitative data as the main source of data, but dismissed this for three reasons: firstly, the success of other authors I had identified within the literature review (Lim et al., 2007; So and Brush, 2008; Lopez-Perez et al. 2010); secondly, a quantitative approach would require the identification, categorisation and control of several variables which I would need to specify and examine (which would be at odds with the DBR approach explained by Collins et al. (2004) and McKenny and Reeves (2013); finally, the ability of other practitioners and researchers to interpret my findings – no two groups are the same. However, using quantitative data to support and triangulate against my qualitative findings provides a

degree of assurance. This also forms part of my conclusions and framework for other practitioners to develop.

The University runs a regular survey of units (BUS – Bedfordshire Unit Survey) to quantify, manage and better understand students' experiences. The data the University collects is anonymous, but identifiable at a unit level. This is part of a quality approach to allow for management decisions about the quality of units, and to respond to students' feedback. The BUS was designed to reflect the questions and predict the outcomes of the NSS. The questions in the NSS operate at a course level, and the BUS reflects this with language which reflects a unit-level analysis. Data in the survey are captured using an ordinal scale with the extremes being strongly agree to strongly disagree, with a not applicable option – this is the same as the approach used in the NSS. I used existing University analyses of data which had been anonymised to provide only a department code and a level,[11] and the satisfaction level (expressed as a percentage).

The BUS results form an interval scale, but following the methodology of calculation of the NSS outcomes the data becomes ordinal in nature. The satisfaction percentage value (the NSS language is agreement) for an individual question is calculated by combining the number of responses for strongly agree and agree, and dividing these by the total number of responses, excluding non-responses and abstentions. The result of this calculation is a derived percentage value which is called the 'satisfaction value' by the University; the NSS version is 'percentage agreement'. The University uses the same technique for analysis.

[11] The University units use a code structure which identifies individual units e.g. CIS001-1 – the dataset I utilised removed the three numbers that could identify a unit, and replaced them with a random string e.g. CISAJRX-1.

$$\%_{Sat} = 100^* (T_{StronglyAgree} + T_{Agree} / T_{Responses})$$

Figure 1 – Calculating the percentage satisfaction for an individual question

Questions are considered as groups (factors), and satisfaction at a question group level can be calculated by combining the data from all questions in a group. The formula in figure 14 is similar to figure 13, but works with groups of questions – for example for group 1 (SA – Strongly agree : A – Agree : ΣQxSA / ΣQxA – Sum of responses for strongly agree/agree for a question : TotalResponses – total number of responses for a question): ΣQxTotalResponses – all responses for a question).

$$100^* \left(\frac{((\Sigma Q1SA + \Sigma Q1A) + (\Sigma Q2SA + \Sigma Q2A) + (\Sigma Q3SA + \Sigma Q3A) + (\Sigma Q4SA + \Sigma Q4A))}{(\Sigma Q1TotalResponses) + (\Sigma Q2TotalResponses) + (\Sigma Q3TotalResponses) + (\Sigma Q4TotalResponses)} \right)$$

Figure 2 – Calculating the percentage satisfaction for a question group

The seven question groups in the BUS from 2013/14 through 2015/16 are: *The teaching on this unit*, *Assessment and support*, *Academic support on this unit*, *Organisation and management of this unit*, *Learning resources for this unit*, *Personal development during this unit* and as a single question – *Overall Satisfaction*. The University classifies the overall quality of units by using the overall satisfaction. In total there where 2,463 individual surveys delivered in CST over 3 academic years.

My examples from the literature review demonstrated efforts at using correlations (Ramsden, 1991; Rolfe, 2002; Raaper, 2018; Bell and Brookes, 2018) to check the relationship between question groups and overall satisfaction. I used two tests to analyse the CST BUS data: firstly, a Spearman's ranking coefficient; secondly, a Cronbach's Alpha test for the question groups. Spearman's ranking method is used for two reasons: firstly, it is more robust when dealing with outlier values – or non-

normal data; secondly, it tests for a monotonic relationship between two variables (e.g. teaching as it relates to overall satisfaction). Cronbach's Alpha is a standardised test to check the internal consistency of groups of questions, and I used it as a check to compare with the output from the Spearman's test. Rapper (2018) and Bell and Brookes (2018) both use a Pearson's correlation, but they have both a significantly larger dataset and a normally distributed dataset.

Additionally, I carried out a comparative analysis for the same year groups for the result of the University where I excluded CST data. The purpose was to be able to compare the priorities of the CST students with the rest of the University. This was a significant amount of data and it required a complex and automated process written in Microsoft Access to calculate the results. I give a brief overview of the techniques in the following paragraphs. The Spearman's ranking test was carried using formulas in figures 15 and 16. Cronbach's Alpha testing was conducting using Excel utilising the formula shown in figure 17. The formula used when there are tied ranks is:

$$\rho = \frac{\sum_i (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_i (x_i - \bar{x})^2 \sum_i (y_i - \bar{y})^2}}$$

Figure 3 – Formula for tied ranking elements in a Spearman analysis

Provided tied ranks are taken into account by using an average of the ranking position the formula used in figure 16 can be used.

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

Figure 4 – Formula used after tied ranks are taken into account

Using table 4 the first stage is to calculate the ranking of the two variables under consideration; the ranking is shown in the same table.

Question Group	Question Group Value / %	Overall Satisfaction / %	Question Group Rank	Overall Satisfaction Rank	Difference	Difference Squared
1	70	90	1	1	0	0
2	40	40	2	4	2	4
3	40	70	2	2	0	0
4	30	50	3	3	0	0

Table 4 – A simplified example of a Spearman ranking calculation

In table 4 there are two items where the Question Group ranks are equal (marked in dark grey). In this case the rank is calculated as the average of the ranks, e.g. (2+2)/2 = 2. This becomes slightly more complex when the dataset is larger, but I built this into an automated algorithm. When ranked, correlation comes from exploring the difference in ranking between the question group rank, and the overall satisfaction rank. If the two items are aligned closely then there is a stronger correlation.

For example, when the values are inserted into the formula from figure 16 the result is:

$$p = 1 – ((6 \times 4^2) / 4 \times (16 – 1))$$

$$p = 0.6$$

This provides a view of how well a set of questions' outcomes are aligned with overall satisfaction. The values produced from this method range from -1 through to to +1: a value of 0 suggests no relationship and 1 (or -1) a high degree of

relationship. This does not imply that question groups are causally linked to overall satisfaction, but rather that there is a statistical case for claiming an influence.

Question Group	Questions
1. The Teaching on this unit	• Staff are good at explaining things • Staff have made the subject interesting • Staff are enthusiastic about what they are teaching • The unit is intellectually stimulating
2. Assessment and Support	• I can see the relevance of this unit to my course • The assessment arrangements are clear • I know what I need to do to pass this unit • The BREO site for this unit is clearly organised • The BREO site for this unit supports my learning

Table 5 – A sample of the question groups and associated questions from the 2013/14 to 2015/16 BUSes which presented the highest reliability. The full set of questions can be seen in appendix A

After three years of use, the University changed the structure and the questions asked within the survey, but the last year group to be captured (2015/16) covers the departmental-level views of all four groups of students (the two main groups, and the test groups) in this study. I include the data up to 2015/16 as it covers the time the student groups in the study completed the survey. Cronbach Alpha testing can be used determine if responses to question groups are consistent measures. For a group of questions to be considered reliable the Cronbach's value returned must be greater than 0.7 (Cho and Kim, 2014; Taber, 2018).

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum V_i}{V_t}\right)$$

Figure 5 – Cronbach's Alpha formula

The final part of the analysis involves an examination of both the individual questions for the highest Spearman's Rho, and for the items which demonstrated the highest values for Cronbach's Alpha. In conducting an individualised analysis, I utilised the mean, weighted mean and distribution.

The weighted mean was calculated by taking the overall number of responses for the question group and dividing each of the question's satisfaction values. In this way the impact of low-population samples with outlier values do not skew the average. In order to demonstrate the difference, I calculated both the average and the weighted average. The data is presented in the results section of the report.

BUS Dataset limitations

There are three limitations to the BUS dataset: firstly, it does not record the demographic nature of the students who respond (and in this regard is it similar to the TEF and NSS); secondly, it is likely that only the students who attend class fill in the survey; finally, an analysis of the BUS data at a faculty level (as there is more data) reveals that the a non-normal distribution when comparing overall satisfaction verses the total number of responses. To check I utilised a Spearman ranking on the dataset which revealed a significant, but inverse relationship (p= -0.46 / n=76). This indicates that as the number of respondents increases, there is a corresponding drop in overall satisfaction; the reality of this is, as the total number of respondents increase there are less instances of 100% satisfaction. Exploring the dataset reveals a large number of units with very low response rates, mostly with 100% satisfaction.

f. Ethical procedures and considerations

In this section I give a brief overview of the ethical procedures I developed, followed by an explanation of the potential ethical issues I had identified.

In order to conduct research as a student of Lancaster University, but an employee of the University of Bedfordshire I required three different types of approval. Firstly, approval from Lancaster's ethics committee; secondly, as a result of the approval from Lancaster – I had to seek permission from the University of Bedfordshire's research director, and my own head of Department in the Centre for Learning Excellence (CLE). In both cases the outcomes where provided in writing via email.

I identified four main ethical issues: firstly, the need to ensure both staff and students participants remained anonymous; secondly, the need to balance the development of GL and TEL was implemented as the University expected, but not to cause significant disturbance to the learning experience of the students; thirdly, to ensure that changes where proportionate and would not cause students to undertake unnecessary work which might adversely impact students' assessments. Finally, participation was entirely voluntary for both staff and students. In the case of the four staff participants I provided them with an anonymous name: Dr X, Dr A, Dr D, and Dr S. I provided each student with an anonymous ID number: the purpose was to allow me to collate and transcribe interview data, and to make it easier to identify common themes in the data. I use this same ID number – Student 1, 2 etc – within the results and discussion section.

From a practical ethical position there three risks related to student-facing activities and I explain these in order of potential impact (low to high): firstly, that it might not be possible to complete the process of implementing and testing GL iteratively. I have alleviated this issue by making sure that I had an opportunity to conduct work and interviews with a main group (Dr X), a pair of test groups (Dr A, Dr S – interviews) and a second group (Dr D) to confirm the results of the first; secondly, that the changes I wanted to make would have a negative impact upon students'

experiences. I considered that as I was asking for permission to make changes, and the changes where not related to fundamentally changing the alignment of the content against the learning outcomes. The potential impact upon students' satisfaction in surveys such as the NSS would be low because I was dealing with first year students; thirdly, I considered the possibility that my actions might cause students to undertake more activities than required to complete the assessment (meaning students did not adequately complete assessments). I included these potential risks in specific form in the Participant Information Sheets (PIS) for both staff and students as part of my ethical and consent procedures.

I utilised a limited amount of departmental quantitative data to triangulate the outcomes from the primary data source (interviews). This secondary data is collected as part of the University's business practice of evaluating units: participation by students is voluntary, and the questions contain specific references to the use of the VLE which had formed part of the justification for the ongoing implementation of GL. Permission has been granted by the University to use the data, provided I maintained anonymity of individual units and did not reveal data that might identify individuals. I had included the possibility of a low-level survey with students, but I was concerned this might have led to the identification of an individual unit or student, and to an over-surveying of students. For this reason, I used high-level department data available within the institution to all staff, which was reported at University committees and formed the basis for decision making by University managers. The dataset I worked from had the unit codes removed and replaced with an anonymised value, and only identified: the department, the level of study, the total number of participants responding and their responses on a scale of 0 to 5. There was no data relating to any protected characteristics (e.g. race, age, gender) and it

would be impossible (even from the raw data) to identify an individual student as the survey is anonymous at the point of completion, and this data is not collected.

g. Assessing the status of GL in Dr X's and Dr D's units

All units registered with the University have an equivalent presence in BREO (the University's VLE). Lecturers normally place content within the unit site, but the problem in the case of Dr X's unit was that content was available, but it did not match the requirements stipulated for GL.

In order to assess the current position of Dr X's and later Dr D's materials, I developed a schema which allowed for a quick evaluation and to decide what steps to take. By taking the requirements of GL and tabulating it along with an outcome score I was able to assess the standard of the existing content. I settled on a scale running from 0 to 4 – where 0 = no content and 3 = content is fully compatible with the GL requirements. I provide a simple example in table 2.

Content name / week nr:	
Guided learning requirement – from guidance online	Rating
Introduction about the task including rationale, alignment with learning outcome, relevance to assessment, information about time to be spent	0 – no introduction to the task is given
Introductory learning content, in the form of your own writing on the page, images, quotations (properly referenced), etc.	1 – content is provided, but not in the format expected in the guidance
Further learning content on subsequent pages, with embedded audio or video or other Open Educational Resources (OERs)	0 – no external content is provided
Link to activity, such as a discussion, a personal journal for reflection, a wiki, a quiz or survey	0 – no outcome / learning check is performed directly after the GL content
Closing content, springboarding the outcome of that activity into the next part of the unit	0 – no links provided to next week's content

Table 6 – a list of the guided learning requirements (left) and the status of the materials at first examination.

h. Methodology summary

In this chapter I have explained my rationale for utilising TA to provide a rich description of the environment I am investigating. As part of this process the TA-focused data collection and analysis centres around the use of DBR (Design Based Research). I explained my approaches to validity and reliability and laid out the

standards and expectations which is intended to promote a clear explanation of process – again this is for other researchers to follow. In addition to interview data, I also explain the role of secondary quantitative data which is intended to promote the outcomes of the qualitative data. The data also acts as a form of triangulation for the qualitative data – again the purpose is to demonstrate to other researchers that the conclusions I draw are not just based on my own interpretation, but rather there is a secondary source of supporting evidence. The chapter concluded with a method to examine the state of GL in units, the ethical issues this research presented, and the safeguards I put in place. In the next chapter I explain the practicalities of the rules I have set out, and demonstrate how I follow the methodological requirements I have laid out.

4. Delivering GL, collecting and handling data

a. Chapter introduction

In this chapter I provide the practical application of the approaches I laid out in chapter 3 (methodology). I begin by providing an overview of the activities I undertook (table 3) details of the approaches used by staff participants, followed by an overview of student demographics for the group, an assessment of GL in Dr X's and subsequently Dr D's unit, explain how I worked to ensure the GL was delivered according to the University's rules, and data analysis methods. This chapter is separate from the main methodology chapter as I wanted to maintain a logical break to demonstrate the rules I had set out, and then the practical application. During this phase of creation, I kept a log of issues which I encountered which I intended to utilise as a method of reflection upon the policy decisions enforced by the use of GL.

Though I explain my approach in a linear fashion within chapters 3 and 4, because I followed the DBR requirements (Amiel and Reeves, 2008) I made an iterative attempt to develop my research which is explained in table 3.

DBR Area	Actions undertaken
Analysis of practical problems	1. Conduct literature review 2. Highlight key issues and develop an initial plan / examine methodological requirements 3. Obtain ethical approval 4. Examine BUS data for prior year cohorts for specific action points

Development of solutions	5. Begin discussions with Dr X about approaches to collaboration 6. Test interview questions and reform 7. Agree implementation process with Dr X
Iterative cycles of testing	8. Implement GL according to University rules 9. Interview students and analyse data
Reflection to produce design principles	10. Evaluate existing GL material
Iteration to the analysis phase	11. Begin discussion with Dr D about potential for implementations 12. Agree implementation process with Dr D
Development of solutions	13. Analyse domain to test for areas where further exploration possible 14. Extend initial interview questions to include new areas of investigation
Iterative cycles of testing	15. Implement GL according to University rules based on evaluation from (9 / 10) 16. Interview students and analyse data 17. Revaluate existing GL material

Reflection to produce design principles	18. Analyse and compare groups 19. Extend existing analysis to ensure analysis covered both group 20. Collate and analyse department BUS data 21. Review of qualitative and quantitative data to determine links 22. Finish analysis and comparison 23. Generate framework based on first and second iterations

Table 3 – An explanation of how DBR influenced this work's development

b. Staff and student groups within the study

To support this research, I was able to gain the assistance of four academic colleagues. Two staff members, Dr X and Dr D, are the focus of my efforts to implement GL and form the basis of the results I present in the results and discussion chapter. Dr A and Dr S assisted by allowing me to try out my interview questions with their students as well as helping to provide me with an opportunity to assess their own students' responses to GL. In the cases of Dr A and S, their results, and those of their students do not feature in the results and discussion chapter because as I used these as test cases. I utilised the feedback from these groups to aid my more general understanding of the domain.

Dr X and Dr D taught the same unit, but at different times and at different rates. The instance of the unit Dr X was responsible for had a cohort size of around 200 students (group 1) which was taught from October to June – (15-16 academic year). Dr D ran the same unit with a much smaller cohort (12 students), but on a condensed delivery pattern starting in February and ending in August (15-16 academic year) (Group 2). Students in Dr D's unit studied their first year compressed into the period from February until the end of August. Undergraduates normally study a pattern similar to Dr X, and these students where a cohort to maintain later cohort sizes. Students from Dr D's cohort would then merge into the regular second year of the course. Dr X and Dr D each taught and assessed students alone, except when students undertook the final assessment where a viva was conducted.

Though I will discuss this later in the results and discussion chapter, I give a brief preview of the differences between the two groups. In group 1 the students had little cohesion and it was unusual for me to find students working together as a coherent group. Though this changed when the students reached their final assessment, as this forced the students to work together. There was a significant and increasingly significant attendance problem with group 1 students, and this persisted right up until around the final assessment. The students in group 1 studied in the first year on a standard undergraduate degree program. The students in group 2 studied together much more coherently as a very tight knit group. There was an obvious cohesion in the group, and they did operate quite efficiently as a team. Whereas group 1 students had trouble with knowing where to start, group 2 students had a much more driven approach to their study. I think this was partly because of the speed at which they studied, and the fact that Dr D's pedagogical approach was more focused upon

setting the students tasks. It was this that focused the students' approach to learning.

c. The contexts underlying Dr X's and Dr D's teaching approaches

In this section I explain the nature of Dr X's and Dr D's student groups, and how I developed a sampling methodology to capture data from both. I explain the nature of the unit, the assessment points and then subsequently, how I went about sampling and collecting data.

Students who study in the Computer Science and Technology (CST) department regardless of the main course of study, must study a core set of units. These include the units delivered by Dr X and Dr D. All first-year students undertake a standard set of units comprising: two different types of programming languages, the fundamentals of computing, and professional and personal development. All four of these units run on a year-long basis from October to May. Dr X's unit was worth thirty credits (one quarter) of the total cumulative first year grade. Dr X handled the teaching for the unit for majority of the time on their own. The sample of students from Dr X's group was officially listed as 230 students, but this varied over the course of the unit's life for three reasons: firstly, not all students continued after registration; secondly, students withdrew from the course; finally, and most significantly – students failed to attend lab sessions in large numbers. Dr X's estimates where in the range of 80–90 students regularly in the lab sessions, and this had dropped to around 40–50 by the last few practical (lab) sessions. I spent time in Dr X's class after we gained approval to talk to students and get to know the group, the aim of this process was to allow the students to become familiar with me, but also so I could gain some understanding of the students. I made three observations: firstly, many of the

students had difficulty communicating or found communication quite difficult; secondly, for a number of the students present in the labs English was a second language; thirdly, once I was in the practical session a number of students asked me if I was teaching so I used the opportunity to interact and discuss students' approaches – I noted in some cases there was a profound lack of understanding of programming and modelling. I ensured I did not interview students I had interacted with in this way.

Dr D's version of the unit had a total of 12 students, and the student group presented totally different to Dr X's group in three ways: firstly, the students worked together as a tight-knit group; secondly, the students seemed significantly more motivated and generally more articulate than Dr X's group; finally, though the students clearly struggled with the programming and modelling tasks, I was left with the impression that they applied a large amount of effort to the problems they wanted to solve and they appeared to present with significantly more academic nous than Dr X's group.

The teaching methodology Dr X and Dr D employed was based on a lecture followed by a practical laboratory session. In the lecture session Dr X made a recording using a tool known as Panopto.[12] In the first week the purpose of the lecture was to introduce a programming-related topic. In subsequent weeks Dr X and Dr D used part of the formal lecture time to give feedback to the class as a whole on the work they had submitted to a digital dropbox. This allowed Dr X to monitor students' progress, and if students had engaged with materials (students' engagement could be checked). Feedback from the dropbox process was provided in the lecture

[12] https://www.panopto.com

session. Students needed told to anonymise the materials they handed in if they did not want to be identified.

The assessment of students in Dr X's and Dr D's unit took place in four distinct assessment stages.

Assessment 1 – a Computer Based Assessment (CBA) delivered in week 10 and consisted of multiple-choice questions. To prepare for assessment 1 students had the opportunity to undertake a sample test. This was designed to ensure they had adequate knowledge of how the software would work, and secondly, to give them some idea of the types of questions they would be asked to answer.

All of the interventions I applied occurred after the completion of assessment 1.

Assessment 2 – a selected portfolio of work based on the content based on regular practical sessions which students had to submit along with an explanation of how their code or diagrams worked. Students could choose to demonstrate three levels of competence.

The portfolio was a self-selected showcase of students' works from 15 weeks of activities. The three parts 1–3 are a reference to the degree of difficulty and competence which students had to demonstrate, with 1 being the simplest and 3 being the hardest. Submission of mostly part 1 exercises was likely to afford a pass grade, and it was unlikely that a higher grade would be given. Students submitting part 3 exercises could receive an A+ grade. In all cases the students had to provide an explanation of how their code worked with adequate supporting documentation. The assessment limits the size of the submission to 20 pages (including code); this ensured students' explanations and code could be succinct (and easy to mark). Students could submit what they believed to be their best work. This judgement is

based upon weekly feedback from Dr X and students' desire to reach a certain grade.

Assessment 2a – a timed exercise for students to gain extra credit was also made available after the completion of the portfolio.

This was a sub-assessment offered as an extra credit assessment for students. It was based upon one of the lab exercises used for the portfolio in assessment 2. Students had the opportunity to complete a modelling and a programming exercise. The assessment had to be completed and submitted during the session (3 hours).

Assessment 3 – a final group project which drew together all of the elements from assessment 2 where students needed to produce a working application. The assessment involved both attendance at a viva and a 20-page written report.

With the experience of creating and delivering a portfolio for assessment 2, students needed to produce a fully operational application as part of a group project. There was an expectation that both modelling and coding would be used to create the end product. Dr X selected the student groups individually The final product students produced was supported in a viva – where code and modelling methodologies are explored by the lecturer, with a supporting assessor for moderation purposes. Students also had to submit a group report and copies of code for assessment. During the viva students might have been asked about any part of their application, code or modelling.

Dr D's unit was exactly the same in terms of learning outcomes, content within the VLE, pedagogical approach and assessment. The group size was 12 students, and the timing of the unit was from February to September.

d. Student population and demographics

Group demographics

In order to provide context to other researchers exploring my study I have collated some high-level demographic data for the 1st year students in the 2015-16 cohort. Within this section I provide a quick overview of the data, and reflect upon how this may have influence this may have had on the data I collected and the disposition of the students. Data was drawn from the University's student records system - SITS, and I have avoided highly granular analysis to avoid identifying individuals.

Gender-based split

SITS only recorded two categories of gender at the time data was entered into the system. As generally seems to be the case in the literature (Shadbolt, 2016, Gordon, 2016) the student group mostly consisted of students who identify as male. In this sense the cohort is perhaps 'typical' of the gender breakdown one would expect. I reflected this balance in the purposeful sampling I conducted. I would suggest that the gender split was not as significant factor as ethnicity or origin.

Gender	#Students	%Total
Female	23	10.7%
Male	192	89.3%

Table 7 - Gender breakdown of the student group

Location

To avoid potentially identifying individuals I have aggregated the location data to EU, non-EU and UK-based students. Non-UK students make up 26.1% of the total cohort. Reflecting on the participants I interviewed, I had managed to sample according to the ratio outlined below. However, I did notice that there where a greater number of EU students present and willing to participate when the final

assessment was due. The University is situated in a town where there is a major airport with destinations to EU countries, and local employers such as Amazon tend to (from conversations with students in the cohort) tend to draw in students. If another researcher wanted to replicate this study, I would suggest that an exploration of students' activities outside of the University factors impact upon learning. A source such as the UKES (UK Engagement Survey) could provide an additional insight into students' behaviours.

Geo Area Name	#Students	% of Total
European Union	35	16.3%
Overseas (non EU)	21	9.8%
United Kingdom	159	74.0%

Table 8 – Distribution of students by origin (fee types)

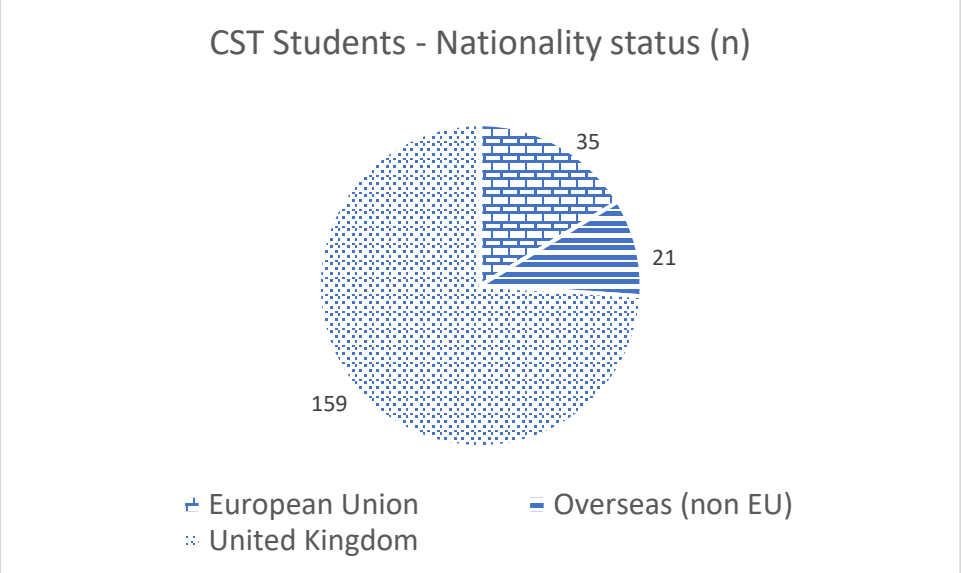

Chart 1 – mapping the origins of students

Age groupings

Data taken at the point of initial enrolment demonstrates that the largest group of students are 18-21 year olds. For the purposes of comparison to other non-UK HEIs, it would be worth noting that the majority of the group (72.4% of the total students) are recent school leavers. In the results section the BUS (Bedfordshire Unit Survey)

data demonstrates a propensity towards understanding the assessment requirements. Part of this effect could also be attributed to the lowering of the University's entry tariff which was the case for this academic year. My discussions with all the staff participants led me to believe that the students' approach towards assessment had become more challenging, and was the basis for Dr X considering removing the portfolio exercise and replacing it with a single timed exercise. The students in group 2 fell into the slightly older age groups. I would suggest that this may have been a factor in their approaches to learning, which was generally more systematic.

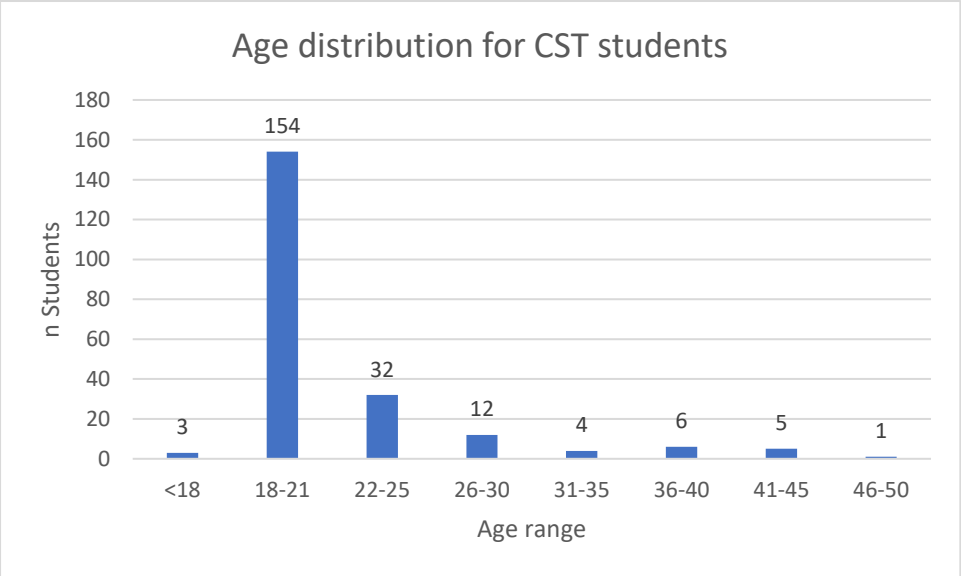

Chart 2 – age groupings for CST students

Ethnicity

The University has a main campus in Luton, and the town is known for its very diverse population, and as a widening participation institution drawing in students from high and low IMD (Index of Multiple Deprivation). Students in CST reflect the town's diversity, with very closely related numbers of Asian, Black and White students. The category 'Others' is provided in the table below to ensure that

individual students are not identifiable, and it consists of a small group of Chinese students, along with ‘Other’ and ‘Unknown’. Wider institutional data suggests that in some cases Asian students outperform Black and White students, but this data is for final year undergraduates.

Ethnicity	#Students	% of Total Students
Asian	59	27.4%
Black	64	29.8%
White	68	31.6%
Mixed	6	2.8%
Others	18	8.4%

Table 9 – a breakdown of students by ethnicity

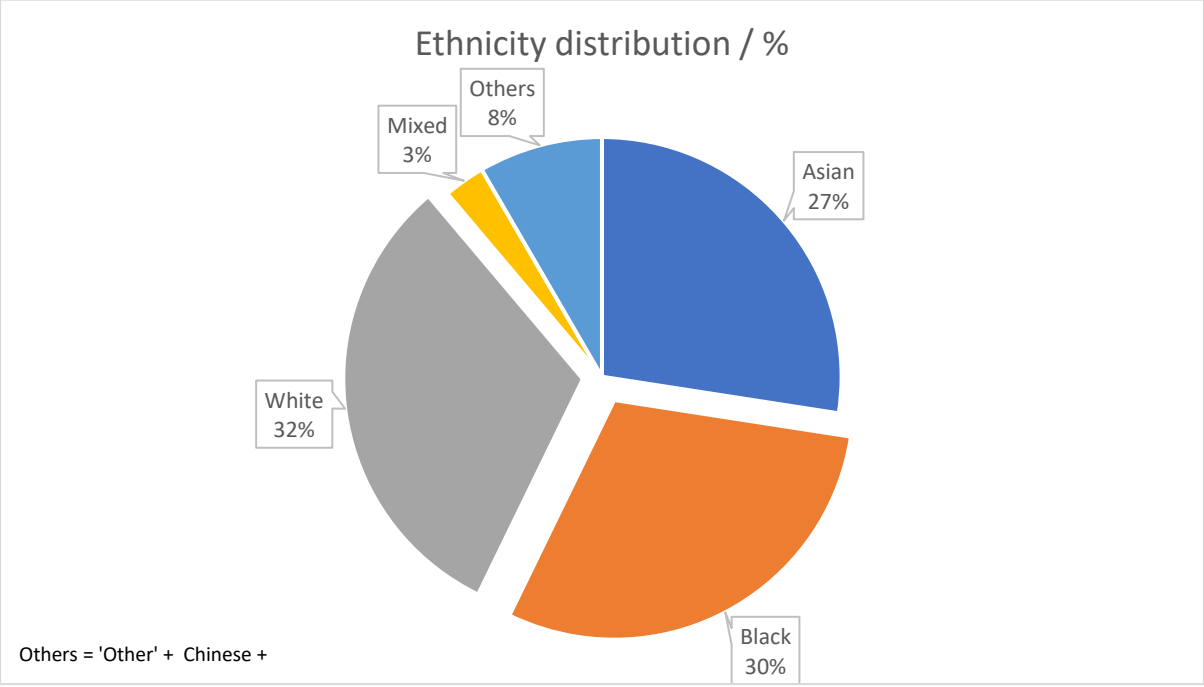

Chart 3 – breakdown of students by ethnicity

What influences does the demographic data potentially pose?

Discussions with all of the staff participants led me to believe they thought students concentrated less on learning, and more on assessment. Evidence from the staff members’ perception can be matched with data from the University’s own internal unit survey (BUS) which correlates assessment related questions more strongly

(Spearman's ranking) and reliably (Cronbach Alpha) than any other category for students in CST. At a University-level the most significant feature of the data (and this is now a target of a specific Access and Participation Plan from the Office for Students) is the ethnic diversity of the student body and the rates of achievement for groups, and CST presents as a subject area is very high diversity. This brings challenges for academics in terms of how they approach and engage with students as there may be cultural barriers to seeking help, or the nature of feedback delivery being effective, or in some cases understood by the students. Other researchers looking to replicate this body of work would need to make a careful examination of their own rates of achievement and other contributory factors I have identified in this section. At a high-level the outcomes are likely to be similar, but the purpose of utilising a DBR approach (Amiel and Reeves, 2008) means I explain the context I am working within in great detail. Other researchers will need to form a judgement based upon the framework in the chapter 6 – conclusion.

e. The status of GL in Dr X (and subsequently) Dr D's units

In all the cases for Dr X's materials we looked to transform, the material was laid out in a logical order, but it did not meet the University's requirements for GL. Having discussed this problem with Dr X, we agreed on some changes I would make to the existing content which could then be exposed to students.

The changes in the first iteration (Dr X) included:

- Refactoring of existing content to meet the GL requirements and ensuring content delivery was via a learning module (as indicated in the guidance)
- The drawing in of links external to the University with content explaining their purpose

- Where possible the addition of additional materials such as tutorial content, OER-based materials or videos (as prescribed in the GL guidance)
- The addition of a learning check quiz at the end of the block of learning
- Links and reminders about the flow of content.

Given the timing of ethical approval from Lancaster, my own institution and my discussions with Dr X, we settled upon changes to the remaining 4 weeks of lab and lecture time. The reasons for this change: the interference in the lecturing schedule of the Easter break for that year; the lack of student attendance led Dr X to subsequently sought permission from senior management to turn assessment 2 into a single timed exercise. This was at least suitable as it gave students experience of GL which was delivered by Dr X, and then GL delivered as the University prescribed it. When working with Dr D's unit I started the process of refactoring content much earlier. We made changes for 12 weeks' worth of content. This covered the period after assessment 1 through to and after assessment 3. Dr X's unit assessment approach meant that students would need to spend a significant amount of time re-reviewing the GL content (both old and new) to meet the requirements of assessments 2, 2a and 3. The next stage was to engage with students to better understand how they approached the preparation of their assessments and how GL was aiding them in doing so.

f. Creating Guided Learning interventions

In my initial analysis of Dr X's unit I found that though there was content, it did not meet the requirements of GL. As I wanted to test the reach and utility of GL we had to ensure we actually delivered GL. I had to work with Dr X to transform the content in the unit. To give the reader some context I provide an example in figure 5 of the

existing GL provision. The materials provided to students took the form of two individual items contained details to be carried out during and after the practical session, and the digital dropbox for students to submit their work into. This approach and layout is not congruent with the GL guidance.

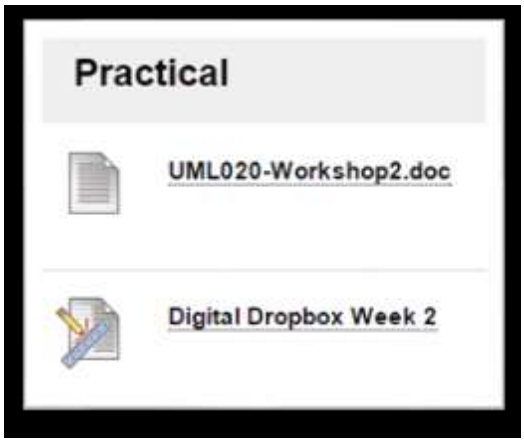

Figure 6 – The original content delivered to students

We implemented changes to 4 weeks' content and the resultant material took the form of figures 6 to 12.

To ensure that students had adequate instructions for the materials we placed clear instructions on the first page explaining how to navigate the materials.

Figure 7– refactored content made available to students

Guided Learning Requirement	Changes made to existing content
Introduction about the task including rationale, alignment with learning outcome, relevance to assessment, information about time to be spent.	New content was added including all of the elements from the left hand side. Students viewed this as soon as they tried to access lab materials.
Introductory learning content, in the form of your own writing on the page, images, quotations (properly referenced), etc.	We reused content which was spread around the unit site in the form of eBooks and links. Consolidated into a single screen pointing out how students could utilise them for the particular lab session.
Further learning content on subsequent pages, with embedded audio or video or other Open Educational Resources (OERs).	The pages from the original content have been reorganised onto pages which allow students to view the content online, and files which are needed for each part of the activity are linked into the existing content.
Link to activity, such as a discussion, a personal journal for reflection, a wiki, a quiz or survey, etc.	We utilised a quiz at the end of the content to review some of the issues students may encounter in the practical session. In addition students are reminded to utilise the dropbox to get receive feedback in the main lecture session.
Closing content, springboarding the outcome of that activity into the next part of the unit. summary of the changes made	In group 2 a fuller summary page was used to help students review content.

Table 10 - a full explanation of the changes we made to the material.

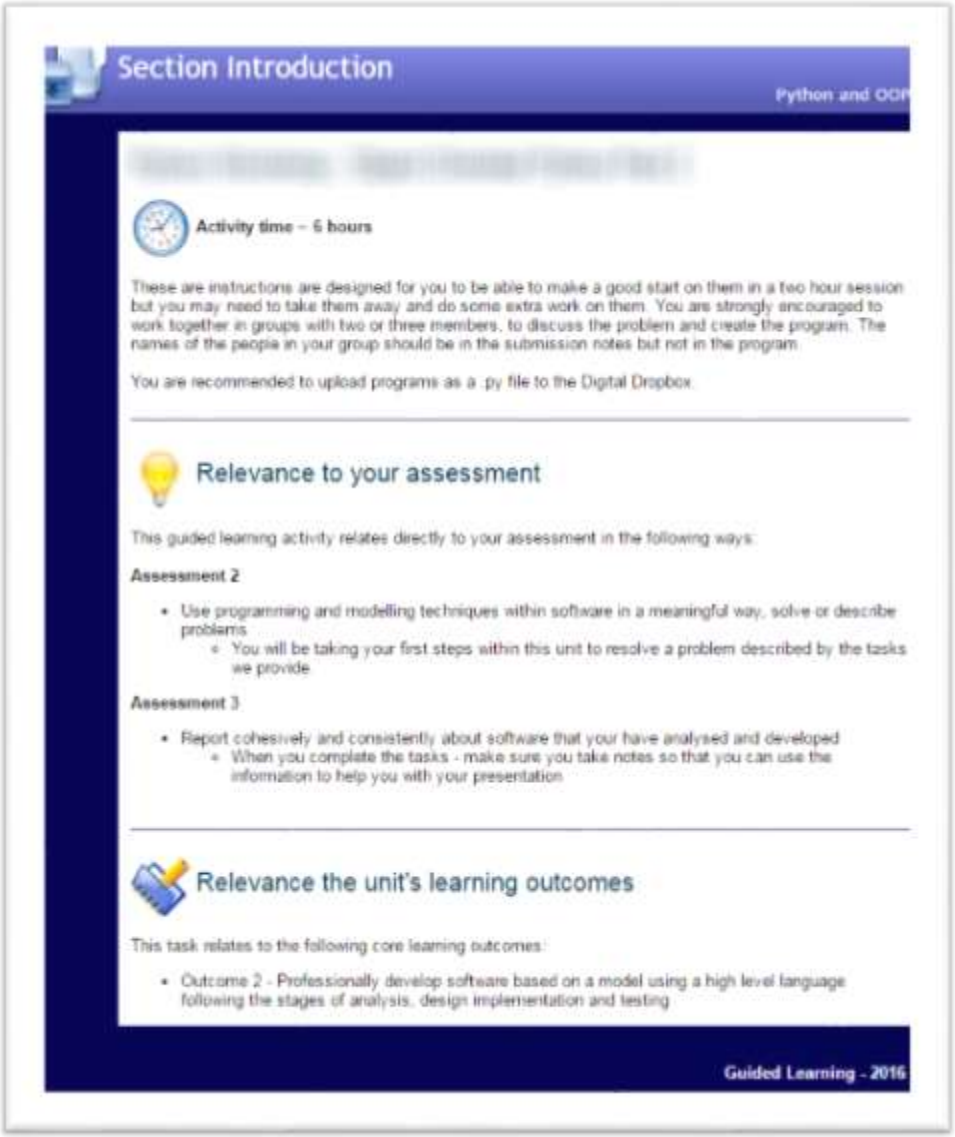

Figure 8 – The new 'GL' compliant material – the first stage before students access materials

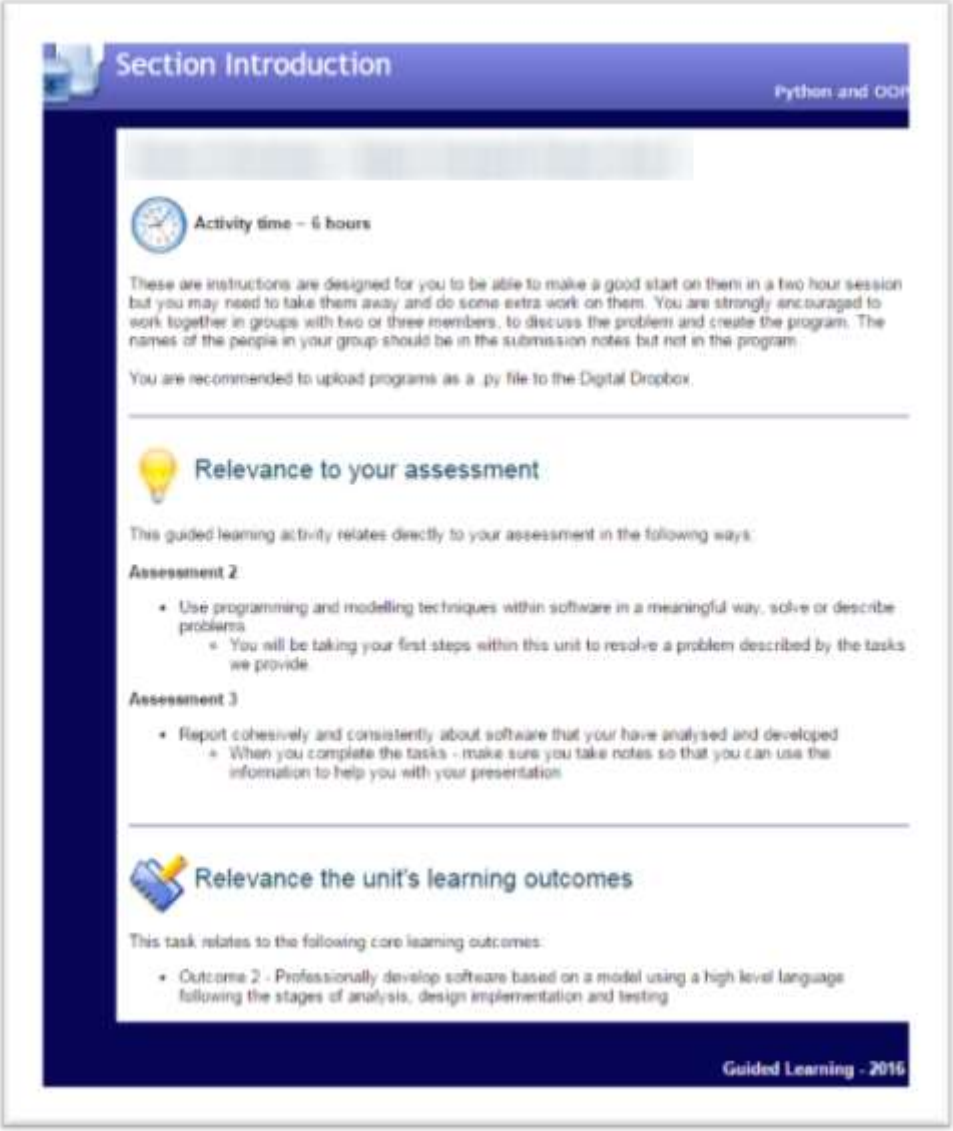

Figure 9 – Page 1 of the newly formed materials with links to assessment and learning outcomes

We also refactored in some of Dr X's content which was distributed throughout the unit into clear elements for the students. In figure 9 this took the form of online resources which supported a specific block of learning.

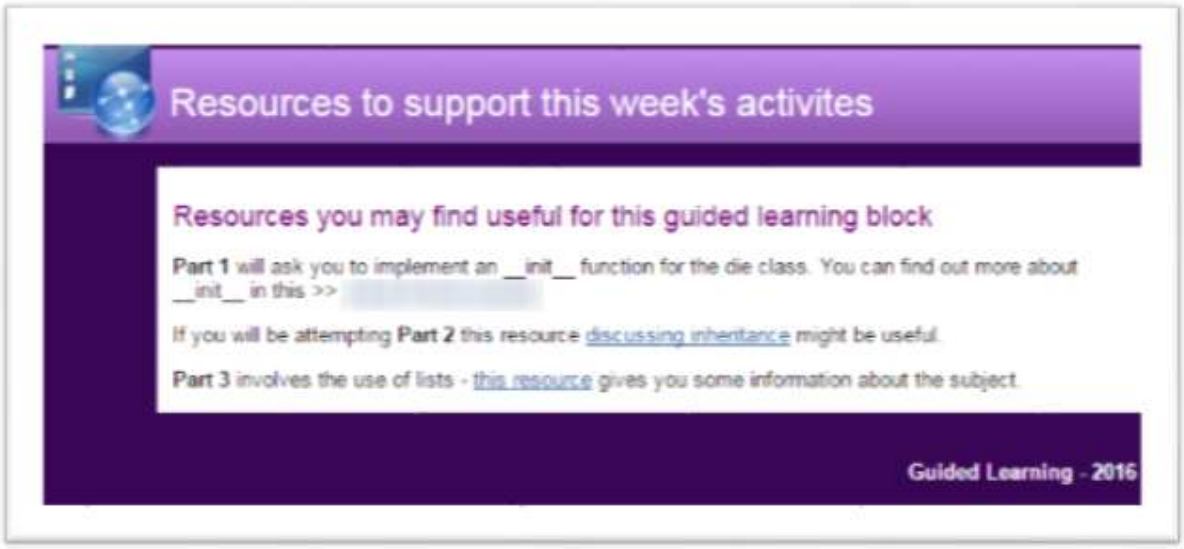

Figure 10 – The resources distributed within the site - provided in context to support the activities in parts 1 to 3

At the end of the learning block we set a quiz to give feedback. In our discussions Dr X suggested that we utilise quizzes as they would mean students had instant feedback and meant that there was not an additional pedagogical burden. I placed emphasis upon the part 2 activities in the initial quiz.

Figure 11 – A sample of the quiz template informing students of the purpose of the quiz

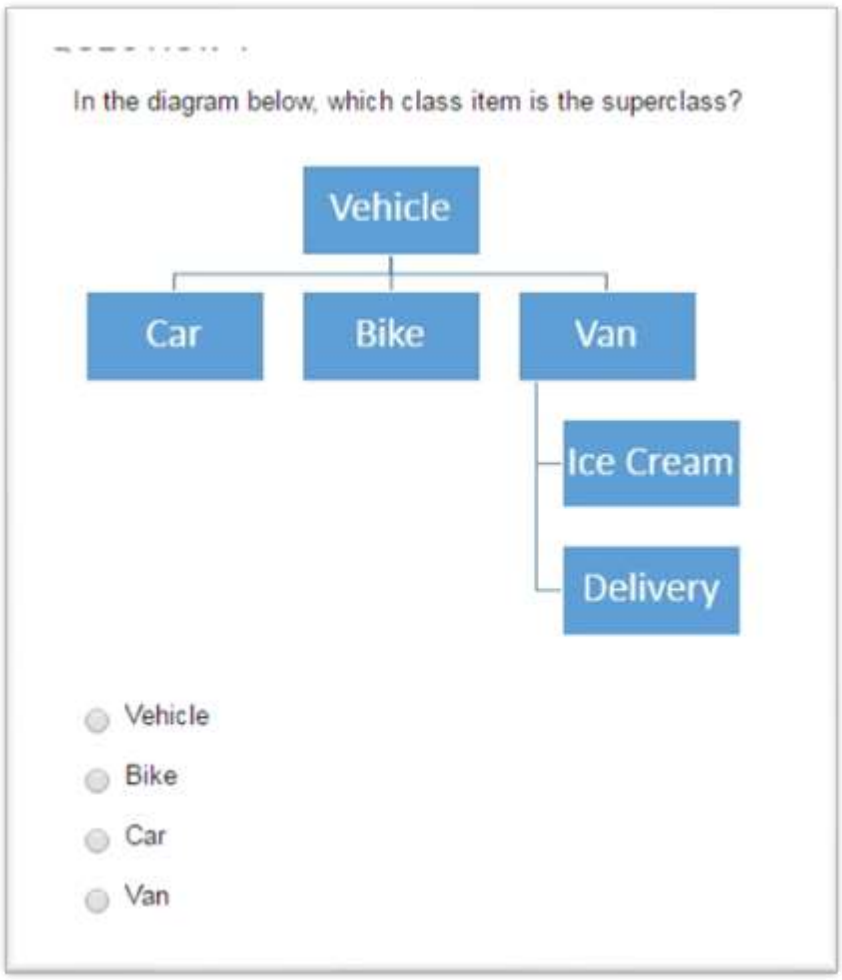

Figure 12 – An example question designed to probe students understanding of classes, super-classes and subclasses

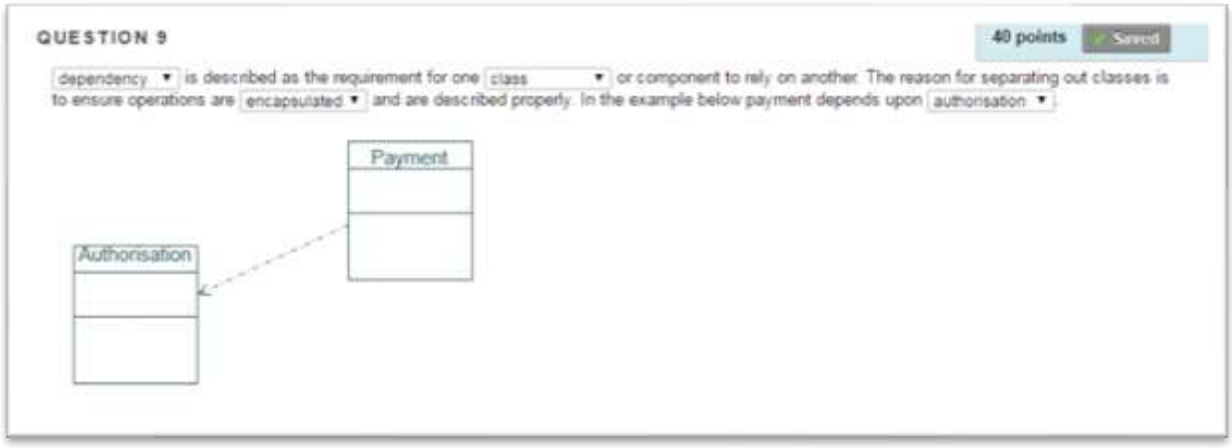

Figure 13 – An example of a drop-down style question which requires students to select the correct phrase or word from a series

g. The Thematic Analysis approach to data collection, processing and analysis

I utilised Braun and Clarke's (2006) outline of analysis, which is detailed in six parts. In this section I explain how I approached the analysis and the considerations and constraints on the methodology that lead to an effective analysis. The six high-level stages of the approach are: familiarisation with the data; the generation of initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the final report.

I utilised four different data collection points (two are my actual study group, and two test groups). In the following section I detail each of Braun and Clarke's (2006) phases, apart from the final "writing the report".

Familiarisation

After I had transcribed the interview data for each group, I took a two-stage approach to familiarisation. My intention was to become aware of the language used by students, and to form a general sense of the ideas students presented. I kept the transcriptions as close to the original speech as possible, taking care to use punctuation and to capture the expressions delivered by the students.

Generation of initial codes

Using the transcripts, I needed to find a simple way to organise the outcomes from the interviews. To aid initial code generation I utilised a method where I summarised each transcript using a spidergram and a set of shorter transcript notes, finding a term to classify responses from students into an initial code. For example, where students spoke about assessments, I generated an initial codes like: assessment

requirements, assessment grades, problem solving with assessments. I give some examples of these initial coding in the results section. I collated the full list of initial codes so that they could be used to work into high-level themes. In figures 1a, 1b, 2a and 2b I provide some examples of the cataloguing methods, interview summaries and spidergrams I generated when considering the initial ideas that the students presented. I used these to help catalogue and determine the best way to collate the themes and to present them logically.

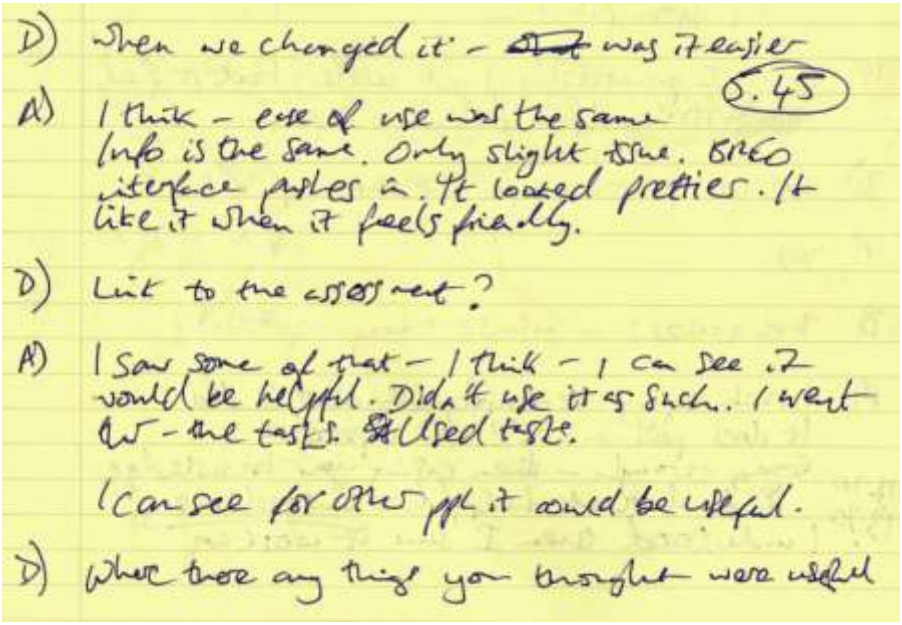
D) When we changed it - ~~that~~ was it easier
5.45
A) I think - ease of use was the same
Info is the same. Only slight tone. Bred
interface makes it. It looked prettier. It
like it when it feels friendly.
D) Link to the assessment?
A) I saw some of that - I think - I can see it
would be helpful. Didn't use it as such. I went
for - the tasks. Skilled taste.
I can see for other ppl it could be useful.
D) Were there any things you thought were useful

Figure 14 – Field notes example

I took first impressions from interviews to ensure I had a general sense of what students had said, and also to check my understanding of the language used

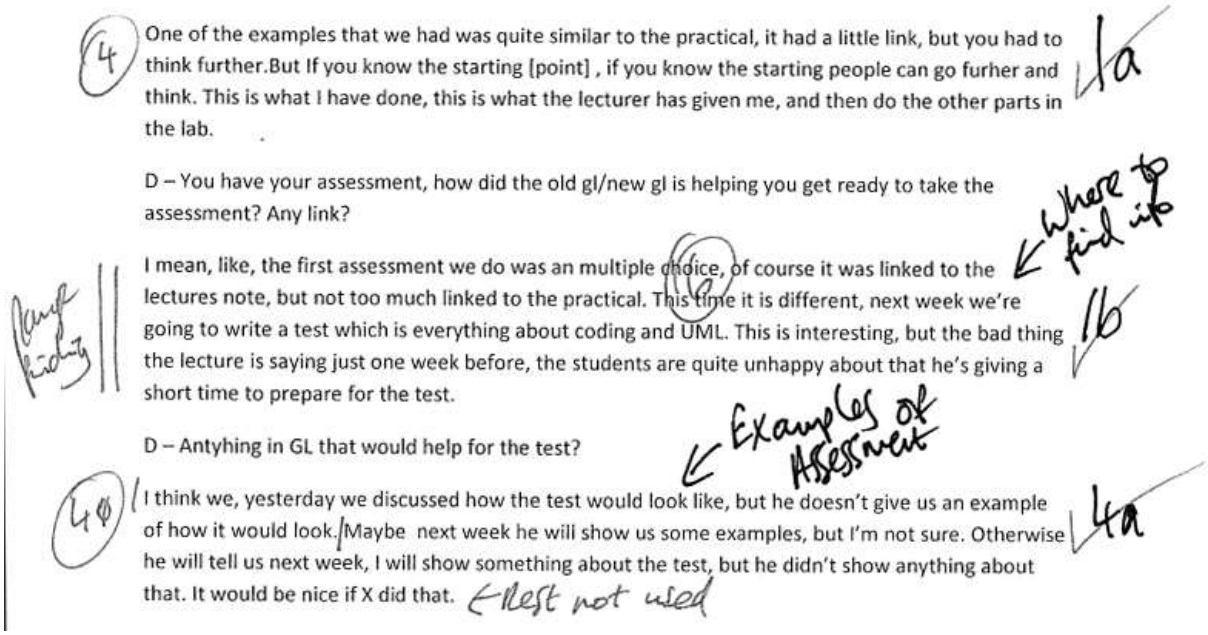

Figure 15– Manual attempts to classify and determine themes for data

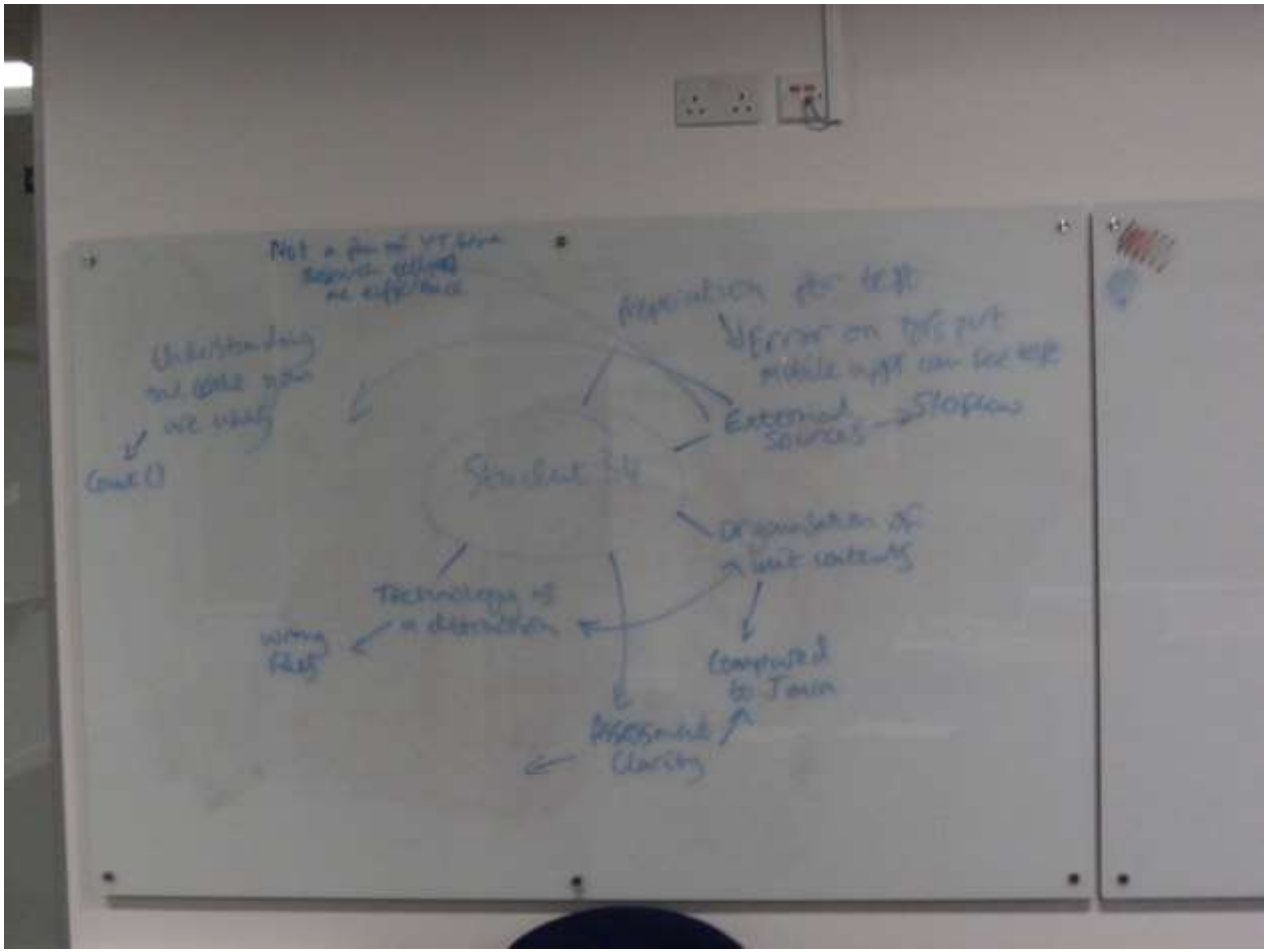

Figure 16 – example overview spidergram created from a combination of an interview transcript and summary

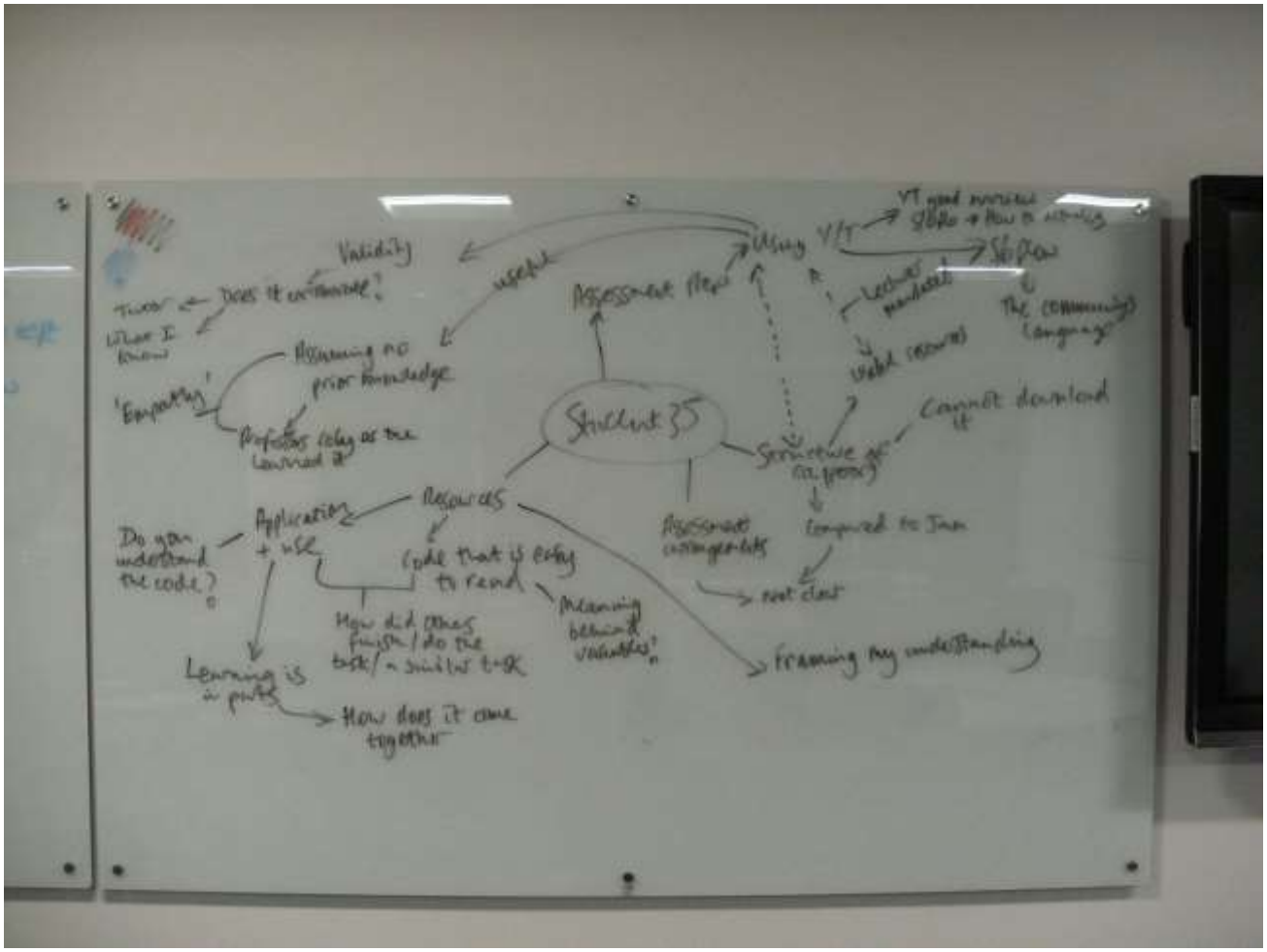

Figure 17 – example overview spidergram created from a combination of an interview transcript and summary

Searching for themes

Once the initial codes had been generated, I found they made reference to several different concepts, but some logical relations existed between them. During this stage I considered two different approaches I might use: being solely data driven, or viewing the data through the lens of my research questions. My research questions gave me two broad macro-level themes: the use of GL and TEL and student' approaches to development for assessment. I decided that the initial themes needed to avoid these two macro-themes because it would be likely that not all of my data would fall into these categories. My initial efforts yielded a total of 21 themes which included subthemes which required further reduction and refactoring into more directed groups. The starting point for this process was structuring portions of the students' responses to interview questions. In figures 3a, 3b, 4a and 4b I provide an example of aligning the responses from students to the initial set of themes. My aim was to ensure that if I had identified a theme that it was based on a quantity of data from students. It helped me to identify where themes overlapped, and to identify themes where there was little supporting evidence which provided an opportunity to determine if the classification was logical.

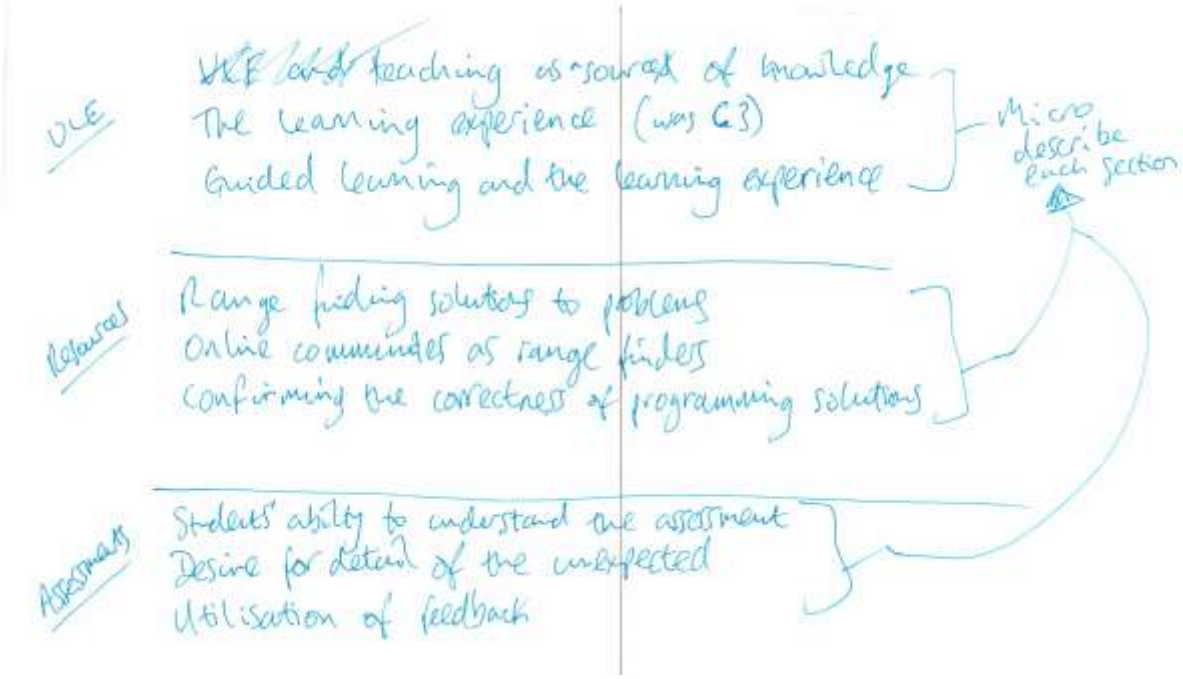

Figure 18 – An initial view of potential categories, before expansion – from my original notes

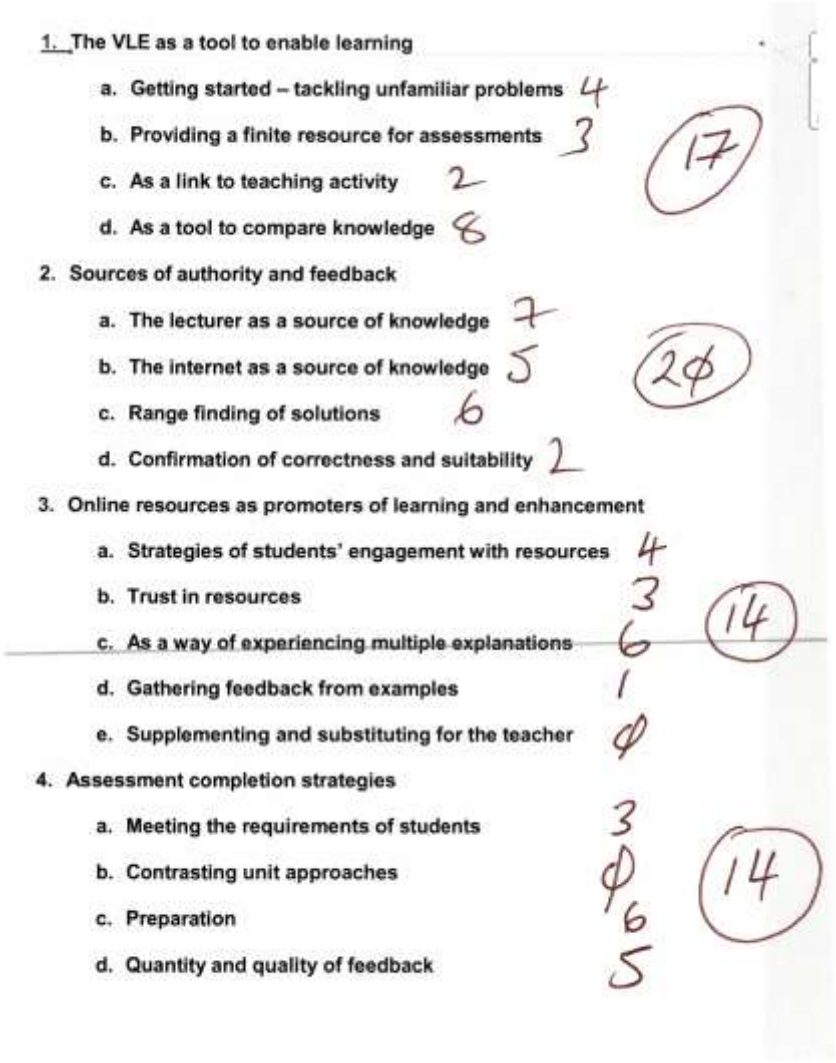

Figure 19 an expanded set of themes designed to help checking to see if there was a logical ordering and to test my structure. In this handwritten example from my notes I am looking at the quantity of supporting that exist for each theme.

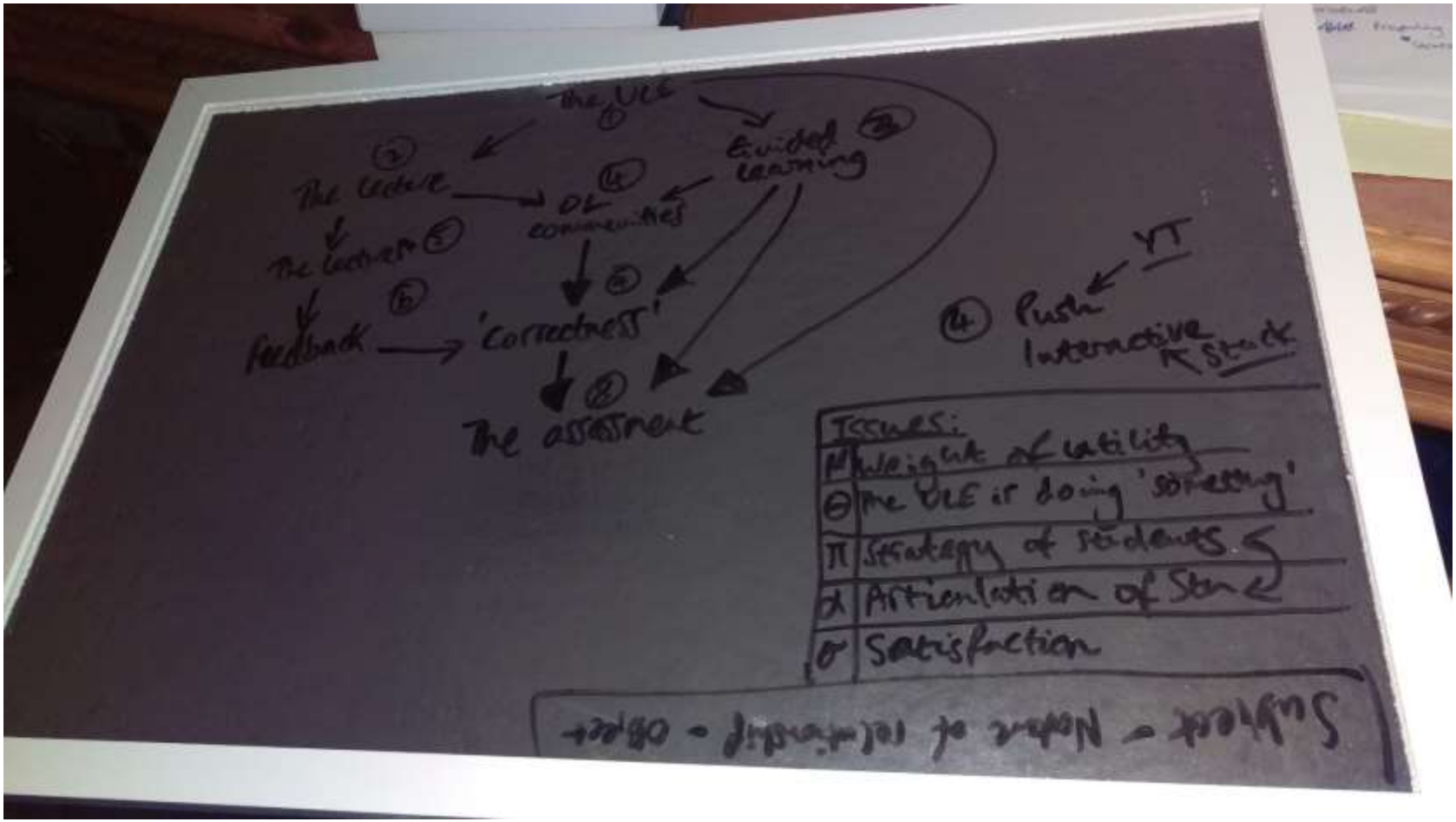

Figure 20 – advancing from the initial set of themes and outcomes

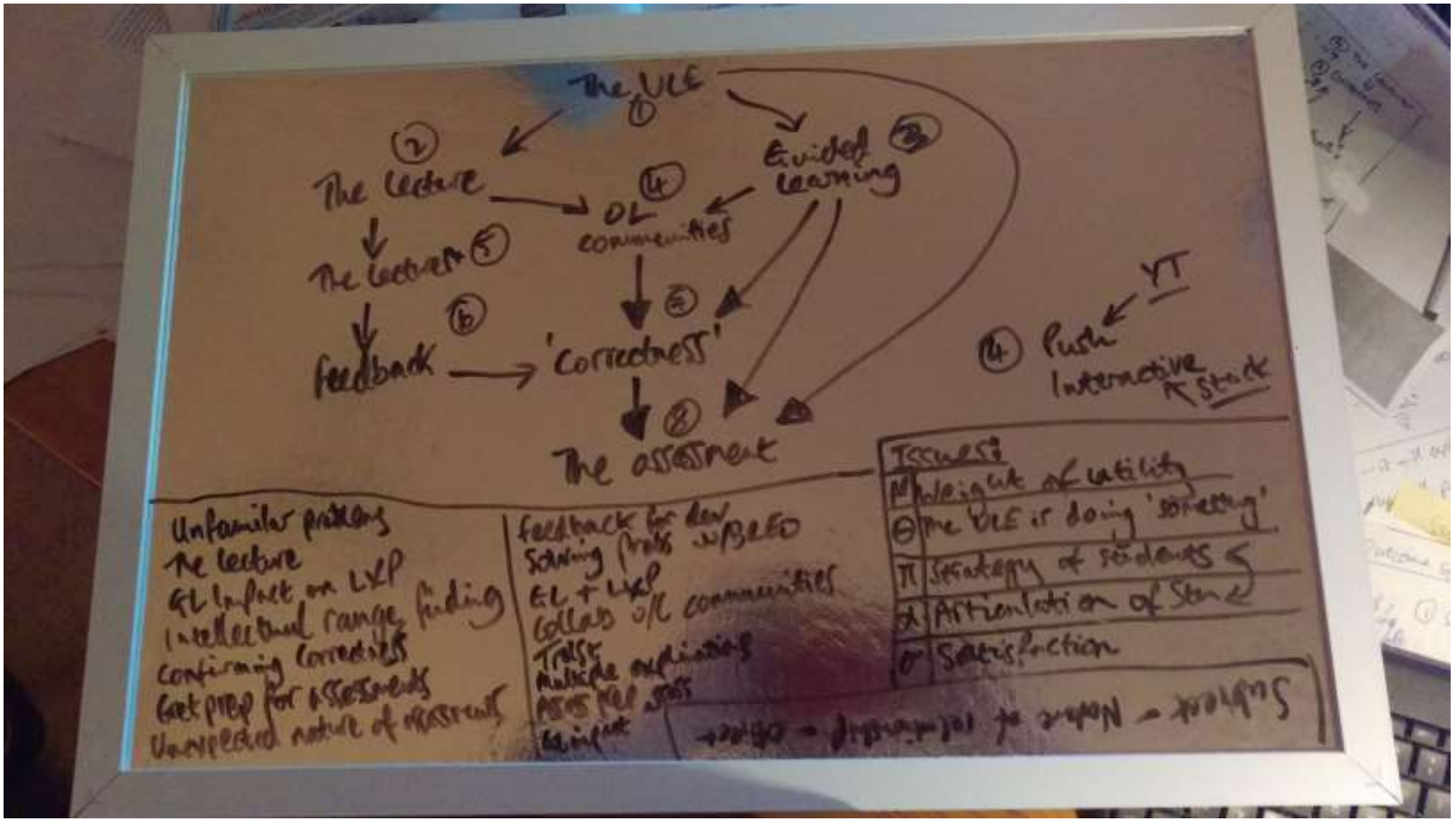

Figure 21 – the near final set of themes I lead with in the results and discussion section

Reviewing themes

Once I had completed the initial set of themes, I laid out the transcriptions with the themes and quantised the number of sections of each transcription that matched it. This enabled me to determine if a particular theme was describing a wider aspect of my dataset or a smaller subsection. In the latter case this indicated to me if a theme was not well supported by the data, and to identify themes that shared a common base. From this I performed two actions: firstly, to determine if a theme was coded appropriately (in the case of small-scale theme) in which case I could review the data attached to it; secondly, in the scale of a more all-encompassing theme to ensure that it was not a high-level theme which should actually form smaller subunits.

Defining themes

Once I had considered the themes I went through two more iterations before I arrived at the final set of themes. I took three elements into account: firstly, that I could tie the data in a theme into the overall heading; secondly, that each theme could be arranged into a level – I detail this in the results and discussion section; finally, that I would be able to succinctly describe (in a few lines or phases) what a particular theme represented.

h. Chapter summary

This chapter has discussed the practical aspects of chapter 3's methodological approach. I provided an explanation of the staff participants, the context of the implementation including information about the plans for assessments, student demographics, the status of existing materials (which did not meet the requirements of GL), the interventions put in place, and finally demonstrations of the methods I

applied to the data captured from students. In following the University's guidance I found that a number of issues with the requirements, and I uncovered additional complexities around the implementation of GL. I detail these in the results chapter as they relate to RQ2.

5. Results and discussion

a. Chapter introduction

In this chapter I detail the results of the main part of my investigation. I detail the themes that I have reached from the analysis of my data. I then consider the impact of my findings against the first two research questions as these relate directly to my primary data. The third research question is dealt with in the conclusion. I consider the design and application of GL and the effect of the changes made upon students' experiences, along with presenting some reflections I collected along the journey of interviewing students and working with staff to produce this application of GL. Towards the end of this chapter I provide some data related to the BUS (Bedfordshire Unit Survey) which provided an unexpected insight into the students' expectations and priorities. I conclude by exploring the outcomes of my investigation against the first two research questions. Research question 3 is dealt with in the final chapter.

b. Themes generated from the analysis

In figure 18 I have laid out the structure of the themes to represent the journey of the students during my data collection processes, and this figure should be read from top to bottom.

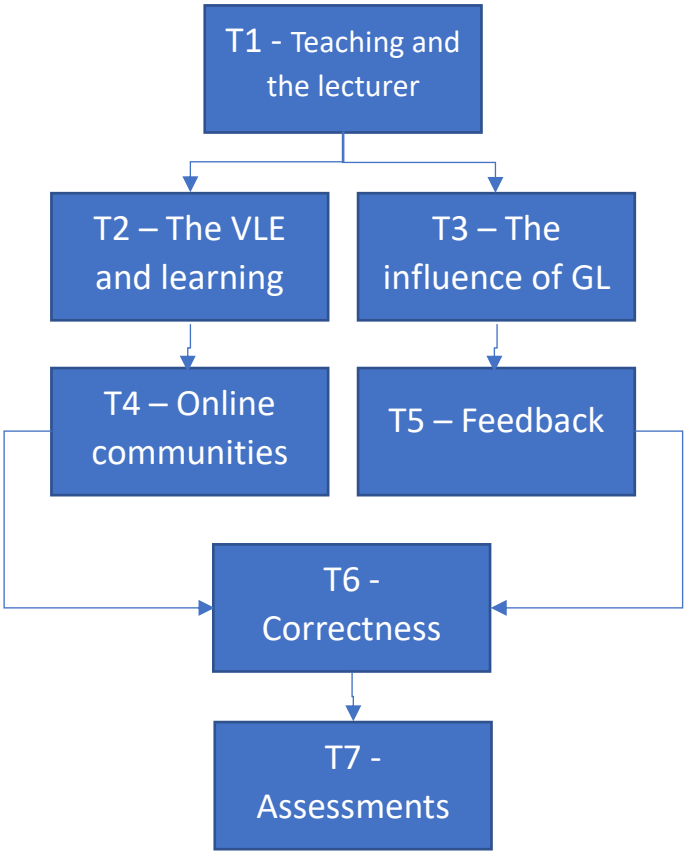

Figure 22 – An overview of the themes from this research – the progression is from top to bottom

The progression of students towards the intermediate or final assessments placed different demands upon the students and required increasingly complex knowledge.

The grouping online communities is linked to both the activity in the VLE and GL, as in most cases students relied on online communities to understand the materials and the information provided in lectures and in the VLE. It became apparent though that the students used the information online for more than just the purpose of research,

in some cases as part of their final programming assignment. Of all the issues I explored it is the last one which seems to cause the most problems and I believe an issue of trajectory of students' skills into the final year. I return to the relevance of this problem later in this chapter.

c. Theme 1 - Teaching and the lecturer

In the literature review I explained that blended learning proponents possess an enthusiasm for depreciating the lecture as a source of interaction, and their intentions to replace it with online interaction. Within the interviews with students I wanted to see how the formal lecture session and the practical sessions contributed to students' learning experiences and as an aid towards their completing the assessment. I found there was a significant amount of utility ascribed to the lecture because it would tell students what to expect in the practical, and also provided knowledge in the form of source of code which could be used to construct programs that inform lab sessions.

A consistent feature of students' descriptions of the way they used lectures focussed upon the need for 'more examples'. This shows that students still expect to find what Bruce et al. (2004) found – the need for constant feedback and input from staff. In this case the examples act as a form of feedforward; they allow students to be presented with a conception and for them to subsequently test out their conceptions.

> *"I mean, like, the first assessment we do was a multiple choice, of course it was linked to the lecture's note, but not too much linked to the practical. This time it is different, next week we're going to write a test which is everything about coding and UML. This is interesting, but the bad thing the lecture is*

saying just one week before, the students are quite unhappy about that [Dr X]'s giving a short time to prepare for the test." (Student 3)

In the main students' experiences of formal teaching led them to see the lecturer's efforts as being necessary for basic information transmission.

"It helped a lot, I went to the lectures, almost every lecture. The stuff that was presented in the lecture was exactly what we needed to do in the lab sessions. Usually, right before the labs. After the lecture we had fresh information we could use in the programs in the labs." (Student 1)

With some frequency the students utilised the lecture sessions and associated materials as a revision aid. The students' activities focussed upon looking up information, for example:

"It's up to [Dr x], to decide how [their] lesson/lecture plan works. But, however, in terms of sources on BREO, it's never too much of an issue. If I find something on a lab session I don't know, I can always look in the lecture from the previous week, or the lab session for the previous week. I can connect my own dots, so this what needs to be done, regardless of what's been in the lecture last week." (Student 26)

"[Dr X] always puts my lecture, the notes from the PowerPoint [they're] using, so I find that helpful to just go over it again. Also, [they] publish[es] online resources we can use with every practical session that we have. So if there are any problems there's like related topics we can go through." (Student 1)

There was little sophistication in the students' approach to drawing upon information in the VLE. The difficulty is what to make of this problem – this indicates a position of technology **enabling** learning as correct. My interpretation of this was that the

information was necessary, but equally I could see why technology enthusiasts might seize upon this idea as a focus for enhancement.

d. Theme 2 – The influence of the VLE as a resource for learning

This category reflects a starting point from which many of the students' other activities orbit. I have chosen the term orbit as a metaphor – students tend to depart from a combination of the activities within the VLE and information from the lecture to work with external resources before returning to content within the VLE.

Sequentially, students initially experienced a lecture which dealt with a theoretical aspect such as UML modelling (a technique used to determine the requirements of a piece of software) and then a practical session at which content and instruction from the lecture could be put into practice. It is not particularly sophisticated, but the students do need to have a point where they get essential information. This makes for an important point about the need to structure materials to allow students to start working. For example, there is an issue where a student is faced by an unfamiliar problem – the VLE is allowing the process of learning to take place:

> *"You know for examples, for use cases/activity diagrams I did use examples that he [Dr X] gave us. Because it was very helpful and it was the first time doing those types of things. So for me it was very helpful, when you do something and you've never been used to it before it takes some time. It was very helpful; it gave all the stages of the use case for examples more particularly in activity diagram. Use case diagrams and activity diagrams are completely different from each other."* (Student 18)

Once you provide an essential amount of information, students can sometimes think this is not enough. Student 32 spoke from the perspective of solving a problem, and was critical of the resources in the VLE.

> *"Personally, I've been using the university as a guide, instead of what I am supposed to know. Of course I am going to use the university [resource] and everything. I learn better by myself. I don't think people should rely on someone else, everyone has their own learning style right? As I say, the university should let us know what we're supposed to know, at a given time. Err, yeah, I mean even the university doesn't encourage students to look for other resources, I mean people who care, right. Plus, also I think people are looking for an excuse to not try. I mean because, even in my class, I hear students say, I don't care because the university doesn't care."* (Student 32)

This speaks to a problem that is colloquially called 'spoon feeding', the VLE must either provide everything a student wants (which I could argue makes students more satisfied), or the lecturer may provide it. Students also spoke of the VLE in terms of what needed to be completed in the practical session, in terms of a deficiency:

> *"So, the only thing I find on the practicals is that, it's not the same for everyone, perhaps there should be more hands-on explaining. Let's work together, let's go through, that's how I find it difficult. Sometimes reading it, I don't understand the theory of it, how am I going to expect to understand the practical. I find that speaking to other students, they are struggling to understand as well, the process of it."* (Student 27)

The VLE has a limited use in that it is being used to push content to students. It equips our students with a base level of content which they can then utilise, or as one student described it, a starting point.

> *"One of the examples that we had was quite similar to the practical, it had a little link, but you had to think further. But If you know the starting [point], people can go further and think. This is what I have done, this is what the lecturer has given me, and then do the other parts in the lab."* (Student 3)

Student 31 gave an example about a problem from the lab sessions: as part of their project they needed to write information to a file:

> *"We had the choice of writing to a text file or SQL. I decided to go the way of SQL because it's a bit more industry standard and I wanted the challenge of connecting [Language X] and SQL. I couldn't remember half the syntax to open and read the files. You know you open files, read files, I couldn't remember the syntax. I remember going through lots of BREOs to find that particular thing. You go online and there's all different variations of it. I remember there was a nice clean PowerPoint slide of what we did…*
>
> *That particular example was quite difficult to find in BREO, I really struggle to find it in BREO."*

Tackling a new problem might also involve students using other resources that are indicated as being useful, or linked from the VLE. There was also an issue described by another student that talked about the flow of materials from one concept to another, and how this was not clearly laid out in the VLE:

> *"A lot of the exercises [in BREO] are done in isolation. Some of them exercised do link back to the previous exercise, but not in a way which*

massively meaningful. I thought that starting with a very simple program, and then beginning to implement other parts of the programming, other different aspects of the same application helped me gain a greater understanding of how these assets and parts intersect and can be used with one another. We want a program that creates a class, you know and then creates an object from that class." (Student 35)

Only two students in total mentioned using books to help understand problems, and it leads me to question if students think the information is in some ways either too dense, or not aligned to help solving problems. In the case of Student 27, there is an echo of what the reader will find in themes 4, 5 and 6 – efforts to access as many types of resource as are available:

"Oh yes, some other books in the library, other references on the internet to find out the information. Like Dr X said, you've got to read 10 books before you find which book you understand." (Student 27)

In response to a specific question about the use of the library or journals Student 10 indicated:

"No, I reckon probably next year we'll start to have to use it [books/journals]. This year I just stick to BREO."

This theme therefore is more about the basic tools we give to students, and I have deliberately set it apart as a limited experience. A common thread amongst the examples is the idea of using a practical to understand a lecture, or using a lecture to understand a practical. There is little sophistication in students' approaches when you ask them to describe how they begin to solve problems. Most will admit, but in

fairly limited terms, to following the instructions believing this will yield a useful result. More often than not, it leads to a result the students do not necessarily understand.

e. Theme 3 - Guided learning (the influence of)

I anticipated that providing students with GL material structured as the University mandates might achieve three things: firstly, as way to determine if the promises and claims made about GL (it enhances students' learning, it encourages students come to the lesson prepared) are feasible goals; secondly, that by making the links between the GL materials and the assessment explicit it might prompt students to realise there was a purpose to activities; finally to determine if either of my first two points had any impact upon the learning experience. The impact of the new GL material upon the students' experiences was not significant, and the presence of GL is not something that engages students in deep or reflective learning.

For example, when I asked Student 16 how they typically used GL, the functionality seemed to be mostly mechanical, much like the typical responses I found for lectures:

> *"Went to the lab, opened the program, looked at the instructions, like what I have to do for the thing to be completed, and I just start doing it. I go back to the BREO Guided Learning things, because they are usually specifically linked to the exercise I'll have to do. For like lab work, there is a specific week of the course that teaches everything we need to know, I got back to the specific week and start doing the exercises."*

When I explored the approach of students with the later projects there was little variation in the experience. There was also the familiar reference to the finite utility of the resources that students found within BREO:

> *"For this project I use the GL as some sort of guideline to build procedural programs. The start of writing the program, but erm, we used a different approach on the project. We used things that were not in the resource, so, we extended our sources but we used BREO as well."* (Student 16)

The difficulty for GL is that many students either want to be given specific feedback or guidance tailored to their needs. In reality this is probably not sensible for two reasons: firstly, it does not take into account students' experiences and expectations of GL; secondly, the amount of time to deliver content and activities would probably not be met with equal engagement from the students.

Here are two typical examples addressing both of my points:

> *"The way I learn best is through many different examples. So, erm, sort of when I mentioned that I have trouble getting the gist of information. What I will tend to do is look on about 10 different sites I can get the concept."* (Student 21)

> *"So, and of course there are some notes on the lab/practical, get this function and set this function, if you know that, still you have to make it in mind that you have to look in the practical and lecture slides."* (Student 3)

> *"I think it would be useful if you asked of the students if they would like to see more tutorials. Like video tutorials, if it's just me, if it's the technique that's teaching me. If I am stuck on something I will go look at videos."* (Student 1)

I was expecting (hopefully) that the changes Dr X and I made to the GL would prompt students to think more deeply about the learning that was taking place. The reality was that students already understood what they needed to do, and had

settled into a routine. To illustrate my point I include some examples of the feedback from students.

> *"I didn't really mind whichever format it was in. The new one has online resources, first it has the task we need to do, online resources and an introduction that we have to do. I find that online resources bit very useful because I just go back to that."* (Student 1)

> *"Of course, like, I did learn in the end you have in the end resources you can use. It would be nice to have some tutorials, when we start with [Language X]. So, putting some tutorial videos to help us think about, [Dr X]'s just putting some videos like – don't be under stress if you're writing a test. I mean [Dr X]'s putting them and making us more nervous. These tutorials are nice to prepare for the test, you can have a look and remind what you have done."* (Student 3)

> *"Yes, there's no kind of overriding way of organising way of formatting and organising those resources, and it boils down to how an individual lecturer would use those resources. A system admin could go 'oh look, we've set it up in this way…' – I'm just going to whack them up there willy-nilly"* (Student 35)

This unfortunately sets a precedent for the rest of the examples in this category. Students did not see any inherent value in the changes to the material. But I do not consider this a failure. It did enable my capturing of the processes that students undertook in other categories. To further relate to Student 35's position I include some other examples of students' experiences:

> *"Yes, I remember there were some changes. I don't think I'm in a position to comment on them. I probably just said, this looks different. It's quite often with*

other applications that we use online when they do make changes, whether it's eBay or Amazon you just tend to adapt fairly quickly to them, to the changes."

And

"It's probably no news is good news. Where I have used websites where they have changed it, why did they do this. I would sit here all day long and tell you about it. The fact that I carried on using it and adapted to the changes means it was consistent." (Student 31)

For Student 31, it was part of a natural cycle of change and probably something the reader may also relate to. The most profound statement came from Student 34 who in an echo of Clarke (1994) – Clarke suggests media (read: technology) will never influence learning – gave quite a robust view on the changes we had made:

"These old technologies are designed to help us, not to distract our attention, not to divert us from the topic. It's, that's why we make a log of things, that's why we make a note of things, if we, we go back track what we studied, and what we're looking is not found - it happened on a few occasions in [unit X] and [unit Y]."

I questioned the impact the changes I made in the GL with respect to the learning experience: firstly, students made rather extensive use of online resources; secondly, the material requiring transformation was much more disorganised than I anticipated and so it proved difficult to produce a fully useable final product; finally, the utility that students derived from the changes appeared to be diminished when compared to the advantage students gained by working together as a group.

Something I had not envisaged when adding content was the use of mobile applications, and the experience of receiving notifications regardless of content being hidden (for desktop users):

> *"You put quizzes prior to our test. I thought it was related to the test, I did the first test and then the second test, and I checked what number of quizzes …."* (Student 24)

I was also given a reminder of the reality of being a student studying full-time whilst keeping a full-time job:

> *"My point is that people like us [students], ok, including my other colleagues they are, they all are expecting something structured."* (Student 24)

In the case of group 1, Dr X had discussed the difficulties students who worked and studied full-time would have. In Dr X's assessment it was likely to impact upon students' abilities to spend extra time working on class-based materials. Despite the interview demonstrating the student to be very committed it was difficult for me to see technology held in this regard. Instead of being a force for movement to enhancement it was having quite the opposite effect. Part of the problem was the original source materials: many exhibited poorly design or had missing parts. It would seem that in working with students in the class the lecturer is able to make corrections and changes. The University's intention is to have lecturers create content. Repurposing content was a very difficult task and the delivery in class did not match what was online so changes often made at the last moment. Students made comparisons between different units and the content they are offered within. For example, Student 35 explained the problem of organising learning resources in the unit in some more detail:

"…they're a copy of [a unit not within this study] based on different languages, the same assessments, projects and the rest of it."

And

"There's no overriding way of organising [or] formatting and organising those resources, and it boils down to how an individual lecturer would use those resources."

This was referring to the learning experience in one unit being significantly different from the other. Particular reference was placed on the differences in BREO by another student. Student 36 also remarked about the lead-in training available for the use of BREO, and the organisational aspects:

"I think it would have been very handy to have someone explain how everything works on BREO."

And

"Everything is all over the place, if I could go back I would someone to tell me where everything is. If I knew the structure of it later on when my projects kicked in, it would have been a lot easier."

The GL materials insist on a particular structure, but do not explain the detail of what might actually form a useful approach to naming and organising content for students. This is the comparison that the students are drawing with the two units. In the other programming unit content is named and it is clear what is stored within individual folders. In the unit within this study content is named on a week-by-week basis. When students attempted to locate content or to revise they found themselves looking in folders to discover content.

Much like students from group 1, Student 32's experience was predicated around the use of examples of different types:

> *"Seeing something in a different way is definitely helpful. I prefer doing that because I see the common points [among] different people. I understand what is crucial and what's optional."*

Student 36's experience of the group project left them wondering what they should do:

> *"I think a better understanding of what is demanded of us. The expectations from us. We don't really know what we are doing, we're just putting something together and hoping for the best. I'd have liked to see something like a better assignment brief."*

There is an expectation that students should be given the freedom to learn, but equally the University should maintain a tight hold on what information students are given and when. To some extent this seems at odds with the idea of a higher education learning experience, but one where there is very tight definition of the scope and range of learning that should take place.

Part of the problem might be explained by adopting a wider context to the use of examples within the class. As Student 35 explains:

> *"A lot of the exercises are done in isolation. Some of the exercises do link back to the previous exercise, but not in a way which [is] massively meaningful. I thought that starting with a very simple program, and then beginning to implement parts of the programming, other different aspects of the same application helped me gain a greater understanding of how those assets and parts intersect and can be used with one another."*

It is the last part of this quote that demonstrates a problem the students faced when developing their group project. In all of the other assessments they have been producing a program in isolation.

Student 31 explained the group project experience as using some resources from BREO, but using BREO to gather pieces of information needed for the project:

> *"I know that I look at how I was going to do the project. Then I would go onto BREO where I felt short of expertise. We need to know to do this, I'll look at the notes to find it."*

Student 35 described the problems of using the content from BREO:

> *"Once again you go through the example source code, and you can tell it's been written by someone who doesn't seem to appreciate this is a learning material."*

For students who have a high degree of understanding, the learning experience they receive from the resources in BREO does not lead me to believe the resources are adequate. There needs to be an extra dimension to check and explore students' understanding. In the same fashion as group 1, I asked the students about how feedback impacted their learning experience. The response was surprisingly limited.

For example, I asked about the use of the dropbox which students in group 1 had access to:

> *"No, we don't use dropbox, because it's a very small group. We get the feedback straight away, and maybe we will use that in year two. I think we will need to use that in year two, it will be a big challenge."* (Student 34)

Time pressure existed for some students, which is a reminder of the vastly accelerated rate they undertook their studies at:

> *"Dr D did tell us if we'd submit [our work] a few weeks before [Dr D]'d tell us if we're on the right path. We were overwhelmed, I don't think anyone did, we were all working until the last day."* (Student 31)

I had assumed that the quizzes might have had some form of impact upon learning, but the students did not mention them in useful terms.

f. Theme 4 – Online communities

Students used online resources quite frequently, but the strategies employed for the resource use varied greatly. There are two general high-level types of activity that students undertook: firstly, trying to make sense of the problems faced in class – making sense of information provided; secondly, as a way to check what they had produced. Specifically, this was experienced through the use of online communities in two particular ways: to search for alternative explanations which supported problems faced in the classroom, and then in the assessment; secondly, to search for specific instances of problems experienced by other people. Broadly, I split the student experience into two kinds of community: information push – YouTube is the example students commonly cite where information is presented visually and verbally; and exchange – where students witness the development of solutions via discussion and arguments amongst a community – for example sites such as StackExchange and StackOverflow.

Firstly, an example of information push – I asked Student 1 how they approached using YouTube to support their learning:

"Well, you have to experiment with it a lot. You type in the topic and 100 videos come up, and then you go through the first 50 and that's not it, and you find the right one. Then I just click on the user, and do the rest of his tutorials, if I find the right person that explains it right."

The reader may recall my introduction where I suggested that students placed quantity over quality of resources. It is not a very clearly thought through distinction for students, for example – student 4:

"Practising the same topic in different ways, is the best way I seem to find to learn. Going back to the video bit, I had gone through a number of other videos before I found this one that works for me. Being able to have different approaches to the same problem I think is good. Everyone is different and they learn in different ways."

And

"I tend to use a lot of YouTube video to get the basic or basics, so when I come to do an exercise I understand what they are on about. I know that's very – just go to YouTube – people put tutorials on there. Let's say if Dr X doesn't explain in depth enough, I just go off to YouTube type in the codes [Dr X] was talking about. There's a lot of useful tutorials." (Student 27)

The issue is similar here: there are implicit assumptions that: the sources are trustworthy, that the information must be out in the online community and it is merely a question of locating it, and that the information will lead students to a solution or enhance what they have already. Student 12 revealed the motivation for using video as a preference over text:

"Sometimes it is much more easier to watch a video than read through a whole block of like [text] you can go straight to what you want." (Student 12)

The rationale explained by another student was:

"There are some things that you can definitely find them in the GL. But there are some things that are maybe… I don't wanna say they are not there, but you might find more examples if you look somewhere else. You can definitely find examples from Dr X, and the GL, but maybe you need something more, sometimes like for certain things." (Student 19)

In this case the student was making reference to seeking out content for their final assessment – the group project. At a general level students believe the information is out there, somewhere, and that someone else must have already solved the problem. It is just a case of knowing how to search for that information and to bring it into focus.

The utility of YouTube as a resource also took another form – experiencing multiple explanations. The literature review in this study demonstrates that advocates of blended learning (and for that matter GL) indicate this is a key part of the utility of their approach. Students' experiences of push communities tended to gravitate towards particular users which they felt offered a 'good' explanation. This may be a problem the students wanted to address, or within an assignment.

"I mean, this is an example I want to use for, arr, for networking assignment. I found a bloke called ITDaddy, he's in America. The way he explains it, very short words, bullet points, he does it like a bullet points, and very spot on, I liked it, the way he does it. I mentioned it, nobody knew about it and people

laughed at the name. I checked it and it does make sense how he had done it. He made a very straightforward and easy way to work out." (Student 34)

Another way to experience YouTube's usage was where it linked to prior knowledge, or to use the cliché – joining the dots. Student 35 described this thus:

"I found if I was watching a video that was basically making me go 'ooh' I remember xyz tutor telling me that. Talking about it in slightly different terms, perhaps using a slightly different analogy that kinda helped me to think ahh right, now that stuff I covered previously makes more sense because I've seen it explained in a slightly different way. Yeah, I guess it's about frames of reference."

There is also a temporal aspect to the experience of working with online resources. Student 32 acknowledged that there was a series of stages leading towards understanding a concept.

"The professor probably knows better right, but for someone like me who is a beginner, I'll chose the other guy who explains things in a certain way. Because that's what I can understand right now."

Students utilise search engines such as Google as the starting point for a problem. I found students used these sites for two reasons: looking for problems that others have solved and helping to find code they can try to utilise. For example, Student 16 talks about database connection issues:

"YouTube, Google, StackOverflow, mostly StackOverflow because there are people that are on there, they have the same problems as we have. We can Google one question, and StackOverflow pops up people are answering / offerings solutions to the problem. I for one used it in our [programming

language] one, our [programming language] project, to read and write data from a database. We didn't study that in the [Language X] unit, I used that to help me understand how it works, how [Language X] connects to the database."

The strategy of using online resources is directed at answering a question or a problem faced by students. However, as with many forms of advice, care must be taken to ensure that it is accurate. I asked students about their conception of trust in the answers communities give them. There are two methods the students presented: firstly, is the answer or information given poor feedback by other members of the community; secondly, does it corroborate with components of existing knowledge of the student. For example, Student 25 discussed the first example of the technique (I have added emphasis to draw attention to some points I will return to later):

"Not correct or? Well, occasionally, often you'll go to StackOverflow – but – erm, there are plenty of wrong answers. ***They tend to get down voted, but I've seen plenty where they are not down voted.*** *There is a lot of misinformation, I can't tell you how much misinformation I have, but… has there been… I can't think of anything to do with… I suppose a lot of the UML stuff actually. That's not really a programming language with defined syntax. People will a little bit more freeform with a diagram, there are a lot of different standards floating about."* (Student 25)

Contrast this with Student 21's approach to correctness:

"YouTube, watched so many YouTube videos. Oh yeah, Googling how to do this, and then at the end Yahoo!, and see what other people think. They all

explain it on Yahoo!, and you ready why they done that. ***Other people say that's wrong, and you read why it is wrong and <u>that's how you learn</u>.****"*

In this particular case the student is attempting to suggest that learning is something that can be conducted by exploring other people's mistakes, rather than actually struggling and attempting to understand the problem yourself.

Not all problems are as deterministic as programming ones: for example, if you are using a modelling technique as it deals with abstract concepts. This causes a problem for students, because the information is not as clear cut, and it makes it harder to know exactly what should be produced. For example:

"Essentially, the biggest one, when you look at it online a lot of people I think, I think there are a lot of standards, some are less rigorous, there is less information in it. So erm, it's quite easy if you type in UML diagram of x, y or z, use case, erm, that will come up with a lot of different syntaxes. It can be a little, it can be quite overwhelming, what syntax should I be using. ***So, and that's of course where it is difficult to use online resources, and you have to stick to what the university wants. Rather than, to go from other sources****."* (Student 25)

Google, or searching more generally, is the route many students take when looking for specific information. Usually such efforts are directed to understanding a particular problem or concept; the variation for these students comes when you consider the rationale for their approach. Student 31 experienced this problem when trying to find the specifics of a command:

"…if I just type in Google, i'll probably get the command, and you go through three or four StackOverflows, and you'll go oh yeah, that's how it is, that's how

it works. Often, a lot of us we just do the Google, then go to BREO even though we know it's on BREO."

For example, Student 34 gave two examples of the work they had been completing recently:

"When I had the error['s] common base, the error itself, and type [Language X] in front of it. Yeah, so it knows I am talking about, then the first and second thing that would come up would be something from StackOverflow".

And secondly, in terms of reliability of answers from web searches and social media:

"Sometimes they're complicated, because we're still rookies right, there are many things we don't understand and that we haven't done.

So yeah it can get confusing, err, maybe a lot of the time actually, it gets confusing.

You have to be very specific about what you're looking or, what you type in."

A variant approach was utilised by Student 35 who suggested approaching the problem backwards:

"Sometimes not necessarily solutions, but sometimes the questions people have posed which will help me to answer the questions [I] have. One of the problems you have with StackOverflow is, once again it's a communication problem, sometimes people don't always articulate their questions in the best way, and they get a horrendously complicated answer."

As a method for solving problems this represents a very high functioning understanding of how to solve a problem. This demonstrates an issue which relates to digital literacy, namely the ability of students to locate and discover information

appropriate to a task. The problem for students is then what happens when they try to re-use techniques they find. For example, during a lab session Student 34 wanted to solve a particular problem, and Dr D suggested looking up a solution online, the result was:

> *"I was looking and I found something, and there was a built-in function, count, I used [it], and then I did not read it what it was, because I was in a rush, because the lecture time was about to finish, to just to show that it works I just copied the code and did it."*

However, when questioned about what the function did:

> *"And then Dr D then questioned what is count? I wasn't able to answer because I did not know"*

> *"I think it was a good learning curve for me, because [Dr D] said to me, when you don't know what it is, then you should not use it."*

Student 34 also expressed Dr D's pedagogical position on the matter:

> *"[Dr D] has no problem with us using something we haven't learnt in the lecture, is something, you can use only something that you know what you are using."*

This demonstrates the risk of using content from the internet. There is a need to combine both the ability to locate information from the internet with a demonstrable understanding of what exactly the code or model does.

Students want to ensure the answer is correct, but either rely on the University for correctness (via the VLE) or they utilise the benefit of online communities. This is something learning technologists seem to want to rely on the internet and their own

form of community in the form of OERs (Open Educational Resources). In looking for materials I also found similar issues about correctness and quality, which meant I was unable to suggest incorporating their use within GL materials.

It is far from an exact science, but in the absence of other forms of authority or answers students will look to find ways to seek reassurance or knowledge from sources other than the lecturer. I saw how this later impacted the students' assessments. During assessment 3 (the group project presentation) a number of students admitted to finding 'code on the internet' which they could not explain the purpose of properly.

g. Theme 5 - Feedback

Feedback came in a range of sources for students: creating models, running programs, using the digital dropbox, from other students, and from the formal lecture session where content from the digital dropbox would be critiqued. It was in the last of these mechanisms that students had the opportunity to see a range of the cohort's work. Dr X was also able to use this as a monitoring tool to ensure that students completed work in the labs. In each instance the condition of the instructions indicated students should upload their content online. At around three quarters, the number of students uploading content into the dropbox was very low. This led to Dr X seeking management permission to convert assessment 2 into a single timed exercise, the premise being Dr X was not confident students completed their own work.

Student 26 gave an interesting account of the dropbox's use:

> *Yeah, the speed of the feedback, and the fact you have to do something. Even if you do put work into the dropbox, um some people are like: I don't*

want it to be shown on the screen. And for me when I did it the first time, I didn't want my name up there along with my work with this many people."

Student 21 described the use of the dropbox as an experience which was not helpful:

"I thought it [my UML diagram] was really good. Well, he said there was a few problems and overall it wasn't too bad."

I wanted to see if Student 21 found the feedback helpful – hence I was asking them to make a value judgement:

"No, because I wasn't listening to what [Dr X] was saying, I just heard the end of what [Dr X] said. I was too busy telling the person in my group it was us…"

"I can learn from the feedback. If there is feedback written down, then I will react to it."

Which would present a significant difficulty, because it would take a large amount of time to provide feedback in a written form to all the students. Student 6 described the use of the dropbox as helpful, but equally difficult when their work is displayed to the rest of the class:

"Your name doesn't come up in front of the whole class, obviously you know you done it wrong."

And

"I guess, that's a one-off thing, like I don't know, in six weeks you don't know if you're going to get a feedback. Maybe if [Dr X] going through every single one will be long for [Dr X] as well. If [Dr X] put a solution for it the following week that would be useful."

The problem with the last part of Student 6's request is that this would reveal the answers to the e-portfolio element of the unit. So giving a final definitive answer is not a plausible plan, but giving general feedback gives hints and clues as to the correct practice students should be developing and encourages the group to learn more.

There was a problem of clarity around the purpose of the dropbox, Student 7 explained in response to my question about using the dropbox:

> *"I have… the reason I haven't is mostly because, when we first started the year. It's not clear what those are put in place for. And it's not until you get half way through your year, oh hold on, I'm meant to be submitting this work because I've done work in lessons and have just [thrown it]. If I was to submit I wouldn't mind if my work was shown. The reason I wouldn't mind, is because [Dr X] doesn't say whose work it is. I would prefer for [Dr X] to comment on my work, even if someone had a laugh about it, or if it was wrong (or whatever) – again [Dr X] doesn't say who it is. I would sit there like 'oh god that's mine'."*

Other students saw the quizzes we provided as part of the newly developed GL as a mechanism of feedback, Student 7 for instance made reference to another programming unit which I have chosen to include here as an example typifying students' experiences with quizzes and tests.

> *"So, erm, when we had questions when we got questions wrong they would come up straight away – you got this, this and this wrong. [Dr X]'d tell us to write them all down, and then go over them. So the next time you took the*

test, you had all the questions you did wrong, and obviously it was a different type and they are similar, and you just go over them again and again."

Student 4 described tests as being useful to utilise after completing a practical:

"I think they, err, they re-enforced what I did. I mean again it does feel a little bit repetitive. They did help, I think, coz actually going through and then going through and using your knowledge be able to see in action I find that helpful, it's, er, doing it straight after your practical things, it helps to say 'ah yeah, I did understand that and I can see it working'."

Student 6 described problems with obtaining feedback from the quizzes we set:

"In some of the quizzes they don't give you the marks in the end. If you number, if you get the question wrong, they don't tell you what the eight question is. Which is like, if you want to improve on it, and you want to improve upon it, you don't know what the right answer is."

Student 27 contextualised the use of the quizzes as a tool to judge existing knowledge of a subject:

"It gives you an idea what you understand of the topic, and I did one that was terrible. I cannot remember the topic, I had to go back and revise it. What I was reading made sense, it just disappeared. It gives you an extra tool to brush up. It gives you an idea of where you stand."

Student 16 provided an example of what I would deem the deterministic nature of tests in providing feedback:

"They were really easy. [laughs] No, they were easy to use, but not to answer, I like the part that after you complete the quiz it shows you the wrong

answers. So you can go back and see what you did wrong. It would be good to go back get the correct answer and the explanation of what you did wrong, why is it that answer and not the one you chose. Question 2 for example, answer b is correct because, and that wasn't on BREO. It would have been helpful."

The problems with quizzes as a tool to promote and provide feedback took three forms: firstly, they take a large amount of time to write; secondly, feedback should be provided for both correct and incorrect answers; and finally, it was to me unclear what students did with the feedback other than knowing they had an answer right or wrong. To expand upon this, it was clear that I could not measure the long-term effect of the quiz on students' knowledge or ability to apply what they had learned.

I explored some of the interventions Dr X and I designed in the form of quizzes, our thinking being that students would utilise the test as a form of feedback. Not all of the students utilised them, but when interviewed I uncovered some examples of students' practice:

"They help, I think, coz actually going through and then going through and using your knowledge be able to see in action, I find that quite helpful."

and

"Doing straight after your practical things it helps to say – ah yeah, I did understand that and I can see it working." (Student 4)

The speed that feedback was made available to students also had an impact:

"In some of the quizzes they don't give you the marks in the end. [The question number] if you get the question wrong, they don't tell you what the

eight question is. Which is like if you want to improve on it, and you want to improve upon it, you don't know what the right answer is." (Student 6)

Student 16 described the quizzes as

"….easy to use, but not to answer."

and

"I like the part that after you complete the quiz it shows you the wrong answer. So you can go back and see what you did wrong."

There also seemed to be some confusion as to the purpose of the tests:

"I attempted it initially, but I thought it was like, it was based on your performance, then I realised it was based on what you know. It was to test your knowledge and stuff." (Student 18)

Unfortunately, this is both the benefit and the drawback of such implementations. We could see that students, to a limited extent, engaged and completed the tests, but there are four problems: firstly, they are very difficult to write; secondly, it is hard to ensure relevance to the students' current learning experiences; thirdly, it took a large amount of time to write them; finally, a small group of students tried to use them as a means to satisfy themselves as to the score. Both Dr X and I concluded the tests were useful for monitoring engagement, but further work would be required to determine if they are useful over a longer period of time.

h. Theme 6 – Correctness

After hearing about students' approaches to exploring online resources I wanted to explore students' experiences of quality with respect to materials external to BREO. The GL material, understandably, can only explain so much to students. For

assessments 2 and 2a (portfolio tasks) students utilised a methodology where they tried to determine what might be a reasonable answer. Here is an example explained by Student 5:

> *"I am trying to see different approaches; I am trying to make my own result and compare my own result with another person to see if it's the same thing."*

I considered there are two ways to view this approach: firstly, students do not understand what really should happen with their program; secondly, without seeing (experiencing) something which hints at the answer being correct they will lack confidence in the answer they have produced. I have chosen to describe this as the correctness of the students' solution. A good solution in either programming code or modelling is to have an answer which you both can explain (the implication being a student understands it) and that you can manipulate. This is an essential part of the second and third assessments – being able to explain how the code was created and how it works. The assessments 2 and 2a produce models and programs that are compact and deterministic. There are simple ranges of potential inputs and outputs. Testing one of these programs is a non-complex task. However, when the focus is UML (modelling language) the definite answer problem appears. It is harder to get a model that is considered correct. The diagrams, though they are subject to some rules of structure, have a certain subjective nature. Students expressed a lesser degree of confidence and spoke about the challenges of relying on assistance from the internet.

> *"Essentially, the biggest one, when you look at it online a lot of people I think. I think there are a lot of standards and some are less rigorous, there is less information in it."* (Student 25)

It is often difficult to tell how correct a solution is unless you understand the subject well enough to make such judgement call. Ideally, the person conducting the assessment should be able to give some guidance, but at the same time need to ensure students apply adequate intellectual effort. Student 14 pointed out two excellent examples of the problems with using the internet as a source of advice and guidance:

> *"One thing I noticed with the internet, is that people explain things differently. Our lecturer explains it a lot more, [Dr X] is a lot more easier to understand."*

Student 14's other point was about the subtle differences in versions of languages. I fell afoul of this problem when trying to locate resources to include in the GL packages. Specifically, there was a problem with issuing a command in an older version of the programming language both the student and I used.

> *"We're doing a lecture about x – and you'd see the way [Dr X] set up the coding, but then you go online and other people, a lot of people do in their own different styles. Sometimes it's maybe version 2, but you don't quite know. We're not meant to be reading up about version 2."*

There are significant differences in how programming languages functions and interprets commands from users. Two examples of this are: trapping errors (exception throwing) and the locality of variables. Running code intended for the older version of the language causes the program interpreter to execute and produce very different results.

Students' use of the internet did not surprise me, but their reliance on the medium and their trust in the content led me to probe students' experiences of the trustworthiness of information from the internet. I asked additional questions about

students' techniques for evaluating online resources. I found the results disappointing and did not lead me to believe there was a deep level of engagement in most cases.

For example, Student 21 in response to a question about Yahoo Answers:

> *"It's hard to tell, you just have to look through as many as you can and see like which ones are similar, which ones are completely different."*

Compare this with Student 1's utilisation of YouTube:

> *"You type in the topic and get 100 videos come up, and the go through the first 50 and that's not it, and you find the right one. Then I just click on the user, and do the rest of his tutorials, if I find the right person that explains it right."* (Student 1)

There was not much consideration of how or why the video's author is presenting suitable information, it was simply a question of trial and error, and corroboration with existing knowledge. An example of the latter was explained by Student 19: they considered the collective ability of a community to weed out poor solutions, and to offer corrective advice:

> *"Yes, I think about it, but it's, it's the same as the group work, it's a community. If you say something wrong there is definitely someone who is going to turn your answer around, he's going to correct you."* (Student 19)

The implication being that the community can solve problems because there is a collective effort to ensure that information is correct. Part of learning to access the knowledge of the community involved learning the language the community used.

Student 29 talked about the need to understand the language of the community being engaged with:

> *"Not just how to search for it, but how to search for it correctly, how to search for what you are looking for."*

And

> *"If I just typed in a [programming language] and how do I check a field is empty, it might not come up with exactly what I am looking for."*

Students will keep looking online until they find a question, or an answer which better suits the circumstances of the problem they try to solve. Some have a better grasp of the technique than others do, but I would question the scope of students' ability to learn about learning – rather than learn how to solve specific problems.

> *"I think simplicity, what quite often you find, this is why I liked going to back to BREO, it's simple and exactly what we wanted. Often on StackOverflow someone answering a problem that someone has go. I'm trying to write to an account file, and this is what we wanna do. They may not answer the problem we're searched, oh guess what we had put [read()] but I am going to tell you how to fix that problem another way."* (Student 31)

Student 35 explained that they used internet sources and other information from the lecturer and BREO to arrive at a solution. I discovered that the information provided in BREO was not always up to date, and this was something critiqued by students.

> *"If it kinda boils down to if it kinda corroborates everything I've already kinda learned of that makes sense. An example of this is subnetting, it's kinda [difficult] to me. We've been through it, most of the PowerPoint slides are*

pretty awful, you can tell it's about technology and it hasn't been updated in a very long time, it's going on about legacy standards and stuff. I found if I was watching a video that was basically making me go 'ooh' I remember xyz tutor telling me that."

Though Student 35 gave an example from a different unit, I include it here to illustrate the hierarchy of information quality which students refer to, and because Student 35 was using this example to illustrate problems in the unit within this study. The methodology is similar to group 1, but I found group 1 students less likely to be able to interact with the lecturer given the group size.

I have considered push communities to be a space where students are experiencing content audio-visually (e.g. watching a video). The difference between this community type and collaborative communities is that students do not experience as much discussion and narrative, as the primary focus is upon the audio-visual experience. I decided to probe the problems of quality and trust in online resources. I wanted to explore who students would trust more, a lecturer, or a seemingly unaffiliated presence on YouTube. The reason for this was to further explore the idea that a lecturer was a definitive source of information. In addition I wanted to investigate the mechanisms students employed to evaluate content, specifically what considerations they made when judging content for use with assessments.

Student 31 suggested the 'professor' and the reason was quite interesting – a "vested interest", it was not something any of the other students highlighted:

"The professor would be my first call, [they] ha[ve] a vested interest to get it right. [They] can't afford to go on there and say something that isn't good."

Along with a rather astute observation about the motivation of other providers of content from the internet:

> *"So you sometimes think that wow, you guys are saviours. What's in it for you? But, obviously they get the subscriptions and they monetise the ads and they get money."*

In using their title the professor does have a vested interest in ensuring information they provide is correct, or least of a certain quality. This could be because of the affiliation to the home institution or reputational reasons. Equally, once information is provided in an area like YouTube it is entirely possible that they will lose control of it. For example, people may recycle a video to increase their own subscriptions and views. Users who are not affiliated to an institution are not bound by any reputational requirement to provide correct information, but poor materials may be given negative feedback or be 'down voted'. It is in reality impossible to know how this would impact upon searches for such materials. For some students there was some utility to be found in the use of material with non-academic presenters:

> *"It would, I think if it wasn't a professor they will keep you interested a lot more. They will throw in jokes and not be so serious about the subject. But you can sorta get a good understanding of the subject. If you use a silly example it will stick to your head. But you won't see a professor throwing in jokes in an example."* (Student 36)

Students in this case are looking to see if there are different ways in which a concept might be explained. It is possible to find details of a concept, but there may be further work on the students' part required to understand exactly what is being delivered from an online community.

Student 35 suggested that the problem might be more to do with empathy than teaching. I thought this was an interesting idea, as it both acknowledges the assumed correctness of a 'professor' but understands that someone concentrating on the narrative of how they solve a problem is more helpful. During our discussion I asked if Student 35 thought the professor was formal, but the YouTuber presenting was informal and so used a different perspective.

> *"Yes, I think it ultimately boils down to empathy, this plays a massive role in it. If you've got a professor who's spent the last 20 years becoming an absolute expert in, you know, whatever, they eventually become so far removed from what it's like [to be] an amateur they lack that kind of ability to empathise with somebody that's coming at it from a completely amateur perspective."*

Only one student identified with the monetisation aspect of YouTube, which results from views of videos by internet users. Despite the reservations about monetisation, the importance of YouTube remains strong:

> *"I think YouTube is probably up there in the top two learning resources. These guys that are creating videos have got an incentive to put some hard work in, because they want people to watch it. They want people to recommend them. So you sometimes thing that wow, you guys are saviours, what's in it for you? But obviously they get the subscriptions and they monetise the ads and they get money. So because of this, I've seen some, if you know all this why are you not out at work earning good money. Why are you up in your bedroom making these videos."* (Student 31)

i. Theme 7 – The production of assessments

In this theme I consider the methods that students used to work towards their assessment. Much like the use of GL there is not a lot of sophistication in the techniques students use. The techniques students employed depended upon the assessment and included: maintaining contact using mobile devices, trying to guess the content of the assessments based on prior resources given, repetition of exercises from weeks past to prepare for assessment 2b (timed exercise) and comparing material from lectures and posts online.

Some students however use tools which are both convenient and available. When referring to the group-based assignment (assignment 3) Student 19 explained:

> *"We had some discussions on WhatsApp, we had some discussions [on] Skype, we had some discussions face to face, we all live in Luton. I live right across the street, another colleague lives in the campus. So, it's, it's pretty easy to meet up. The only problem we had was with the work schedule, making it ok for everyone. We're not all working on the same schedule, some of us work nightshifts, some of us work dayshifts. I work really complicated schedule. It's not something fixed."*

Most students however, preferred the simplicity of preparing for their assessments using the information available and additional resources available from the internet, for example:

> *"If we have a test or assessment. So I pick all the slides what we have done and repeat everything and have a look and even the practicals are open, so I actually have open both sides, and what is similar which question could [they] ask about that."* (Student 3)

In terms of the last assessment (the group project) Student 16 said:

> *"Yes, definitely, the labs sessions were preparing us for the final product. So using all of the resources online, and additional that wasn't given to us in the lectures, the additional files, we were able to pull out the program to make it work."*

and

> *"It did help, but for that presentation, it was mostly talking about the code. And not only about the code, so what we did in the labs prepared us to explain about the code, but for talking around the code, and the problems that we had. The labs were not as helpful. They helped understand the code."*

The assistance in preparation came from students revising content, rather than working through new ideas. This would make some sense because they needed to prepare for their assessments. In this example Student 26 is describing their approach to creating the relevant parts of the portfolio.

> *"I downloaded previous lectures that [Dr] X had put up, and then I've looked at alongside the seminar posts that have been put up I realised this is an example [inaudible]. I basically did teach myself, I am working out what's been put on BREO, this is a really useful idea. Within the first night of looking at it, I've finished one, I've got one more to go."* (Student 26)

For the students in this study, the priorities where different: they wanted to know the structure and dimension of their assessments. There was an expectation that this should be provided via the VLE, and that such information would allow for better preparation. From the literature review I consider the issues of students' motivations,

and my analysis leads me to suggest that the students in this study are motivated to complete assessments, but are also equally afraid of the unknown.

Student 18 said when asked about preparing for the timed exercise for assessment 2a (the exercise was planned for the day after I interviewed them)

> *"Just an example, a little of what we'd experience in those 90 minutes, and how we can overcome the situation."*
>
> *"I think yesterday we discussed how the test would look like, but [Dr X] doesn't give an example of how it would look."* (Student 3)

As the timed assessment task was only to be seen in the class, Dr X permitted students to access the internet and other resources. This means that GL could play a role in looking up, or checking for answers from particular weeks. Naturally, with such a big set of resources it was inevitable that students would need to have a clear idea of where content was located. However, information in this context is only useful if something can be done with it.

There are variants to the request to know the task, Student 6 discussed the idea of an example, but instead of it being of the work itself it was more the size or structure that was important. When exploring what students would submit for the assessment I found there was a desire to gauge their own efforts against others:

> *"…this [the portfolio] has no word count, but [Dr X] said that one of [their] students did 65 pages which is kinda crazy. Obviously, you want to know how much other students have done, you don't want to do less, but not go overboard."* (Student 6)

The problem to an extent for students' comes from the way they approach assessments. This was illustrated by one student in a specific response to a question I asked about how they approached their assessment:

> *"It's like a game you need to play, they give you an assignment and then you need to learn the way they want you to".* (Student 1)

This is somewhat thematic as other students responded by suggesting the lecturer could or should tell them what they needed to know to complete the assessment task. The students wanted Dr X to provide some highly specific advice about the assessment, for example Student 3:

> *"Yesterday we had a lot of concerns about the introductory lecture. People are complaining that [Dr X] has given us a short time to prepare [for the assessment]. Some students have written an email to [them]".*

Students' approaches stand a danger of being procedural rather than functional. By this I mean to draw a distinction between simple knowledge and the ability to perform the higher order activity necessary to conduct analysis. Procedural knowledge would prevent improvisation and would not be strong enough for more complex tasks.

One student made quite explicit reference to the assessment in terms of completing the assessment for the sake of completing it. On paper (or in terms of grades) such students would appear to be high performers, but the reality would be a student who was only competent at passing assessments:

> *"If any student tells you any different, they're lying. Essentially, it is a question of how can I get the highest mark. Sometimes learning goes out the window. Learning, getting around the learning comes below how can I get a good grade."* (Student 19)

The method of preparation depended upon the assessment. In early assessments some of the student group believed the assessment was constrained by what was presented in the VLE. Student 34 gave a rather succinct description of their approach to the Computer Based Assessment (assessment 1).

> *"The first one and I really studied for it. I overkilled on it. I think I got a high mark, I think I got a 90. Wow, that was good, everything, I only just revised [it] this morning. I'm so glad I went through everything. You make the understanding that everything that is on the test is constrained to BREO. That's my first port."*

The students in group 2 provided a very clear picture of how the original GL materials helped them get ready for the assessment. For assessment 1 – a computer-based examination – prompted an interesting range of strategies from the students to make good use of the mock materials, and they explained a range of different approaches of how they both prepared for and used the formative tests. When it came to assessments 2, 2a and 3 the students' strategies took a form remarkably similar to group 1, but I found that group 2 students articulated a much clearer academic strategy for their engagement with online resources.

In dealing with the mock tests students split the problem into two categories, understanding how to use the test software and taking a test – for example, Student 12's description of the mock tests made available to students:

> *"I used all of the mocks that were set up on BREO, and read some we did previously. I think I used mostly the BREO, the one that was set on BREO, so I know how it works so it would be much easier."*

Student 12's technique for revision was fairly simplistic, but is a starting point that other students described:

> *"I went back to the previous weeks and I went through the PowerPoints and redid the practicals."*

Student 31 described how they used BREO in a similar way to Student 12, but with an emphasis on structure and syntax used in the programming language the students studied. What I want to draw attention to is the specific point that there was an expectation that the test only covered items found within BREO:

> *"You make the understanding that everything that is on the test is constrained to BREO. That's my first port [of call]. I started from week 1 and went through each slide writing down, I wrote them down actually as I really needed to rely on my memory."*

Student 31 explained that if a concept did not make sense then there was the opportunity to further explore by using a tool like Google:

> *"If there was something on the slides that I didn't understand, I would expand it in Google."*

Student 35 approached the problem of revision in an opposite, but eventually complementary way to Student 31:

> *"Most of my sort of swatting up for that [the test] I did using online resources, YouTube tutorials, the rest of it."*

And

> *"BREO did have some links up there for, you know, other resources available on the internet."*

However, there was the point made that:

> *"If a lecturer has signed off on it and, [says] oh this is explaining it in a way which is relevant and pertinent to what you'll be tested on."*

And

> *"The reference point was definitely BREO for any computer-based exams."*
>
> *(Student 31)*

Again, like for group 1, this approach demonstrates a tendency of students to use the lecturer and BREO as the definitive source of information, even though the two groups showed quite great degrees of independent skills and abilities.

j. Meeting the requirements of Design Based Research with another iteration

After the first group of students had finished studying the unit, I made some improvements to the methods we utilised for group 1. I waited until group 2 had completed the first assessment, for two reasons: firstly, because I wanted students to have some experience of both using BREO and undertaking an assessment; secondly, because this was the point I also approached members of group 1 to participate.

I had been told by Dr D that the students from group 2 formed a much more committed and worked together much more cohesively than group 1. For two reasons: firstly, because group 2 students studied at an accelerated rate; and secondly, because the student group was much smaller and worked constantly in small groups. The intention was for them to re-join the main year 1 cohort at the start of their second year.

The data captured from group 1 led me to make some minor changes in GL implementation for group 2:

1. The addition of a more comprehensive introduction screen making clear the aims, objectives and links to assessment for each section of content
2. Quizzes placed at the beginning and the end of the sections of learning content
    a. Quiz answers containing links to the slides where questions and/or content came from
3. Directed reading with clear indications as to the use of materials.

k. RQ1 – Summary

RQ1 – In what ways does GL and Technology Enhanced Learning (TEL) practice impact the first-year computing students' learning experience?

The impact of the teacher is always to be acknowledged, but the students wanted particular information from both Dr X and Dr D which they did not always provide. Students always wanted ‘more examples’ of what they should do. It was impossible to encapsulate these into one simple GL package. However, what is provided in the VLE was important and the students indicated that they needed to scan the materials to find specific examples which they thought would be of service to them. A direct answer to the research question is: apart from ensuring students where provided with information, students did not appear to care how it was formatted or explained; they simply wanted to use the materials to find what they needed to do and to then use other resources to engage with the assessment process.

The provision of GL allows for the university to demonstrate that it is doing something, and that technology is making a contribution. However, it is the value of

the contribution which is unclear, and perhaps the problem is made worse by the mechanism by which GL is meant to be packaged. The difference between the two groups was that group 2 students where considerably more articulate. Guided learning was simply a container, and the outlaying of links to assessment, quizzes and online resources did not really help students solve practical problems. In some ways it would be easier to provide students the bare minimum guidance and materials. The main advantage of adopting the GL structure was expressed by students in terms of ease of navigation and the convenience of content being online. When considered against the amount of time it took to structure, agree, develop and implement the resources, I would suggest that the time would be better spent on the act of teaching and using the VLE as a structural tool.

Students in group 1 did not demonstrate a rigorous approach to utilising resources online, and this is where the GL materials did present utility when students could not find the lecturers. Students found they could compare their work to the materials they had available to them. In this way the materials where used to confirm what they had found online. Could students perform the job of building assessment artefacts without the internet? I think the answer is probably yes, some students I observed and interviewed had a very impressive aptitude for programming. The issue would be that the students who are poorly skilled would struggle to produce an assessment. I recall an earlier point I made during the literature review about blended learning: reducing interaction in the classroom and shifting the activity online caused students with poor academic skills to perform worse. The problem for GL is that academically poorer students are more likely to struggle as they need the interaction in class to help them gain understanding. I also question if this means a student has learned anything when they utilise online resources in a way which

provides direct answers to the questions. If students possess skills that enable them to construct an assessment from the internet, this does not mean that they are skilled in constructing programs; yet likely they believe they are skilled at solving programming problems.

Thinking specifically about the assessment, in the case of group 1 students GL acted as a baseline to both receive and determine the assessment requirements. It did not offer any further status to the students, as they could receive information about what they required to do from BREO. To some extent I wondered if this was due to the type of assessment the students completed as I captured data from them. I make this point for two reasons: firstly, that in group 2 I interviewed students who seemed to have a better recollection of the assessments; secondly, students tended to believe that BREO held the answers to assessment problems. With the online test that students sat (assessment 1) there was only so much knowledge required and this could be found within the finite bounds of BREO. After all it would be unfair for the University to test students on something not available in the GL material, or taught. Once the assessments became more complex students could no longer rely on GL alone, something else was needed. It was these parts that allowed students to form a judgement around what was required for the assessment. This was in contrast to the idea that students would learn skills to allow them to understand the assessment in detail; rather students where interested in simply passing the assessment and would do whatever was necessary to complete this task. This speaks again to the longer-term trajectory of the students' skillset. Students would not be prepared to undertake new and difficult problems.

I. RQ2 – Summary

I kept a log of the impact the GL-based changes I implemented for both groups of students, and how the structure and nature of the content impacted upon their assessment development. At this point I had begun to understand some of the potential difficulties faced by lecturers when they implement GL. These emerged as six issues which I have detailed in the following paragraphs.

Firstly, OER content – which was a suggested source of content in the GL guidance. Before I suggested using any of the content, I was keen to try out the techniques and work with the instructions provided. I found two significant issues: the quality of the OER objects varied greatly, and objects did not always completely cover the requirements of the GL material. This meant that any material would have to be translated to fit the GL requirements, edited for completeness and then deployed. For this reason, I made the choice that it was not going to be appropriate for implementation, but could be used if students wanted to spend time practising with extra materials. It would be quite likely that the impact upon students' assessments would not be very positive.

Secondly, the guidance suggested that we utilise materials from the internet that would support students' understanding of topics. Some links already existed in Dr X's unit site, and these where already used by students. However, in discovering other resources that might be useful to the students we found that many of the items where inappropriate for students. One site contained answers which if copied would allow students to successfully complete a part 3 (the most difficult) submission. It should be noted though that despite copying the content a student would still need to both adequately explain the code's structure, and secondly, students would need to

explain why the similarity tool Turnitin (which work is submitted to) had detected the code as being similar to an online source.

Thirdly, the videos available online in places such as YouTube are of variable quality. Quite often they contained errors within the videos, or the techniques explained in them considered to be at odds with what was taught in Dr X's class. My own observations and discussions with students led me to believe that some students found sites like YouTube quite distracting. Additionally, some of the videos dealt with different versions of the programming language the students needed to complete their assignments.

Fourthly, the quizzes provoked an interesting reaction from the students. Some students went almost immediately to the quizzes before completing the three-part exercises. From my observations and discussions, it appeared students used the tests as a measure of how much they knew already. In one case we had neglected to switch on the feedback element of the test, and one student had taken the test more than ten times to guess the correct answers. Dr X and I became concerned that students took the test to gain a grade, rather than using it as a learning tool. For this reason we agreed to make the questions asked within the quizzes more complex.

Fifthly, Dr X pointed out the problems associated with developing materials of this type. Two issues existed: firstly, although the materials could be edited it was a new way of presenting the content; secondly, it was difficult to approve and validate the resources which are on the internet.

Finally, when taking these points into account we realised that there was a maintenance overhead. For each internal and external resource there is a need to

check, refresh and update it. Increasing the number of resources increases the number of items which need to be checked and if necessary, removed or updated. Dr X pointed out that there was a real danger that if resources moved, or for example became absent from YouTube then there would be a need to fill the gap.

m. How might the subject area choice have influenced the outcomes of this work?

The focus upon computing in this thesis has likely impacted the outcomes in the data, and I would suggest in three ways: firstly, computing and specifically computer science courses have difficulty with attainment and long term outcomes (Shadbolt, 2016, Gordon, 2016, Woodfield, 2014). In chapter 4 section D I explored the very diverse nature of CST as a department, and the same attainment issues tend to occur for students in CST and the University at large; secondly, the difficulty of the subject area – programming is difficult subject area and other authors (Yao and Chiang, 2011; Pudrath et al., 2013; Chen et al., 2015) have identified that attendance has a more acute impact upon students studying the more technically demanding subjects; finally, when I reflect upon the differences between group 1 and group 2 students I would suggest that the students in the former group presented as less motivated. The comparator I draw between the two groups is in group 2's case they had focused and intense periods of study. My observation and interviews led me believe that some students are highly skilled in matters of programming, but lack a wider or more versatile skill-base (e.g. communication, group work, thinking critically).

In the results and discussion section indicated that the larger group of students (group 1) had poorly organised strategies. The underlying issues could be attributable to factors such as UCAS entry tariff, or students' prior educational

experiences leaving students unprepared. Another explanation is students in CST end up studying the same units up until the middle or end of their second year. Unit specialisms are not offered until the late second or final year. Gordon (p. 11) makes this point *"These problems lead to a gap between the expectations of what a Computer Science related degree will include, and the actuality of degree content and requirements.".* Coupled with the unfamiliarity of the subject area, poor academic skills, and the requirements of a computer science degree which are not as students anticipate it – these are likely contributary factors in students' approaches; if you are worried about subject knowledge, focusing on assessments allow you to demonstrate success. I explain this in hindsight, as the literature suggested that teaching would be the most likely predictor of students' satisfaction (Ramsden, 1992; Bell and Brookes, 2018). A related issue which may have influenced the students' focus upon assessment could be because they decided that the assessment was a problem which did not require immediate action. I found some evidence to suggest students are more likely to fail if they have poor attendance records (Yao and Chiang, 2011) and the more complex the subject the more likely attending will lead to improved outcomes (Pudrath et al., 2013). Less technically demanding forms of computing subjects seem to be more resistant to the attendance gap. When Dr X threatened the portfolio a timed exercise, this focused students' minds. Ergo, I would argue there is something to be said for the action of being 'present'. I base this upon the approaches of group 1 and 2 students – the latter having significantly more cohesion. Little effort was needed from Dr D to encourage the students to attend and work together, but Dr X had a greater challenge as the students' attendance was erratic. I would suggest this was because students did not see the immediate need to complete their assessment, the method of continual

generation of assessment artefacts was not focusing students appropriately. Though both Dr X's defence given the relative size of the teaching group, and the fact Dr X worked alone another method such as focused assessments each week would be completely unviable.

Further down the I would suggest the lack of attention and presence cause problems for students. For example, Shadbolt's (2016) review highlights the falling employability of computing graduates, and specifically computer science graduates in the UK. The trend has also been examined in high drop-out rates elsewhere in Europe (Kori et al., 2015). Sadly, the trend continues even in 2020 (Turner, 2020) which would have impacted the students in this study after their graduation. Rightly, Shadbolt points out this is confusing, because there is an increase in the number of jobs which require specialist skills. If students choose to focus upon assessment rather than learning (as they present in this study) then it is not surprising that students struggle to develop skills which would aid in their successful employment at a graduate level.

n. An analysis of the BUS outcomes for the department

In this section I explore the BUS results for the CST department, and finish the chapter by linking the institutional data with the qualitative outcomes of the results section.

I found the data outcomes surprising in that they did not match with the common position that students' satisfaction is aligned with teaching and classroom activities (Ramsden, 1992; Bell and Brookes, 2018; Raaper, 2018) – rather for the students in this study students satisfaction appears to be driven by assessment practice. I

determined this via a Spearman's ranking analysis (Gautheir, 2001; Hauke and Kossowski, 2011).

Findings from the BUS

The most important influence for the first-year students in this study group upon overall satisfaction comes from Assessment and Support. Table 10 shows a *p* value of 0.9 which suggests an almost predictable relationship between the overall satisfaction with assessment questions. The value 0.9 should be read as the Overall Satisfaction bearing a very strong similarity to Assessment group of questions level of satisfaction. In a contrast to the literature, final year students for the academic year 2015/16 also possess a similar link between Assessment questions and overall satisfaction. The relationship is not as strong with the *p* value being 0.77, but in the final year group's case the strongest links to unit organisation (0.8), and teaching possesses the lowest effect (0.56). The questions relating to assessment include: I can see the relevance of this unit to my course, The assessment arrangements are clear, I know what I need to do to pass this unit, the BREO site for this unit is clearly organised, the BREO site for this unit supports my learning.

Cronbach's Alpha values

The difficulty for all three suggestions is the reliability of the instrument used. Reviewing the Cronbach's Alpha values for the question groups reveals that the only time the BUS generates consistent results is when students respond to the Assessment and Support section. The next closest section is Teaching, but this is below a threshold of 0.7 which is described as a minimum level for an alpha value to demonstrate reliability (Taber, 2018); but there is some room for flexibility. I have taken a pragmatic approach and have explored where the Cronbach's value

approaches a reliable value. The other values are below 0.6, and so this demonstrates that the instrument used to survey students is not reliable for these questions. This is also borne out by the lower correlations each non-reliable group presented within table 13.

Average and weighted average

After finding that two groups of questions Teaching, and Assessment and Support had the highest reliability, I explored the average and the weighted average of each question in the two question groups. A simple average does not consider the effect of sample sizes of each contributing set of responses. I used a three-step calculation to arrive at a weighted average:

1) Calculate the total number of responses for the two groups of questions.
2) Divide the total responses for an individual row of data by the group total – this provides a weight (from 0 to 1).
3) Multiply the question's satisfaction by the value from (2).

	Staff are good at explaining things Q1	Staff have made the subject interesting Q2	Staff are enthusiastic about what they are teaching Q3	The unit is intellectually stimulating Q4	Total Q'Responses
13-14 L1	70.6%	66.4%	79.7%	74.3%	1393
14-15 L1	75.5%	70.2%	74.2%	68.4%	938
15-16 L1	84.2%	75.2%	79.8%	80.2%	806

Table 11 – Weighted % satisfaction values for BUS questions 1–4

	I can see the relevance of this unit to my course Q5	The assessment arrangements are clear Q6	I know what I need to do to pass this unit Q7	The BREO site for this unit is clearly organised Q8	The BREO site for this unit supports my learning Q9	Total Q'Responses
13-14 L1	84.8%	83.2%	84.0%	82.6%	78.1%	1725
14-15 L1	79.5%	72.5%	75.6%	70.5%	70.5%	1163
15-16 L1	87.3%	87.7%	86.1%	86.5%	87.5%	1031

Table 12 – Weighted % satisfaction values for BUS questions 5–9

To demonstrate that there was a link between the Spearman's ranking value and the weighted average I calculated the overall satisfaction values (using the final question). The values are given in tables 6 and 7.

The weighted average values for overall satisfaction for each academic year are:

2013/14: 73.3% (n=340)

2014/15: 81.3% (n=272)

2015/16: 84.7% (n=200)

Close inspection of table 7 for 2015/16 values shows little variance against the overall satisfaction, demonstrating that there is some agreement with the Spearman's ranking analysis.

Year / Question	Q1	Q2	Q3	Q4
2013/14 First Year	2.7%	6.9%	-6.4%	-1.0%
2014/15 First Year	5.8%	11.1%	7.1%	12.9%
2015/16 First Year	0.5%	9.5%	4.9%	4.5%

Table 13 – Variance of weighted mean against overall satisfaction weighted mean for Teaching questions for first-year CST students

Year / Question	Q5	Q6	Q7	Q8	Q9
2013/14 First Year	-11.5%	-9.9%	-10.7%	-9.3%	-4.8%
2014/15 First Year	1.8%	8.8%	5.7%	10.8%	10.8%
2015/16 First Year	-2.6%	-3.0%	-1.4%	-1.8%	-2.8%

Table 14 – Variance of weighted mean against overall satisfaction weighted mean for Assessment and Support questions first-year CST students

		The teaching on this unit	Assessment and support	Academic support on this unit	Organisation and management of this unit	Learning resources for this unit	Personal development during this unit	N
Academic year	Year Group	1	2	3	4	5	6	
13-14	1	0.9	0.67	0.75	0.78	0.69	0.68	340
14-15	1	0.73	0.2	0.78	0.4	0.3	0.5	272
15-16*	1	0.75	0.9	0.68	0.63	0.43	0.6	200

		The teaching on this unit	Assessment and support	Academic support on this unit	Organisation and management of this unit	Learning resources for this unit	Personal development during this unit	N
Academic year	Year Group	1	2	3	4	5	6	
13-14	2	0.88	0.75	0.83	0.86	0.5	0.59	289
14-15	2	0.84	0.76	0.63	0.77	0.28	0.8	321
15-16	2	0.93	0.6	0.66	0.85	0.58	0.62	255

		The teaching on this unit	Assessment and support	Academic support on this unit	Organisation and management of this unit	Learning resources for this unit	Personal development during this unit	N
Academic year	Year Group	1	2	3	4	5	6	
13-14	3	0.86	0.53	0.38	0.61	0.43	0.84	334
14-15	3	0.94	0.78	0.78	0.78	0.56	0.86	242
15-16	3	0.56	0.77	0.64	0.8	0.59	0.61	210

Tables 15-17 – p values for Bedfordshire Unit Surveys from 2013/14 to the first year group in the study in 2015/16 marked *

		The teaching on this unit	Assessment and support	Academic support on this unit	Organisation and management of this unit	Learning resources for this unit	Personal development during this unit	
Academic Year	Level	U1	U2	U3	U4	U5	U6	**N**
13-14	1	0.86	0.79	0.76	0.83	0.7	0.75	4938
14-15	1	0.86	0.74	0.77	0.82	0.36	0.72	4948
15-16	1	0.82	0.67	0.72	0.71	0.33	0.66	3738
13-14	2	0.88	0.84	0.74	0.79	0.59	0.73	4875
14-15	2	0.8	0.74	0.76	0.73	0.32	0.73	5026
15-16	2	0.83	0.72	0.76	0.71	0.58	0.79	3644
13-14	3	0.8	0.69	0.73	0.72	0.49	0.69	6011
14-15	3	0.78	0.64	0.7	0.62	0.37	0.58	4565
15-16	3	0.8	0.74	0.74	0.66	0.58	0.65	3682

Table 18 - University-level data demonstrating p values for Bedfordshire Unit Surveys from 2013/14 to 2015/16

Academic Year	Year group	The teaching on this unit	Assessment and support	Academic support on this unit	Organisation and management of this unit	Learning resources for this unit	Personal development during this unit
13-14	Year 1	0.68	**0.71**	0.56	0.52	0.51	0.58
13-14	Year 2	0.67	**0.71**	0.55	0.51	0.54	0.57
13-14	Year 3	0.68	**0.76**	0.58	0.53	0.51	0.60
14-15	Year 1	0.61	0.66	0.52	0.52	0.44	0.55
14-15	Year 2	0.64	0.69	0.50	0.51	0.52	0.58
14-15	Year 3	0.58	0.65	0.50	0.48	0.50	0.56
15-16	Year 1	0.65	**0.71**	0.50	0.49	0.51	0.51
15-16	Year 2	0.63	**0.70**	0.54	0.55	0.53	0.55
15-16	Year 3	0.64	**0.72**	0.51	0.54	0.49	0.50

Table 19 – Cronbach Alpha values for each question group –the most reliable question group related to assessment and support, followed by Teaching

There are four very useful pieces of information within these statistical analyses: firstly, for the year group I worked with, the Spearman's Rho values (row for 15-16 year group 1 – table 13) indicate that students' responses to the assessment questions had an almost predictive link with the overall satisfaction; secondly, the Cronbach's Alpha for Assessment and Support is consistently highest for questions relating to assessment and feedback. This indicates that the truly reliable responses tend to gravitate around the assessment questions; thirdly, consistently over all the year groups the lowest Spearman's Rho value could be found in the learning resources questions. However, equally this also had the lowest Cronbach's Alpha value over all years; finally, the questions relating to teaching – which the literature suggests is most important – does not always feature as the highest correlating item, and even the Cronbach's Alpha value suggests that the question items may need improved reliability.

Having examined the data for

Summary of departmental BUS data

The data presents a confusing picture when contrasted with the qualitative data. Students' satisfaction was strongly linked to five questions relating to Assessment and Support, followed closely by Teaching. I have used a technique of exploring the most significant factors, and confirmation that the source instrument for these results possess a degree of reliability. Of all the question groups only Assessment and Support, and Teaching produced the highest reliability, but in the latter group the instrument was only partially reliable. The manifestation of Assessment and Support as the highest coefficient was surprising for the 2015/16 group – though it did reflect my interpretation of the interviews with the students. There was a very heavy

emphasis upon the need to know what was in the assessment, and the students' efforts to uncover information was linked not to learning but rather the outcomes of the assessment. What does this tell us about first-year computing students? If an institution's effort is predicated upon satisfying students, then it is advisable to start by exploring the motivating factors using a localised survey such as the BUS. If the questions are formed in a way to determine students' priorities, then the data can be used to better understand how the implementers of technology may approach justifying a claim for enhancement or enabling learning to take place. I make this assertion based on table 7 where the students in the 2015/16 group place the use of BREO in supporting their learning as the second highest factor.

o. Summary and final reflection

It is difficult to suggest a role for GL other than as a mechanism to deliver content, but the development of content is marred by problems such as selecting appropriate types and amounts. The VLE is a different matter and it is vital to the students' experience. I make this point based on the BUS data where for the first-year students in this study group the weighted average for the BREO-based questions was:

> The BREO site for this unit is clearly organised: 2013/14 – 82.6%, 2015/16 – 86.5%.
>
> The BREO site for this unit supports my learning: 2013/14 – 78.1%, 2015/16 – 87.5%.

It is clear the students perceive BREO as being well organised and supporting their learning, but the actions of the students in forming their assignments shows that they do not necessarily rely on BREO. When I explored the GL changes with students

there was not really an effect upon the experience. I considered what would happen if I took away the VLE and guided learning: provided the students had access to some medium that provided them with information, it may work. However, given the nature of the larger group I suspect that many of the students who balance work with study would struggle to attend (if that was the requirement) or to access material. The results I collected show that at least the model of pushing information to students in the form of GL has a use. Students did not really engage with the extra material or understand the contextualisation as they had a routine that involved searching for content on the internet to solve problems. The difficulty with this student approach is that it does not allow for a clear development of programming skills, or skills which are applicable in a wider context. It is the teacher that puts this information into context. Technology is not as Walker et al. (2016) describe being used to enhance teaching, quite the opposite, it is not allowing students to properly explore problems by iterative development – they prefer a shortcut. The problem highlighted by Henderson et al. (2017) about students re-reviewing and watching video lectures constantly is indicative of this type of behaviour. Students expect that watching a video or videos can help them find a single piece of information that will suddenly cause them to understand a concept. This is a shift is from undertaking a task and failing to not really learning by making mistakes. The question is, why did the GL content not help, or could it have helped?

I can answer this by using a different perspective. I tried putting the policy and guidance I am responsible for into practice. That way I can avoid the critique of also experiencing GL vicariously (rather than me simply reviewing academics implementing it). In attempting to create GL interventions I struggled with the concepts presented in the guidance. My discussions with the guidance's authors

indicated that it was simply a question of getting the lecturers to write content and to generate activities: these where after all part and parcel of how academics teach and students learn. Here is a reminder of what was required:

> *Plan an activity to take an average student a pre-determined amount of time, say 10 hours (remember, that would be the equivalent of ONE academic credit). It is important that students can clearly see how this contributes to their learning progression, how it meets learning outcomes. A particularly valuable approach would be for preparatory work before a workshop, for example.*

At face value this idea seems quite sensible, but it assumes that students: will complete the activity as the lecturer intended, spend the appropriate amount of time to complete the task, and complete an activity that relates to their assessment. There is a question of feedback – is there something that will either tell a student they are doing well (solving a problem), can feedback help a student fix a problem they have found. There are no guidelines provided in GL to take this into account. Whatever the solution, the starting point for thinking about how to solve the problem comes from the level of effort required to complete the task. If we do not consider feedback, and just the creation of one GL intervention or content set, my estimate is that it may take 3–4 hours (an estimate based on my own attempts at following the procedure) including checking and research. A standard 30-credit undergraduate unit is 24 weeks long excluding assessments. This means we must commit anywhere between 72–96 hours (around 2–3 weeks) per unit just to ensure the basic materials are available in the correct format. To illustrate my point I will repeat the guidance provided to staff:

1. Introduction about the task including rationale, alignment with learning outcome, relevance to assessment, information about time to be spent.

2. Introductory learning content, in the form of your own writing on the page, images, quotations (properly referenced), etc.

3. Further learning content on subsequent pages, with embedded audio or video or other Open Educational Resources (OERs).

4. Link to activity, such as a discussion, a personal journal for reflection, a wiki, a quiz or survey, etc.

5. Closing content, springboarding the outcome of that activity into the next part of the unit.

There is no specific guidance given about the quantity of text and the quality of the content, but it is perhaps arguable the guidance is clear on the expected outcomes. The challenge is the practicalities of enacting the guidance. The learning environment is quite restrictive about what can be delivered, and the content looks at best basic. I found that even with the standardised content templates I developed, that it was difficult to produce items that could be easily maintained. Effort would be better placed on just providing a structure without the additional complications of GL. In sourcing additional content which I thought was appropriate, I had to check and test each item. In some cases, the content available was difficult to understand, was incorrect (I tested the ideas and content) or was misleading. I investigated OERs for the specific subject area in this study, but often the content was either outdated, too complex, or contained details which was not useful or gave answers to the assessment tasks.

The University places significant emphasis upon the ability of technology to enhance learning. The problem is the assumption that technology enhances learning and it is the technology that the University provides. This position is only logical if it is possible to have a definition of enhancement, but the standards of enhancement cannot be agreed sector-wide because enhancement is relative to the surrounding institutional context.

GL is supposed to provide enhancement by scaffolding students' learning, but the data I have gathered reveals that GL does not meet the needs of students and is difficult to enact. The reasons are threefold: firstly, students do not understand what it is they actually require for success in the longer term – a focus on short-term abilities in assessments is not a sensible long-term strategy as develops an intellectual inflexibility; secondly, the problem of providing the right information to students – which information is appropriate and the quantity of information that gives away too much information related to the assessment; finally, that the GL guidance promotes the use of content from sources such as the internet – but this brings two problems: the students I interviewed could not ascertain a good solution to their problems from an inadvisable one, and students lacked the capacity to develop strategies to absorb information and demonstrate functional prowess rather than tweaking online solutions and subsequently claiming they had achieved their goal. I would admit in all of my three points the students are only first years, but my sense from the interviewees was that many operated at a level where they just wanted to pass or succeed in the assessment. I was disappointed by the approach of the group 1 students in this regard; they (generally) had more enthusiasm for a high grade than a high-quality learning experience. The University and the wider pressures on the University in the form of the NSS (as an example), do nothing to quell this problem;

in my opinion in the long term schemes like the NSS actively damage the opportunity for an effective learning partnership between academic and student. I do see some logic in the TEF – if a computing student was unable to perform competently and if an institution wishes to make the claim students are highly-skilled then tests of long-term employability and success of institutions at retaining and developing students' skills is actually a valid measure. If schemes like GL are to be effective, then they need to concentrate upon learning in context other than just supporting formal classroom sessions, they should enhance students understanding of essential study skills and the subject area.

6. Conclusion

a. Chapter introduction

In this chapter I summarise the findings I have made and link these back to the literature I selected, I reflect upon outcomes for the research questions, and discuss a strategy and framework which could be utilised by other researchers who are looking to make improvements to the evidencing they use for technology implementations.

b. Findings and implications for wider practice

Before address the research questions, I make a specific reference to the contribution to knowledge section from Chapter 1 – section B.

1) In contrast to the computing BL literature, I find that students find little utility in the approach to deliver online content and the intention to move lectures online would not align with the expectations of students.

I explore this issue in the final response to RQ1 and RQ2.

2) Data from computing students within this study reveals that the conception that teaching is the most important driver of students' satisfaction.

Though the literature suggests that teaching should be the most significant driver of students' satisfaction for the NSS (and therefore it should impact the TEF) my findings differ from this position for two reasons: firstly, considering the data at a department level (as would be conducted in a TEF exercise) the students satisfaction was most closely correlated with questions related to assessment. For the survey instrument the assessment category was the most reliable. Though it is

not possible to make the same judgement about the NSS the application of the survey provides some consistency. I address in my final response to RQ1 and 2.

3) Providing a standardised framework to improve technology implementations

The outcome can be found in the response to RQ3 (section c) and sections d and e.

4) I explore the question posed by Henderson et al. (2017, p.1568) and explain first year computing students' approaches to digital practice.

This is addressed in section C via RQ1.

c. Joining up the qualitative and quantitative analysis

Students indicated the importance of the lecture as a source of information, but it was interesting to see that across the department that the results for teaching are both lower in correlation and reliability (demonstrated via the Cronbach Alpha testing). I focus upon the assessment aspect mainly as this is a reliable data source. It might be possible to explore the other areas of the BUS data, but the instrument is unreliable it would be unwise to make a strong link between other areas and the interview data. The literature indicates that teaching is the most important factor in determining students' satisfaction with their experiences (Ramsden, 1992; Bell and Brookes, 2018; Raaper, 2018). Given I had critiqued the general approaches in computing when making evaluations, does this make my approach valid? I argue yes it does, because regardless of the reason for the survey-based evaluation, there is still the NSS to consider in the longer term. The survey data helps demonstrate the reliability of my qualitative analysis – specifically the students focus upon assessments. For example, exploring the themes generated from the data reveals several which are assessment focussed: students use of online communities (Theme

4), feedback (theme 5), and correctness (theme 6) which are important factors within the students' experiences of developing solutions to their assignments. I can link the behaviour of the students in their use of online communities – students used these to find solutions to assessment questions. It is not possible to search for a solution online in spaces such as StackOverflow without knowing what the assessment requirements are. In this case it is easy for the students as the requirements for the assessment are laid out in each weeks' package of GL. From table 11 - the question: *The assessment arrangements are clear* has the highest satisfaction value (87.7%) and so students in the department are more satisfied when this requirement is met. Another example can be found in table 10 – where a satisfaction value of 84.2% can be determined for question 1 – staff are good at explaining things. This emphasises the first theme I identified: teaching and the lecturer. I could also relate this to feedback and correctness, as the students often wanted to have the assessment requirements explained to them, or they would attempt to reverse engineer their assignments by looking for help online. Moving to an institutional level, and removing the influence of CST students reveals a different picture. Teaching possesses a stronger link to students' satisfaction. However, the picture becomes blurred at such a high-level as there are many different groups of students with competing interests. This emphasises the importance of department-level and year level data in determining what may drive students' satisfaction. I make this point with one eye focused upon the longer-term aim of the TEF.

What does this tell us about the year group I worked with, and might it prove useful in making sense of the qualitative data I collected? I can suggest three different approaches to interpreting the results: firstly, assuming that the most recent result from 15-16 would follow students through their different levels of study; secondly,

building upon students' prior experiences and reacting to significant elements which drive satisfaction – correcting the problems experienced by first years when students enter the second year; finally, to target elements which contribute towards areas such as the TEF. There are three key points in response: firstly, if students' satisfaction is strongly linked to assessment and support then efforts to implement technology could focus upon this practice; secondly, as a contrast, if the aim where to improve teaching and to use technology to do this it is quite unlikely that the impact upon overall satisfaction would be received; thirdly, of note is the drop in the correlation for personal development for final year students. It appears that the longer the students spend the less linkage there is between the satisfaction outcome and this category of questions.

d. Summary of findings against research questions

The claims I make in this section are a combination are primarily based upon qualitative data, but I use quantitative data as a secondary source. The qualitative data explains the students' experiences in great detail, and provides an overview of how the students have approached the use of GL within their studies. This level of detailed study is not present in the literature. When I interviewed students, there was much discussion and interest about the assessments they needed to complete. Though I did ask students about their assessments, this was more as a passing reference, and I had noted the general attitude and approach of the students was heavily assessment focused. In the methodology chapter I indicated I would use triangulation (Cohen, 2007; Turner and Turner, 2009). In this respect the quantitative data is used to indicate it was not just my efforts during interviews that had

influenced students' responses (I interviewed less students than completed the unit surveys). Additionally, it did provide a more systematic understanding of students' priorities within the department and over different year groups. This approach was necessary as a demonstration of potential approaches that can be used to solve the problem of RQ3 which relates to the TEF and longer-term technology strategy.

e. Summary RQ1 – In what ways does GL and Technology Enhanced Learning (TEL) practice impact the first-year computing students' learning experience?

In contrast to the computing BL literature, I find that students find little utility in the approach to deliver online content and the intention to move lectures online would not align with the expectations of students. I draw this conclusion from the students views of the lecture and from the themes I identified in the results section, specifically theme 1 (Teaching and the Lecturer) and theme 2 (The influence of the VLE as a resource for learning), theme 3 (Guided Learning).

The short answer to this RQ is – in a very limited capacity. If I utilise Osguthorpe and Graham's (2003) indications of the benefits of adopting BL – pedagogical richness, access to knowledge, social interaction, development of personal agency, ease of revision or maintenance[13] – I can only justify GL as impacting access to knowledge. I will explain my position in relation to the literature, and draw a distinction between my practice and arguments.

The root of the GL's (or BL's) impact is that it presents a circular argument: students increasingly use and rely upon technology, a claim is made for shifting students' learning and teaching activities to an online or technology-driven medium 'enhances' or 'improves' learning because we are operating in the students' preferred domain.

[13] This item is not relevant to this specific research question, but I do list it

The assumption is that as Henderson et al. (2015) and Henderson et al. (2017) indicate we assume that the technology implementations present universal utility for students. However, the technology involved merely allows students access to online resources (for example see Chapter 5 themes 4, 5 and 6). An argument to support GL might be found in the standardisation of students' experiences (Reed and Watmough, 2015 and Varga-Atkins, 2016). In this sense though there might be logic in standardisation, I cannot argue that the action of implementing GL leads to enhancement, or anything other than providing information. This position is distinct from the literature, as the argument is for more technology implementation, and for standardisation. I will now explore this problem specifically for computing.

Collectively, the computing literature indicates that there should be a change in the nature of students' learning experiences when BL (aka GL) is implemented with improvements including: satisfaction (Bautu et al., 2018; Tritakan et al, 2016; Bi and Shi, 2019), students' competences and improvements in assessment outcomes (Boyle et al., 2003; Hadjerrouit, 2008; Alhabi, 2016; Breimer et al., 2016; Dawson et al., 2018). However, in the literature review I identified that such approaches have underlying approaches which present snapshots of success, or utilise highly specific implementations which stretch the definition of BL. Hence my inclusion of CAL (Computer Assisted Learning) in the literature review which was utilised in some of the BL approaches (Djenic and Krneta 2010; Djenic and Mitic, 2017; Alhazbi, 2016, Kose and Deperlioglu, 2012). I would argue that the CAL approaches are teaching to the assessment to the extent that students would assume all they needed to know as encapsulated within a specific learning tool, naturally students will perform better so the claim of enhancement may be correct – but it derives from potential assessment knowledge. I know from both the quantitative data I examined in chapter 5 section N,

and the theme 7 assessment that the students are heavily focused upon assessment. This is where GL partly provides a solution, but for students the internet provides greater utility.

For group 1 students - GL was the jumping off point for students, and their behaviour focused upon solving each week's task; technology in the form of the internet formed the basis (themes 4 and 6) for most of the information students to solve problems, rather than relying on developing their own skill sets – the answers can be found with searching. I found that students reflecting the behaviours identified by Boustead (2009), Stamouli and Huggard (2007) and Bucks and Oakes (2011) instead of trying to practice and learn it is more expedient to short circuit the learning process and try to find a solution. The net result of this was for both Dr X's and Dr D's students the final assessment proved the most complex – and it brought into sharp focus students' lack of skills. It became clear that not all of the students understood the nature of the programs they had created. I saw this effect manifested when Dr X used a timed exercise, and similar to Boustead's (2009) findings it highlighted students' inability to cope. The reason being students could not utilise their normal strategies – time could not be spent looking up answers, they had to rely on internal skills. I could argue that GL is not designed to prepare students for this type of activity, I doing so I return to Osguthorpe and Grahams's (2003) claim of personal agency. GL does not directly, unless expressly directed (which it does not), help deliver this type of improvement. Hence my prior point about approaches like CAL (Djenic and Krneta 2010; Djenic and Mitic, 2017; Alhazbi, 2016, Kose and Deperlioglu, 2012) as they offer students false confidence about their abilities.

Putting this into context for Henderson et al.'s (2017, p. 1568) question about the role, meaning and outcome of technology implementations:

> *"More attention therefore needs to be paid towards the reasons why students engage with specific forms of digital technologies during their studies. This raises questions about* ***the roles that these technologies*** *are playing in student learning,* ***the meanings that are being attached to different digital practices****, and the* ***outcomes and consequences of any use****."*

For students the meaning was focused upon the requirements for their assessment, and the path to completing their assessment (themes 6 and 7). I acknowledge this may be due to the peculiar to the particular group of students, but I am mindful of the points I had made chapters 4 (section D) and chapter 5 (sections m, n) and section c in this chapter . I draw a distinction with the literature in that I have both explained the role of technology for students in the frame of Henderson et al., and I have used complementary analysis techniques to explore the students' priorities.

The University has set expectations for GL, and similar to the requirements and approaches of computing BL, has not set them in a way which encourages any development of longer-term effective students' behaviours. It has left the students in a position Bruce et al. (2003) describe of students 'following', and the need for constant feedback, and often not via an authoritative source[14] to maintain their learning experiences (see examples in themes 4, 5 and 6 of the use of online resources). Comparing my research into GL with the BL literature I arrive at the conclusion that I have drawn a distinction against the literature by examining the points raised by Drysdale et al.'s (2013) and Henderson et al. (2017) where I have

[14] In this case I consider the lecturer as an authoritative source as they provide the final assessment of students

concentrated on the specific actions of students (which both authors separately pose questions about) and the consequences of the design of materials to support students.

Addressing the TEL aspect of the research question

Whereas other authors critique (Kirkwood and Price, 2014; Selwyn, 2015) the use of language and structural approaches to describing TEL – which I agree with. My findings demonstrate the consequences of a strategy to technology use which does not consider the longer-term trajectory of students' skills, and the impact upon students' behaviours. If the rhetoric of the GL policy was correct, then any addition or utilisation of the VLE would potentially constitute enhancement. Examples of this include Reed and Watmough (2015) and Varga-Atkins (2016) who use VLE standards as the basis for enhancement, and the UCISA (2016) survey which explains which technologies are in use under the banner of TEL. Dr X and Dr D's units already had many of the standard features of TEL-esque delivery (apart from GL) and included ongoing feedback, the use of electronic assignment submissions, and recorded lectures. Therefore, either their implementation of TEL is not 'correct' or the basis for TEL implementation is not fundamentally addressing the problem of applying pedagogical principles to technology implementation. This position is counter to the narrative presented by Kerres and De Witt, 2003; Osguthorpe and Graham, 2003; Picciano, 2009; Graham et al., 2013 – where the basis of enhancement is a move online and the adoption of learning more remotely. A more informed approach involves the use of a better chain of evidence to determine the impact of TEL, and I will address a differently aligned approach in RQ3 which extends the definition of DBR (Collins et al. 2004; Reeves, 2008; Anderson and

Shattuck, 2012) into a practical framework which could be used by TEL implementers to make improvements.

In conclusion for RQ1 – the impact of GL is minimal but is needed to ensure students have a basic framework to follow. Despite the literature claims I cannot find compelling evidence of the enhancement of students' experiences. GL in this case simply provides a baseline for students' experiences. Though GL and BL are distinct, but related concepts, I cannot find evidence to argue for the type of improvements the literature specifies. I outline my reasons in the following paragraph.

Following the rules of implementation does not enhance students' experiences even when a substantive effort (which I will deal with in RQ2) is made to provide resources in different formats. Even then, students prefer the utility of other resources – I draw this point directly from my findings. It causes a problem for students' long-term development. The computing BL literature was more focused upon proving the success of localised implementations, rather than exploring opportunities to address issues at a department level. I will address this specific issue in RQ3, but I note it is not something found within the literature as my argument for a new framework focuses upon a different evidence base to demonstrate enhancement. For the TEL part of this question it is more difficult – the focus upon – E – enhancement - is misnamed. This is a departure from the literature, as admitting that technology is not enhancing students' experiences leaves it in a vulnerable position of redundancy. It is a counter narrative to the literature. As simple example of my point - If prevented access to search sites such as StackExchange or StackOverflow from students and relied on time-constrained exercises as Boustead (2009), Dr X and Dr D did it would likely demonstrate that internet resources are enabling learning significantly more than enhancing.

f. Summary RQ2 – What are the benefits and drawbacks of adopting the GL model?

As for RQ1 I rely upon Osguthorpe and Graham's (2003) list of advantages: pedagogical richness, access to knowledge, social interaction, development of personal agency, ease of revision or maintenance – I will address these points in replying to RQ2. There are three perspectives to consider the benefits and drawback from: students, academic staff and the institution.

For students, three claims are potentially relevant: pedagogical richness, social interaction and the development of personal agency. Did GL promote any of these elements? On the basis of my comments for RQ1 I do not think there is a suitable evidence base to suggest that pedagogical richness is a valid outcome. This is on the basis that students' interactions involved a lecture, accessing resources on the internet or support they could gain in class. The literature still contains claims which build upon Osguthorpe and Graham's (2003) – for example Niemiec and Otte's (2010, p. 23) claims of increased interaction, and learning effectiveness which result from BL implementation. My results suggest that students see value in lectures (theme 1), but this position is at odds with the literature where there is emphasis upon removing lectures (Jonsson, 2015, Chen et al., 2015, Hauswirth and Adamoli, 2017). When thinking about the materials used with students there is a difficult line to draw. Learning materials can be directed at replicating existing pedagogy, but the difficulty is they only have a limited scope in which to promote action from students (themes 2 and 3). For example, Matthews et al. (2009) and Bati et al. (2014) – which replicated existing pedagogy with 'e-learning' materials (lectures, notes and links). Again, such efforts are only focussed upon providing content – though such activities are highlighted as effective BL. Despite offering highly specific resources, students

still made more frequent use of the internet and for group 1 students often in a way which avoided them engaging in complexity (group 2 had a more nuanced approach). The consequences for practice are as Bruce et al. (2003), Bucks and Oakes (2011), Smith and McCartney (2014) have pointed out – students want personalised feedback, and will in some cases seek to orbit back to an expert or experts. The structure of GL did not seem to elicit a strong response from students (theme 3), therefore I cannot argue for further learning patterning as Thompson (2011) does because of a sufficient reaction from students. Therefore from the students' perspective, the advantages are really only instructional, and as much of the starting material was presentation-based and there is not much more to be gained by originally researching tasks as the internet is a more rounded source of information. Even if practitioners utilised other methods such as providing specialised tools for students to use, this will still focus students on solving problems in very fixed ways. It offers little room for students to develop their own skills.

In exploring staff acceptance of approaches like BL or GL, I will reflect upon the data I collected verses the literature's approach to evaluating students' experiences in BL, and the claims of cost effectiveness and ease of revision and maintenance. My experiences of working with my staff participants led me to believe that the production and implementation of GL is not pedagogy efficient. This position is a highly specific extension of the findings of Lothridge et al. (2013) and Taplin et al. (2013) – where the cost benefits do not justify the experience of students, who would prefer elements such as lectures. Thus, we return to literature which presents a dichotomy for academics: students increasingly want more support, and students' satisfaction is now a vital measure of success with the advent of the TEF. However, is more content and activities online want students want? The literature says:

teaching is the most significant factor in students' satisfaction (Ramsden, 1991; Bell and Brookes, 2018), and Rolfe (2002) and Bunce et al. (2017) attribute this type of demand as stemming from students' lack of academic skills – ergo students expect to be told what exactly to do. Where the literature makes smaller claims about the link between students' satisfaction (Owston et al., 2013) and reward and recognition and higher grades (Law et al., 2010) I have been able to demonstrate this claim at a year-group level and confirmed this is specifically the case for students in CST.

If I approached my staff participants with the rhetoric of the literature I could focus upon either very high-level outcomes (Osguthorpe and Graham, 2003) or view individual studies with specific implementations (Hadjerrouit, 2008; Kose and Deperlioglu, 2012; Selvi and Preumal, 2012) as a method to encourage staff acceptance of technology. However, most of these studies do not address success beyond a localised level. An alternative method might be using statistical means alone (Lim et al. 2007; Ginns and Ellis, 2007; Paechter et al., 2010) – in these cases in the form of students' satisfaction, but these approaches only test a very narrow aspect of students' experiences. I also must consider the issue of determining which aspects of students' experiences are attributable to existing implementations or newly introduced change. The initial performance improvement (Boyle et al., 2003; Lopez-Perez et al., 2011; Paechter et al., 2010) is not necessarily sustainable if the underlying reasons for the outcomes of change cannot be identified. From the perspective of academic staff this makes it very difficult to determine what the correct course of action should, would or could be when implementing GL. Examples of localised success and practice are vivid and easy to recall, but as Oliver and Trigwell (2006) argue lead to practitioner-based efforts being favoured instead of the development of good theoretical reasons for implementation. In summary for

teaching staff, the problem could be described as: GL only offers advantages when much work is put in to developing it, but students' behaviour suggests that once a minimum amount of content is delivered the focus shifts to performing in assessments. Additionally, the literature, unless focusing upon a small area is unclear about the approach to evidencing. Therefore, an approach like GL is distracting because on one hand it claims to offer advantages to staff, but the methods to evaluate or link to institutional priorities to demonstrate alignment of efforts (e.g. the TEF) have not been explored in the literature. I address this problem in RQ3.

In terms of cost effectiveness and ease of maintenance, this is more difficult to answer as there is very little written in the literature about these topics, and the details are likely to be commercially sensitive (Lothridge et al., 2013 and Taplin et al. 2013). To address this literature gap, I provide a view of how I experienced creating content in concert with my staff participants. To start with, I should state I have vested interest in saying the policy is sound and provides a good basis for developing students' learning. However, when I took the opportunity to try out the tasks that students needed to complete I struggled with a new programming language that I had never experienced before (despite experience in both procedural and object oriented programming). When I tried to follow the rules, I am responsible for I found the rhetoric for the use of technology fell short of my own expectations. For instance, the rules indicate staff should use the content OERs (Open Education Resources), YouTube and external media. I refer to Henderson et al.'s (2017) point about students watching videos, and the meaning behind students' digital interactions (see theme 4, 6 for examples). When searching for appropriate content to include, I found YouTube videos often did not cover subjects in an appropriate

way or written for the wrong version of the programming language, had significantly different formatting, or incomplete information. It might seem very helpful and useful that other academic colleagues write content and share it, but it requires time to test and check before exposure to students. More specifically, YouTube videos suffer from similar problems, and it is why I probed students' views about their trust in resources found online. Students cannot necessarily determine if the information provided is correct. The difficulty is further compounded by the sheer amount of materials available to students. A similar problem exists with the types of online communities students engage with. There are lots of answers to questions, and I both observed and during interviews noted that students made extensive use of programming social media sites (theme 4). In many cases this was to explore solutions to problems, to look up specific errors or to see if solutions to assignments existed online (theme 6). These resources are highly interactive, and present significant utility to students in so far as they can complete their assignments.

In summary, the literature presents many advantages for all the parties I have outlined (students, staff and the institution). However, my investigation reveals that these advantages are not present in the student groups that I worked with. The rhetoric as Selwyn (2015) indicates, does not match the reality of implementation. My claim, contrary to the literature is that there are very limited advantages to adopting GL or BL beyond offering basic instruction. Both are never going to match the breadth and spread of information online, and it seems illogical to ask lecturers to create resources that provide little utility for students. Rather efforts could be directed into creating learning opportunities that enhance students' skills which would support longer-term outcomes such as the TEF.

g. Summary RQ3 – What changes to existing policy and practice around GL and TEL would provide a suitable evidence base for the ongoing development of TEF outcomes?

To answer this question there are two contributory segments – both of which are missing from the literature: an exploration of the strategic intentions of technology adoption , considering the issues the TEF/NSS present for the implementers of technology and maintaining an evaluation mechanisms.

I return back at this point to the requirements of DBR (Amiel and Reeves, 2008). In summarising the domain in RQ1 and RQ2 I am now able to suggest an area for practitioners to develop.

Setting aside the outcome-focused arguments around enhancement for the moment – from the institution-level submissions for the TEF, the primary implementation of TEL was the use of Panopto which was offering a chance for students to review and replay content (Eales-Reynolds et al. 2018; Flavin and Quintero, 2018). I cannot argue this is a form of enhancement. If the only evidence of TEL is students replaying lectures and cursory mentions of institutions' VLEs then technology implementers are losing the initiative. Taking the example from Eales-Reynolds et al. (2018) and Flavin and Quintero (2018) I reviewed a sample of the HEI institutional TEF submissions, technology hardly featured, but when I explored further education colleges the prevalence of terms like VLE, learning, and learning environment featured with some frequency. My own institution also made quite frequent mention of the VLE as a source of support for students. As I discussed in chapter 5, the greater the amount of data the more easily lost are nuance.

This is where I believe the subject level TEF may provide the resolution for practitioners. Reframing Henderson et al. (2015) and Henderson et al. (2017) from the perspective of institutional approaches to technology implementation: what are students' priorities, how can these be built upon, what are the current issues with technology implementation, and how can a strategy for implementation be formed using institutions' data supporting evidence? There are three options which I will outline.

Option 1 – Implementations directed in response to institutional surveys

The prevailing NSS position is that teaching is the primary driver of satisfaction (Ramsden, 1991; Bell and Brookes, 2018), but these types of examination are too high level – my findings are different. Nuance is lost at the level of the NSS. A lower-level survey can provide insight. There are many of conceptions of the effective type of survey: So and Brush, (2008); Moskal et al. (2013) inter-class collaboration, linking to students' outcomes – Lopez-Perez et al. (2011). The difficulty is the survey instrument being too precise, results being assumed as causal (Boyle et. al, 2003; Alhazbi, 2016) or repeatable, directed at a specific intervention (Selvi and Preumal, 2012), or as Brew (2008) indicates students may see surveys as a compliance exercise. These factors show the need for the evaluation of technology implementations to operate as separate but complementary institutional approaches to evaluation. The latter should set the tone and strategic direction for the former. Institutional data offers context. From my own data set, I can say it offers a chance to address issues before they emerge in the NSS, by simply reviewing the trends and priorities of students. It is not as simple as collecting the data, as the instruments used in both local and institutional approaches must be reliable and valid. My argument is a departure from literature where I am suggesting adopting precision in

measurement of students' experiences by focusing upon the strategic use of institutional data to drive implementation, as opposed to a claim of accuracy of measurement – which is impossible because the conceptions of 'satisfaction' differ. The option has the distinction of making data available for all years of students' activities, and it is possible to determine the drivers of students' satisfaction. It does require a consistently applied survey instrument, for more than two years.

Option 2 – Implementations directed in response NSS results

The NSS could provide a strategic lead to implement technology, but it is very general in application, and it would be hard to specifically attribute implementations to NSS outcomes. It is difficult to make claims about the influence of technology, for two reasons: firstly, as Reed and Watmough (2015) and Varga-Atkins (2016) suggest that satisfaction derives from the VLE, but there is no definitive proof of this; secondly, the NSS is focused upon the whole course not just specific implementations in given years. I would argue against the literature in this respect as it does not explain the link between the action of implementing technology and an evidence chain leading to eventual outcome. The examples I provide in table 20 are meant to give a general indications, and specific TEF-facing elements are in bold.

NSS Area	NSS Question number and text	Potential role of technology at unit level
The teaching on my course*	1. Staff are good at explaining things. 2. Staff have made the subject interesting. 3. The course is intellectually stimulating. 4. My course has challenged me to achieve my best work.	Provide mechanisms for delivering content in different formats. Link to content external to the main unit or course site to additional internet content. Provide examples of previous work.
Assessment and feedback*	8. The criteria used in marking have been clear in advance. 9. Marking and assessment has been fair. 10. Feedback on my work has been timely. 11. I have received helpful comments on my work.	Provide clear assessment criteria in advance. Deliver feedback within the VLE (TEL). Standardise feedback style and delivery within the VLE (TEL).
Academic support*	12. I have been able to contact staff when I needed to. 13. I have received sufficient advice and guidance in relation to my course. 14. Good advice was available when I needed to make study choices on my course.	Ensure information about staff contact details is contained within the VLE. Make external services available to students via the VLE.

Table 20 - Questions from the NSS for 2019 (Office for Students, 2019) (remaining questions are in appendix C)

Option 3 – Focus solely on the TEF metric outcomes in the NSS

If an institution's intention is just to satisfy the limited sets of outcomes in the TEF then any technology-based interventions should aim to address the following sections of the NSS: Teaching on my course, Assessment and feedback, and Academic support (the full questions are given in table 15).

I begin by presenting Torrisi-Steele and Drew's suggestion (2013, p. 379) about blended learning *"Blended learning increasingly brings the role of education designer to the skill set of academics".* I would paraphrase this to say: the TEF brings the challenge of longitudinal implementation in GL (or BL) and TEL to learning designers. With this in mind when considering the TEF there are four difficulties for the implementers of technology: firstly, that there is a clear issue of evidencing progress and the effectiveness of technology – the use of GL (to a lesser extent blended learning) tends to be administratively driven and focuses upon the measurement of implementation as opposed to understanding the students' experiences; secondly, emphasis is placed upon academics as the primary agent of change.

h. A summary of options 1 through 3

All of the options present methods which might contribute to a wider evidence base to support the implementation of technology, but there is a need to draw these into a more coherent and replicable methodology. My argument which I draw as unique to the literature is to shift the implementation of technology to a position where developments are iterative and are constructively aligned to institutional priorities. These may be general strategies to improve students' learning experiences and can include a TEF subject-level focus.

i. Constructively aligned technology implementations

The difficulty for technology implementations is that they tend to not focus upon pedagogy as a primary goal, or to be highly specific to a small audience. Take for instance the use of EMA (Electronic Management of Assessment) (Newland and Martin, 2016) this is not predicated upon learning as it is an administrative

transformation, and it is strategically aimed at improving outcomes (speed, efficiency and the ability monitor the handing in and completion of assessment). Equally, the example of GL or BL: in either case they are an attempt to substitute teaching for online activity – but they both operate in the hope that students will somehow perform better. This is related to the problem of equivalence I discussed within the literature review (Taylor and Newton, 2013). Other institutions (as I pointed out earlier) have attempted to adopt standardisation of the VLE as their way of demonstrating that technology is making a contribution (Varga-Atkins, 2016), but there is a need to be much more specific about the contributory role of technology. Otherwise technology, via the role of the VLE, falls back to structuring of information for students (which is all GL really does). Standardisation in this fashion suggests a defensive role for technology.

There is much effort expended upon classifying and evaluating lecturers' performance and the outcomes of students' satisfaction, and therefore I made the choice to examine how such data can be used to assist academic staff. It does show that the instrument used within the University is not reliable when completed by computing students. It is important to acknowledge this point, because it is a yardstick by which academic colleagues are judged.

Given my commentary for the three research questions, and the options I presented as a way forward, what new approach is possible? My closing argument has three points of action: firstly, learning technologists need to adopt a strategy that promotes the use of the iterative development that follows students through their studies – in this way we can be sure that a model that exists with one group can be refined for subsequent incoming year groups; secondly, more attention needs to be paid to drivers of students' satisfaction and students' approaches to the use of technology,

be they related to the TEF or more generally – these can also be monitored incrementally year on year; finally, if the correct drivers are evaluated and explored it may allow for an alignment of implementations which can be used to evidence TEF narratives or to demonstrate how technology is aligned with the goal of improving students' experiences.

In the next section I describe a framework that I intend on installing in my role as Head of Digital Learning systems at the University. I acknowledge the approach may have limitations for four reasons: firstly, it may increase a burden upon academic staff to implement a poor solution; secondly, it may prove too difficult to implement when moving from year to year; thirdly, it may not allow for the identification of specific protected groups of students based on their disability, ethnicity or the students' position in the indices of multiple deprivation (IMD); finally, the implementations may not have the intended effect upon key areas that relate to the TEF. In contrast: firstly, technologists must improve their alignment of implementations with institutional and extra-institutional evaluations; secondly, if a technology implementation is pedagogically effective then there is a greater likelihood of it being adapted and developed to move with the cohort; thirdly, an effective implementation should work for all students regardless of protected characteristics – and where these are taken into account enhance all students' experiences; finally, the TEF is not just about the numerical outcomes (z-scores etc): it is about the accompanying narrative. Technology implementers can develop their currency amongst academic staff by being active in pursuing opportunities to better understand the evaluation mechanisms implemented against academic practice and by taking a shared responsibility in success and failure.

j. Provisioning a new framework to support institutional implementations of technology

The problem with many approaches to the implementation of technology is that efforts for implementation are often only singular in nature, and this is the reason why I ensured that I collected main group data twice. The concepts behind DBR's repeated implementations and testing are useful in resolving the longer term TEF/technology problem, and the shorter term issue of strategic alignment of technology implementations. To address this disconnect I am proposing a seven-stage model for technology implementation for practitioners which builds off of Ameil and Reeves (2008) model, my framework is specific for technology implementation. As the TEF/technology problem is not discussed in the literature the three points and my suggested framework are unique: firstly, it maintains a minimum standard for the implementation of technology by focusing strategy upon responding to data generated from localised surveys; secondly, I use a similar methodology by making interventions repeated over several academic years forwards and backwards (to the next year, and to the year behind) – meaning there is a consistent approach to implementation and to students' experiences; finally, that the model is designed to demonstrate that technological change and interventions are linked to a process of continual improvement of the use of technology.

In the following sub-sections I explain each of the elements of the model I am proposing. I make the following assumptions: that an internal departmental, or unit-level survey which reflects the NSS is available and is utilised; that there are suitable NSS data to explore the finality of interventions; that technological interventions (TEL) and approaches like GL both feed forwards year on year and feed backwards

to the year before; and that there is a standardised approach to the implementation of technology (an equivalent of GL or TEL).

Stage 1 – Preparation – determine departmental priorities

Departments are generally aligned to TEF subject areas (there may be exceptions). In the case of the University there are four ways in which to determine potential departmental priorities: firstly, by directly interacting with the department's staff or with the head of department; secondly, by utilising unit-level data as I have demonstrated within the results section; thirdly, by the use of TEF data which might cover a set of groups within the department; fourthly, via the use of NSS data to determine if there are any long-term issues which tend to affect students' experiences.

The combination of quantitative and qualitative data is a vital part of this exercise, and in my investigation, for three reasons: firstly, it provides an opportunity for academic staff to demonstrate the reliability of the data collected from students, because the NSS data in my own institution leaves many gaps it can help address the balance; secondly, it puts staff and departments in a position to track and monitor students' behaviours over a series of academic years; finally, I intend to promote the idea that learning technologists can better understand the more general factors manifesting in data and their actions – in the action of collaborating with subject experts (academics) co-ownership is taken instead of imposition.

In undertaking an analysis of the priorities, the following elements should be considered:

- A suitable sample from which to draw from – ideally at the departmental level, or categorised into subject levels
- Data from the year groups preceding the group under study which matches the group interventions need to be applied
- Cronbach's Alpha and statistical tests (non-parametric or parametric depending upon the data's distribution) are undertaken on the data to discover the nature of any potential relationships between the outcomes of students in past data
    - The measurement of satisfaction reflects the approach utilised by comparable surveys – for example, it combines items such as Strongly Agree and Agree in a ratio with the total responses
    - A specific focus upon TEF-related elements of past survey data
- Determine if groups of specific questions contribute towards the overall satisfaction of the unit a regression or ranking analysis

Stage 2 – Analyse existing interventions or technology implementations

Emphasis in this stage should be placed upon an analysis of:

- Students' existing views of technology implementations
    - Methods may include: an analysis of unit-level surveys, interviews with students, or structured approaches to analysis of students' experiences
- Staff views of existing GL/TEL implementations
    - Working in conjunction with staff on developments or reviewing current usage with staff members.

- The strategic fit of the current technology implementations
    - Review of existing implementation against the outcomes from departmental-level surveys, TEF or NSS outcomes. Determine how the existing implementation is promoting or failing to promote specific aspects of the learning experience of students.
- The short-term maintenance requirements of current implementations
    - Identify any issues with the current implementation that involve the efforts of academic staff to develop, monitor, feedback or otherwise intervene or engage with students or systems.
- The long-term maintenance requirements of current implementations
    - Identify any issues with the current implementation that involve the efforts of academic staff to develop, monitor, feedback or otherwise intervene or engage with students or systems. Determine if the current approach may impact teaching or other academic workloads.
- Current resource intensity required for operation
    - Determine the amount of resource required to maintain the current operation of the technology implementation. Who is involved and what impact do they have?

Stage 3 – Determine potential requirements for interventions or development

In this stage the emphasis is upon determining and planning what changes are required and how they will be delivered.

The priorities are to identify:

- The amount of interventions or developments required
- How these changes will impact the potential stakeholders indicated in stage 2
- Any ethical issues which may impact implementation
- Estimations of the cost and quantity of changes
- The benefits and the drawbacks of change

Stage 4 – Define initial short- and long-term evaluation strategies

Stages 3 and 4 are linked closely as it is important to determine what methodologies will be used to monitor and develop the implementations. Specifically, consideration should be given to:

- Methods of initial evaluation with the student groups
    - This may be via a combination of localised student interviews, or through quantitative means. Ideally, the evaluation would be a combination of both methods.
- Determining local issues for comparative purposes by reviewing department-wide surveys or unit-level surveys
- Determination of longer-term aims of students by exploring NSS data

Stage 5 – Initial implementation with target year group

In this stage the intended implementation is created, and students are exposed to it. At this point there are three important processes that need to take place:

- Students are made aware of any changes to materials and what impact they will have upon their studies

- A backup plan is designed where the original materials or activities are made available
- Students are made aware that the changes are part of an ongoing process of improvement

Stage 6 – Reflection and evaluation for deployment to next arriving year group

It is at this stage that an evaluation of the current implementation should take place. The evaluation, like this thesis, should be supported by different forms of evidence. If the student group is first or second year then an evaluation of the department's unit-level surveys is one mechanism to support evaluation. This should be combined with some form of analysis of students' experiences. In this case I am suggesting that the combination of data from unit or department level (depending upon the status of the intervention) with, for example, interview data presents a powerful narrative case. The data from this stage can be used to improve the existing model, or to generate a new one based on knowledge gained from the original.

Stage 7 – Reflection and evaluation for development to apply to current year group for the next academic year

In this final stage it is important to consider how the existing or potentially new practice can be made available to the following year group. The reason for this type of intervention is to ensure that students are able to experience consistency between year groups, and it is also provides an opportunity to demonstrate the students' experiences are continually monitored.

k. Limitations and difficulties in this study

I only worked with computer science students during this study, and if I had the benefit of 50,000 more words and more research time I would have liked to address six points: firstly, a full review of the staff experience; secondly, an opportunity to test out my framework by moving forward with the first year group I studied and to work with new incoming first years; thirdly, I would have provided a much more comprehensive analysis of the survey outcomes for other departments to compare directly to CST; fourthly, I would have collected more data from different student groups within the University looking at non-GL approaches and GL approaches; fifthly, I would have liked to make a deeper examination of how students utilise resources from the internet and how they interacted with online communities. It is this arena that, on reflection, had the most to gain from exploring assessment strategies etc; finally, I would have made an effort to create much more elaborate and complex GL interventions for the students. However, I think my last point would prove that the implementation of GL would constantly need more than expert pedagogical help to develop such materials. This was the reason I opted for a framework that could be tested and explored within other institutions, and to a greater extent within my own. My intention was not to simply dismiss GL, but I wanted to find out what how students worked with GL and the answer was: surprisingly a little – and this was disappointing. I expect that most students are likely satisfied with the provision in the VLE, and it is the interaction with staff that is more important. I must however, be very careful with the notion that this problem is specific to our computing students; after all computing is a close relative of mathematics, and it is much easier to prove an idea wrong in computing than it is in a social science subject such as education. In delivering GL, should I have

encouraged them to do anything different? I think the answer here is no, because there comes a point where my interference with the teaching process would move from being an implementer of technology to taking an active role in teaching the subject. I do not think this is appropriate and I certainly did not have the resources to do so.

Examining my methodological approach

In asking this question, I prefer to make a judgement of proportionality: was my use of TA proportionate to the circumstances of the investigation, and did it allow me to make valid judgements about the domain? In answering both questions I would make three points: TA is a proportionate method and I have used it to make iterative attempts to understand the domain; secondly, in terms of validity I certainly measured the students' experiences of GL and TEL and how they utilised both – a critique might be that if I was looking for theory I should have used a different method: this is precisely the reason I did not. A theory is a predictive model, and taking into account students' responses to the BUS it is difficult to see how a predictive model would help, what is needed is a more nuanced approach and this is what I have suggested in my framework. By starting with first years, academic staff and learning designers have a potential second attempt to correct their errors and to push an improved model both backwards and forwards (to new first years and to second years).

Further work

There are three avenues of further investigation: firstly, testing my framework with groups of students other than in computing – this body of research is now how I am implementing change in the institution; secondly, investigating students' use of social

and problem solving networks; finally, exploring by testing to see if I refocus upon technology can influence the outcome of the TEF or form the basis for a better technological contribution to subject-level submissions.

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8. Appendices

a. Appendix A - BUS – Bedfordshire Unit Survey 2015-16

DRAFT

EvaSys	Bedfordshire Unit Survey - 2015-2016	>>DO NOT PHOTOCOPY THIS FORM<<	Electric Paper

Mark as shown: ☐☒☐☐☐ Please use a ball-point pen or a thin felt tip. This form will be processed automatically.

Correction: ☐■☐☒☐ Please follow the examples shown on the left hand side to help optimize the reading results.

Your views on your learning experience on this unit are extremely valuable and will help us make improvements in future years. You will be asked to complete a questionnaire for each unit, so **please ensure your feedback relates to this unit only**. Your tutor will not be able to identify you directly from your answers, so please be open, honest and constructive. Please use a black pen to fill in the response boxes - corrections can be made (see the box above for the method to use).

When filling in the boxes please try and avoid the middle response unless you really cannot decide.

1. The teaching on this unit									
1.1	Staff are good at explaining things	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A
1.2	Staff have made the subject interesting	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A
1.3	Staff are enthusiastic about what they are teaching	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A
1.4	The unit is intellectually stimulating	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A
2. Relevance, Assessment and BREO									
2.1	I can see the relevance of this unit to my course	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A
2.2	The assessment arrangements are clear	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A
2.3	I know what I need to do to pass this unit	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A
2.4	The BREO site for this unit is clearly organised	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A
2.5	The BREO site for this unit supports my learning	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A
3. Academic support on this unit									
3.1	I have received sufficient advice and support with my studies on this unit	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A
3.2	I have been able to contact the tutors on this unit when I needed to	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A
3.3	Information on how to contact tutors teaching this unit was easily accessible	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A
4. Organisation and management of this unit									
4.1	The timetable for this unit works efficiently as far as my activities are concerned	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A
4.2	Any changes in the unit or its teaching have been communicated effectively	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A
4.3	The unit is well organised and is running smoothly	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A

F107U0P1PL0V0 05.10.2015, Page 1/2

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EvaSys	Bedfordshire Unit Survey - 2015-2016	>>DO NOT PHOTOCOPY THIS FORM<<	Electric Paper

5. Learning resources for this unit

5.1	The library resources are good enough for my needs	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A
5.2	I have been able to access IT resources for this unit when I needed to	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A
5.3	I have been able to access specialised equipment, facilities or rooms needed for this unit when I needed to	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A

6. Personal development during this unit

6.1	This unit has helped me present myself with confidence	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A
6.2	The skills and qualities developed during this unit are relevant to a range of future career and work options	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A
6.3	During this unit, I have become more aware of the areas I need to develop to improve my future career and work options	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A

7. Overall I am satisfied with the quality of this unit

7.1	Overall I am satisfied with the quality of this unit	Definitely Agree	☐	☐	☐	☐	☐	Definitely Disagree	☐ N/A

8. Any other comments / feedback

Use the next questions to amplify your responses or add other comments. Please ensure you write clearly and keep your comments within the boxes.

8.1 Looking back over this unit so far what are the positive things about your experience?

8.2 Looking back over this unit so far what areas do you think we should improve?

b. Appendix B – Initial and extended interview questions

Initial questions tested with students – I used these as a basic guideline to check that the GL interventions we created had not adversely impacted students' learning experiences, and at first to ensure that my approach to implementing GL had been correct. Once I had a better understanding of the students' approaches to learning I was able to expand my investigation to react to how the students worked towards their final assessments.

1. How did you find using the guided learning packages? (this was to test the new packages, and I expanded this question to explore how students operated within the VLE)

2. In what ways do you think the guided learning packages supported the learning that took place in taught sessions you attended? (I wanted to test the literature conception that lectures have less use)

3. What things did you find effective about the guided learning package(s)? (in an effort to determine students' priorities for using GL)

4. Would you like us to make any changes to the guided learning packages we provided to you? (This was an opportunity to gain feedback on the structural aspects of the packages)

5. In what ways do you think the guided learning package prepare you for your assessment? (I wanted to test the link between students' activities within the GL packages and the utility they found with their assessments)

6. What differences between the guided learning packages we gave you, and the guided learning you had access to in the first semester? (This was intended to allow me to make a comparison between the when the University's rules had not been followed, and then when they had been)

7. How did you use the guided learning material in the first semester to prepare for your assessment and beyond? (This allowed students to explain their approach to assessment which was continuous and ongoing during the academic year – delivered via a portfolio of work the students had created

As I progressed through the initial test interview stages I began to investigate other segments of the domain exploring areas such as:

- What resources did students use to solve lab-based problems
- How did students approach problems in the lab, are there any specific methods that worked
- Which resources did students use online to support their learning?
    - How did these resources help them when trying to solve problems
    - What happened when students discussed these resources with Dr X and Dr D
- How students utilised the feedback from Drs X and D in their work
    - How did feedback influence students' approaches to improving their work
- How much trust students placed in resources they found online – what strategies did they employ

- How did students approach to learning and developing assessments change as they passed through the different assessment points?

c. Appendix C – Remaining NSS questions

NSS Area	NSS Question number and text	Potential role of technology at unit level
Learning opportunities	5. My course has provided me with opportunities to explore ideas or concepts in depth. 6. My course has provided me with opportunities to bring information and ideas together from different topics. 7. My course has provided me with opportunities to apply what I have learnt.	Link to content external to the main unit or course site to additional internet content. Provide different levels of tasks for students to complete which increase in complexity.
Learning resources	18. The IT resources and facilities provided have supported my learning well. 19. The library resources (e.g. books, online services and learning spaces) have supported my learning well. 20. I have been able to access course-specific resources (e.g. equipment, facilities, software, collections) when I needed to.	Ensure that students are able to access resources from the library, in the form of reading lists.
Learning community	21. I feel part of a community of staff and students. 22. I have had the right opportunities to work with other students as part of my course.	Provide students with a high-level space to have discussions and to find (TEL).

Student voice	23. I have had the right opportunities to provide feedback on my course. 24. Staff value students' views and opinions about the course. 25. It is clear how students' feedback on the course has been acted on. 26. The students' union (association or guild) effectively represents students' academic interest. 27. Overall, I am satisfied with the quality of the course. 28. Looking back on the experience, are there any particularly positive or negative aspects you would like to highlight?	Provide access to online surveys which provide feedback to staff (TEL). Add content to unit sites which explains how students how feedback from individual units has been reacted to.