BRIDGING THE KNOWLEDGE GAPS IN INFORMATION SYSTEMS: A THRESHOLD CONCEPTS AND TROUBLESOME KNOWLEDGE PERSPECTIVE

by

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A thesis submitted in the Thesis in Education Science module, in partial fulfilment of the requirements for the Master of Arts in Teaching & Learning programme in the Galway-Mayo Institute of Technology

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Date of Submission: May 2021

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Programme: MA in Teaching & Learning

Module: Thesis in Education Science

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Assignment Title: Thesis Report

Due Date: 18/05/2021

Date Submitted: 14/05/2021

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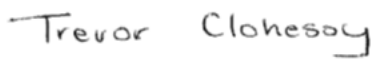

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ABSTRACT

Most students who complete third-level higher education undergo a transformational learning journey. This learning journey is moulded by their experiences not only within the context of the third-level institution but can also be shaped by their experiences in work placement in courses where this option is available. Threshold concepts are core concepts that when understood by students facilitate their transformational learning journey. However, the inherent troublesome knowledge associated with threshold concepts can represent significant barriers to transformational learning. A student's inability to overcome threshold concepts and troublesome knowledge can impact their socio-cultural development and ultimately impact their ability to operate within their community of practice. This research uses a case study approach in the Galway-Mayo Institute of Technology to explore final year business information systems undergraduate students' understanding of information systems. The research objective was developed following a comprehensive review of the literature which determined that there was a research gap in understanding how business information systems students encountered and overcame threshold concepts and troublesome knowledge when learning about information systems. The research objective was investigated using several research questions which were explored using a mixed-method approach combining lecturer interviews, a student questionnaire, and a student focus group. The study adopts a social constructivist research approach encompassing several theories of learning which act as theoretical lenses: threshold concepts, social-cultural development, and communities of practice. The findings reveal that the students find the theoretical, technical aspects, and the terminology used within the discipline relating to learning about information systems challenging. Specific threshold concepts and troublesome knowledge associated with these concepts are identified under these several headings. For example, database design was identified as a threshold concept where students struggled with the troublesome knowledge of normalization and entity-relationship theory. Additionally, it emerged that the students use specific coping mechanisms to assist them in their transformational journey to understand information systems which include peer learning, independent learning, practical application, lecturer support, lecture experience, and work placement support and mentorship. Finally, the results suggest that information systems as social systems constitute a threshold concept whereby the students struggle with the following troublesome knowledge considerations when learning about social systems: communication, ethics, and social system versus technical system differentiation. The study concludes by offering recommendations on how third-level education institutes can enhance awareness of threshold concepts and troublesome knowledge to limit their impact on students' transformational learning experiences. For instance, the study recommends the creation of a lexicon of conceptually challenging terms by lecturers for students for their modules.

KEYWORDS: *transformational learning, threshold concepts, troublesome knowledge, information systems*

DEDICATION

Special thanks to my beautiful wife Saima who has supported me and encouraged me throughout this process and to my beautiful 4 children Aaliyah, Rian, Nya, and Zac whose frequent interruptions during the process enabled me to take breaks and to refocus my energies towards writing in what has been such a challenging year for many because of Covid19.

In such challenging times, the following extract from a poem by Emily Dickinson resonated with me: *“Hope is the thing with feathers that perches in the soul - and sings the tunes without the words - and never stops at all.”* [1]

[1] https://www.poemofquotes.com/emilydickinson/hopeisthethingwithfeathers.php

ACKNOWLEDGEMENTS

- I would like to sincerely thank my supervisor Dr Marie English for all her incredible guidance over the course of the thesis which has been invaluable.

- I would like to thank Dr Pauline Logue for all her support and energy during the TES circle meetings which has enabled me to maintain focus throughout the process.

- I would like to thank Barry McMillan for his writing development sessions which also proved invaluable to the development of the thesis.

- I would like to thank all my TES circle research colleagues and supervisory team whose guidance and collegiality have offered great to support to me during the past 8 months.

- I would like to thank the 4th year business information systems students whose inputs to this thesis have been crucial to the study's findings. Wishing you all the best in your future endeavours.

- Finally, I would like to thank all the lecturers for their guidance, input, and advice on the study. It was great to share experiences of threshold concepts and troublesome knowledges in the classroom.

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Glossary

Term	Definition	Example
Business Information Systems	Business information systems is the study of information systems that are used within business context. All organizations need information systems to function correctly. Information systems represent the social, technical, and business processes required to achieve a business objective.	Let us consider the strictly come dancing viewer voting process which is managed by a sophisticated information system. Viewers (social) use their mobile phones, apps etc. (technical) to cast their vote for their favourite dancer. The business processes relate then to the voting procedures in place to determine the top dancing couple each week.
Learning	Learning is “the process of acquiring new understanding, knowledge, behaviors, skills, values, attitudes, and preferences” (Gross, 2012).	Reading newspapers, watching news broadcasts, reading medical reports, and having informed discussions with a medical practitioner with respect to Covid19.
Liminal Space	Liminal space originates from the Latin word ‘limen’ which means threshold. It represents a space through which learners must traverse to transform from a ‘not knowing’ state to a ‘knowing’ state.	The example of the engineering student studying quantum mechanics above will enter a space of liminality when they first encounter atomic orbitals. The student will remain stuck in this space of partial understanding until they undergo a transformational learning process.
Social Systems	Social systems represent the human side of information systems from consumer and organizational perspectives.	Let us take the example of a business information systems developer who is creating a mobile gambling application. When creating the application does the developer consider the negative social aspects that may occur when consumers use the mobile application?
Threshold Concept	A threshold concept is information regarding a subject matter in higher education that once understood by the students transforms the way they experience or understand the subject matter.	A mathematics student cannot do algebra unless they first understand the letters can stand for numbers. Without this fundamental understanding the student can proceed to do basic algebra.

Troublesome Knowledge	A characteristic of a threshold concept is that its mastery of requires the acquisition of knowledge which is challenging. That is knowledge that when first encountered is alien or counterintuitive.	An engineering student studying the threshold concept of quantum mechanics may find atomic orbitals very troublesome.
Transformative Learning	Transformational learning encompasses critical and reflective learning that goes far beyond the acquisition of simple and routine knowledge. Students who undergo a transformative learning experience can frame challenges using new perspectives. Ultimately, it embodies a complete shift in their thinking.	A PhD student who attends weekly peer meetings and is required to critically reflect on their own work and the work of other PhD students transforms the manner with which they see the PhD process.

CHAPTER ONE: INTRODUCTION

1.1 CONTEXT

This study addresses an established educational framework that is emerging in the information systems research field that asserts threshold concepts as mediators of learning outcomes. Essentially, a threshold concept is information regarding a subject matter in higher education that once understood by the students transforms the way they experience or understand the subject matter. They are concepts which define the discipline and help students define themselves within that discipline. For example, a student may not be able to get their head around algebra unless they first understand that the letters can stand for numbers. Without this fundamental understanding the student's learning may be hindered. Another example is computer science students who struggle with object-oriented programming. This inability to understand this concept can have a detrimental impact on their ability to code and create software. Threshold concepts can lead to or represent troublesome knowledge (Perkins, 2006). Troublesome knowledge represents a characteristic of a threshold concept is that its mastery requires the acquisition of knowledge which is challenging. That is, knowledge that when first encountered is alien or counterintuitive. For example, an engineering student might find fundamental engineering activities such as testing and modelling troublesome. Or a medical student might find various mathematics concepts such as the Maclaurin series as troublesome.

From an educator/lecturer perspective the process of becoming an expert in a discipline embodies a transformation on how we see the world and how we approach the teaching of subjects. Understanding the changes that we have been through informs the manner with which we as lecturers teach our students. From my own perspective, I have often wondered (i) why students can often get stuck with certain aspects of their learning and (ii) how I can get them unstuck through my teaching. Our ability to assist students with comprehending threshold concepts forms a significant role when attempting to initiate them into our field of expertise and help them to connect with their learning. Ultimately threshold concepts are passports which enable students to access a realm of knowledge that they did not know they could access.

Over the past decade, there has been increased attention in the literature pertaining to the role of threshold concepts and troublesome knowledge in teaching and learning and for curriculum (re)design. The seminal research framework proposed by Meyer and Land (2003, 2006) has illuminated the value of threshold concepts and troublesome knowledge and their roles in "improving the quality of instruction but also in shaping the strategies necessary to help students through the liminal stages of learning" (Bajada and Trayler, 2016, pg.461). The threshold concept has been proposed as a method for evaluating how learners gain expertise in conceptually challenging disciplines/fields (Meyer and Land (2006). The framework, which was first used in the study of economics, has now been applied to various disciplines such as nursing, computer science, medicine, management etc (Flanagan, 2016).

According to Schwartzman (2010, pg. 23) "The frame of threshold concepts is generally understood as an orientation in teaching, for any discipline, that is concerned with how to support students' learning of particularly challenging material, aka threshold concepts." Studies which have used threshold concepts as their underpinning theory have addressed questions of (i) how student thinking develops or is constrained in third level education, and (ii) how students and faculty staff perceive and think about teaching and learning and deciphering how faculty staff teach in their disciplines (Donald, 2002). This way of thinking is important as Land (2011, pg.7) argues that "the prevailing discourse of 'outcomes', 'alignment' and 'achievement' has, from critical perspectives, been deemed to serve managerialist imperatives without necessarily engaging discipline-based academics in significant reconceptualisation or review of their practice." Moreover, "threshold concepts enable academics to explore what is fundamental to grasp the subject they teach" (Cousin, 2009, pg.201).

The study of information systems has traditionally proved challenging for students (Cope and Staehr, 2008). From a business information systems discipline perspective, the threshold concept framework enables researchers to understand the transformation of students as they struggle with troublesome knowledge and frequently changing workplace skillsets. Most significantly, threshold concepts can identify aspects of discipline curricula that pose serious barriers to the student learning process. Ultimately, threshold concepts have been described as disciplinary focused and can be used as a research analytical framework which taps into student

understanding, curriculum (re)design and professional identity (Land, Neve, and Martindale , 2018).

Compared to other disciplines, there has been relatively little published in the education literature on information systems threshold concepts and troublesome knowledge, despite calls from authors for more research into this area (see Cope and Staehr, 2008). To advance further exploration and debate in the threshold concepts field and provide potential results to inform teaching practice this study will seek to provide insights into business information students' grasp of specific threshold concepts when learning about information systems. Most significantly, this study will elucidate the ontological shift that occurs when traversing the liminal space (e.g., transformational journey pathway) associated when learning about information systems.

From my own perspective I was first introduced to the concept of threshold concepts while attending a workshop in the area while completing my certificate in teaching and learning. The presentation on the topic resonated profoundly with me. The workshop presenter identified how her research had focused on the challenges of overcoming threshold concepts when lecturing to nursing students. If the nursing students failed to overcome these challenging concepts (e.g., IV insertion) it had a knock-on impact in their professional careers. The presenter finished their presentation saying that it was the duty of every lecturer/educator to identify threshold concepts and troublesome knowledge within their own disciplines and modules. From that moment, the notion of threshold concepts has driven me to contemplate how I would research the area within my own discipline and most importantly within the business information systems module on which I have lectured in for nearly for a decade. Consequently, I have been fortunate to have conducted research into the area as part of this thesis.

1.2 RESEARCH QUESTION OR PROBLEM

The primary objective of this thesis is to identify and explore final year business information systems undergraduate students understanding of information systems using four main parameters: threshold concepts, troublesome knowledge, socio-cultural development, and communities of practice. The findings from this research will provide insights in how to inform better curriculum and assessment (re)design

practices, from the micro (module) to meso (programme) to macro levels (the wider discipline in the workplace).

This study investigates the following several research questions:

RQ1: What threshold concepts and troublesome knowledge do business information systems undergraduate students encounter when learning about information systems?

RQ2: How do business information systems undergraduate students manage the liminal space when they encounter threshold concepts and troublesome knowledge?

RQ3: Do information systems, as social systems, constitute a threshold concept for business information systems undergraduate students?

1.3 RESEARCH METHODOLOGY

Figure 1.1 depicts an initial mind map of the research design plan. Following a number of iterations, it was decided that a case study research strategy comprising questionnaire, focus group and interview data collection methods would be operationalised to investigate the several research questions posed in this thesis. The aforementioned research methods were deployed in sequential order with the findings from the questionnaire informing the focus group research instrument and the findings from this phase informing the development of the interview research instrument. The questionnaire research instrument was created using widely accepted frameworks sourced from the literature. Chapter 3 provides further details pertaining to the research methodology.

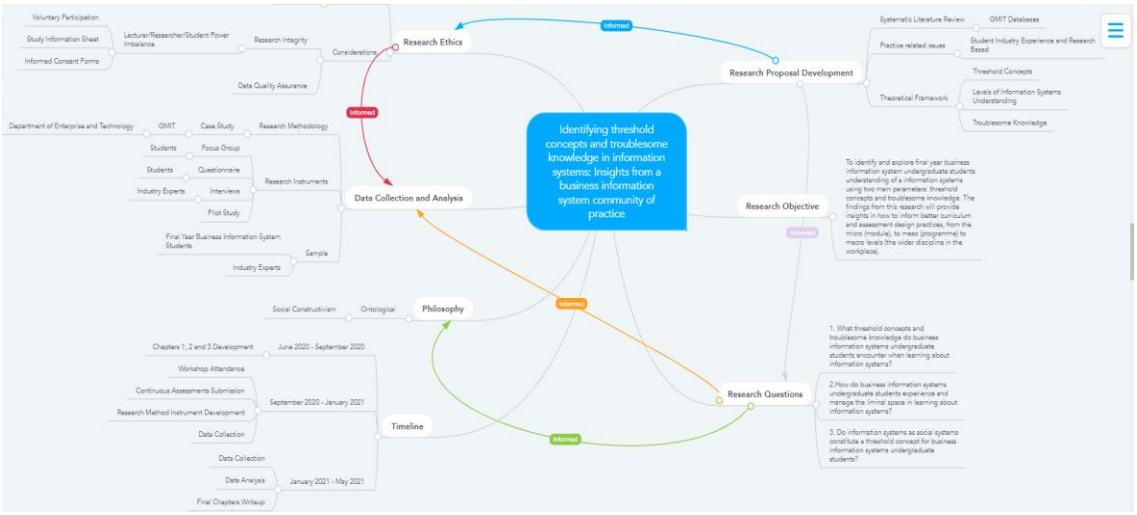

Figure 1.1: Mind map of research design plan

1.4 SCOPE & LIMITATIONS

In terms of the scope, this study has several aims. First, the study will also gain insights from lecturers who have taught business information systems to juxtapose the findings and to identify the teaching related issues that manifest for business information systems with regards to information systems and threshold concepts from a teaching perspective. Second, this study investigates what threshold concepts and troublesome knowledge GMIT final year business information system students encounter when learning about information systems. Finally, the study will also investigate how the students overcome the threshold concepts and troublesome knowledge they encounter.

The following limitations have also been identified:

- With regards to generalisability, while a case study research methodology can provide rich detail this study only considers the final year of a GMIT business information system degree and the sample size can be reasonably small. It does not consider other groups, disciplines, programmes, or institutions. However, it should be noted that study's findings can be transferable to other situations provided that the specifics of the study are deemed similar. Consequently, care will be taken in relating the research findings to the idiographic details of the research design and theoretical concepts. Therefore,

the motivation for the selected research design is aimed at elucidating findings which facilitate naturalistic generalisation and transferability (Tracey, 2012).

- There are also limitations associated with the mixed-research methods and research instruments (e.g., interviews, questionnaire, focus groups). For instance, a researcher may not possess the experience to conduct and analyse both qualitative and quantitative research. As the researcher has previous experience using these techniques steps will be put in place to mitigate these limitations.

- There are also a number of biases that must be considered (e.g., insider bias, interview and focus group bias etc.). These biases will also be mitigated using appropriate ethical research protocols.

- Finally, given the obscure and sometimes nebulous nature of the terminology associated with the research concepts in this study I have included a discipline specific glossary at the start of the thesis.

1.5 THESIS STRUCTURE

Figure 1.2 provides an overview of the structure of this thesis. The thesis comprises six chapters. The next chapter delineates a literature review. This literature review provides a rationale for the study by introducing the main concepts which underpin the study. These concepts are transformational learning, threshold concepts, troublesome knowledge, students' ontological shifts, and the core focus of the study information systems. The chapter also provides an overview of how the literature review was conducted.

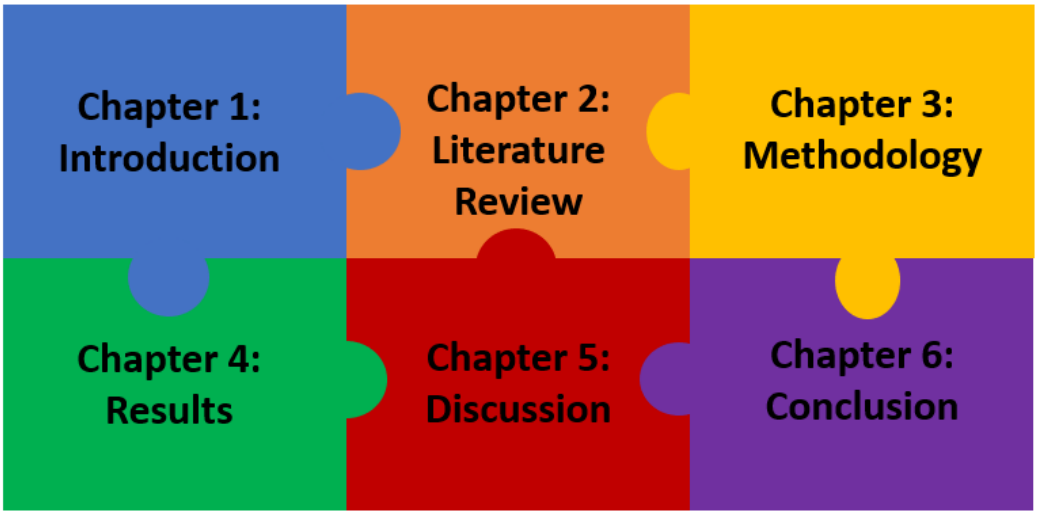

Figure 1.2: Thesis Structure

Chapter three provides a justification for the research methodology operationalised for the study. First, the philosophical assumption and stance are presented. Next, an overview is provided of the research strategy. Finally, the research methods used to answer the several research questions are discussed.

Chapter four presents the findings from the quantitative and qualitative data analysis. The chapter is divided into several sections with each section presenting an overview of the main findings from the questionnaire, focus groups and interviews.

Chapter five summarizes the main findings from the questionnaire, focus group and interviews. These findings are discussed in relation to existing literature. Recommendations arising from the findings are then outlined. Limitations encountered and areas ripe for further investigation are also discussed. These areas have practical and academic relevance.

CHAPTER TWO: SYSTEMATIC LITERATURE ANALYSIS

2.1 INTRODUCTION

This chapter will provide an anchor for this study by presenting an overview of the main concepts which are core to this thesis. The literature review will demonstrate the gap which currently exists in the research with regards to studying information systems as threshold concepts within the business information systems discipline. Section 2.2 provides an overview of the methodology used to review the literature. Section 2.3 discusses the concept of transformational learning and sets the context for the section 2.4 which conceptualises main theories of learning which underpin this study as a theoretical framework. Then, section 2.5 then presents specific implications for teaching and learning. Section 2.6 delineates the focus of the study which is information systems modules which are capstone modules of the GMIT business information systems undergraduate degree. The chapter concludes in section 2.7 with a summary of the chapter's main observations.

2.2 LITERATURE REVIEW METHOD

To identify appropriate educational research studies, the following databases were used, including Elsevier, Science Direct, Web of Knowledge, Web of Science, EBSCO, Springer and Taylor and Francis, Google Scholar, and ResearchGate. It was also important to include business and computer science databases because information systems education research is often published in business information system journals. Keyword strings were used to search the aforementioned databases. For example, the following keyword string was used for the Web of Science Journal: OPIC: ("threshold concepts") AND ALL FIELDS: (student) AND ALL FIELDS: (education) Timespan: 1990-2020. Indexes: SCI-EXPANDED, SSCI, A&HCI, ESCI. This search string resulted in a total of 225 research articles. Resulting articles across all the databases were reviewed and eliminated based on specific criteria (e.g., duplicates). Although much recent research has been conducted on the concept of threshold concepts across disciplines, the lines of inquiry have not focused on the business information systems discipline to any great extent. As evidence of this research gap a tree visualisation was created which segmented the 225 research articles across

disciplines (Figure 2.1). As can be seen 61% of the articles were from educational research discipline. This method was replicated for the other database search results.

Figure 2.1: Literature Review Tree Visualization

To assist with the identification of major threshold concept themes we also created a network analysis (Figure 2.2) of all related threshold concept research published in the Web of Science. The prominent keywords emerging tend to be ‘curriculum’, ‘knowledge’, ‘student learning’, ‘troublesome knowledge’, ‘higher education’ and ‘transformative learning’. Similar network analyses of the other database search results were also conducted. These themes are discussed in greater detail in the next sections.

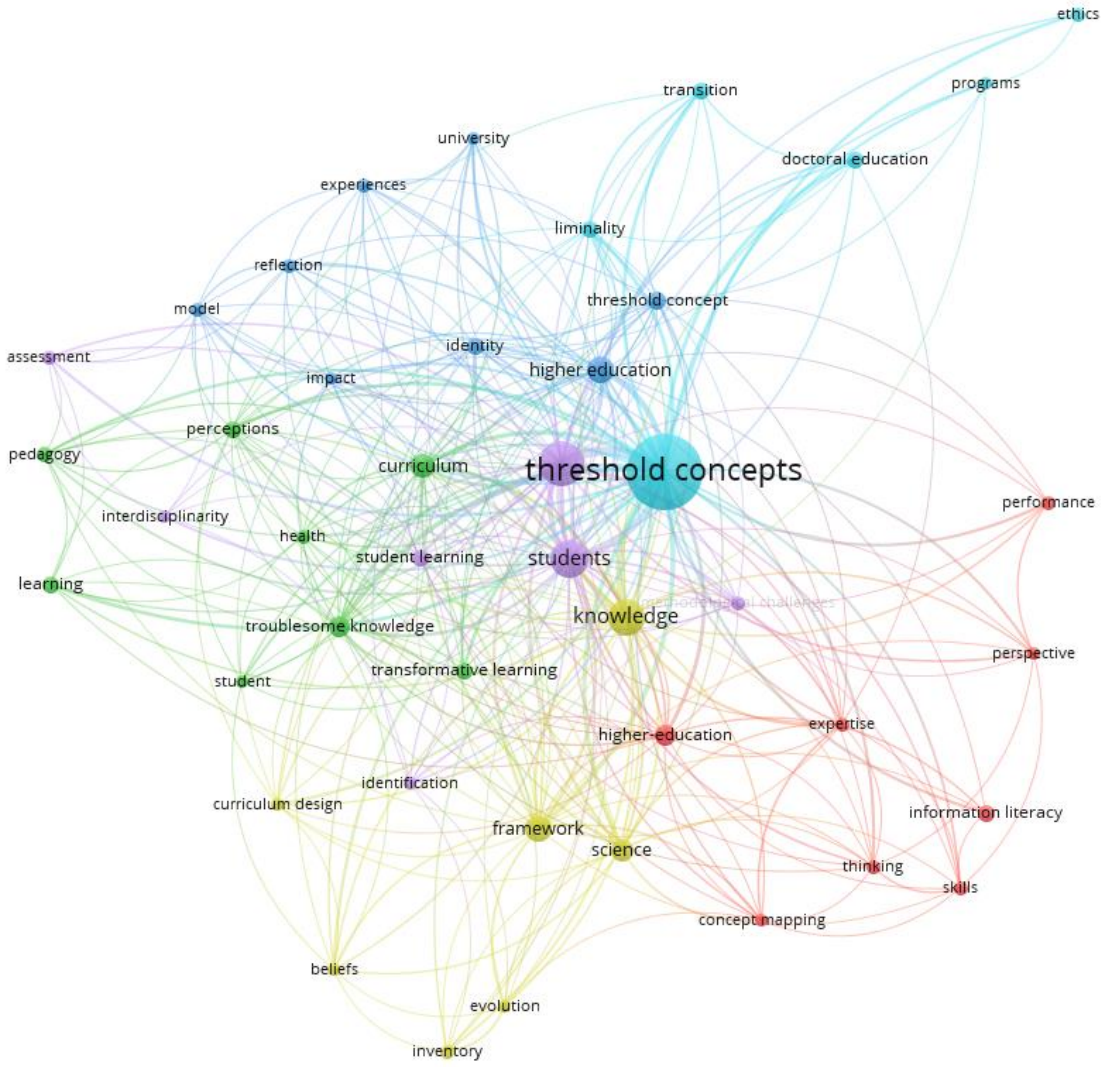

Figure 2.2: Literature Review Research Themes

2.3 TRANSFORMATIONAL LEARNING

The motto used by Monash University in Australia is “Ancora Imparo” which translates to “Yet, I am still learning”. This quote is often attributed to Renaissance artist Michelangelo who is purported to have spoken the words at the age of 87. Many Universities and Institutes of Technologies use Latin mottos which reference the significance of learning/and or the journey of learning that they will experience during their time as students. It reminds us that entering a place of learning students will leave something behind that is safe and familiar and traverse a journey where they will move beyond a threshold. This transformational learning journey will involve complexities, risks and force students to challenge beliefs that they once held whereby “real learning

requires stepping into the unknown, which initiates a rupture in knowing" (Land and Meyer, 2010, pg.1).

The concept of transformational learning in educational settings has been developed over the past decades by Jack Mezirow and Robert Kegan. First introduced by Jack Mezirow to adult education in 1981, transformative learning can be defined as a "constructivist theory of adult learning and a process by which learners are challenged to call into question taken-for-granted ideas, beliefs, habits of mind and feelings, and to experience fundamental shifts in perspective so that they can join colleagues in committed actions for change" (Mezirow, 2000). Table 2.1 outlines ten specific phases which are involved in the process of transformational learning (Mezirow, 1981). These phases are crucial for clarifying meaning during the transformation process. Ultimately, these phases enable students to learn in a manner that "enhances their capability to function as self-directed learners (Mezirow,1981, pg.79).

Table 2.1 Phases of Meaning in Transformational Learning

Number	Phase
1	A disorientating dilemma
2	Self-examination with feelings of shame, fear, guilt, or anger
3	A critical assessment of assumptions
4	Recognition that one's discontent and the process of transformation are shared
5	Exploration of options for new roles, relationships, and actions.
6	Planning a course of action
7	Acquiring knowledge and skills for implementing one's plans
8	Provisional trying of new roles
9	Building self-confidence and competence in new roles and relationships

10	Reintegration into one's life based on conditions dictated by one's new perspective

In 1982, Robert Keegan proposed a metapsychology for transformational learning comprising two core dimensions of epistemology: forming and reforming (Kegan, 1982). According to Kegan (2000, pg.52) “these two processes inherent in epistemology are actually at the heart of two lines of social-scientific thought that should be in much closer conversations with each other: The educational line of thought is transformational learning; the psychological line of thought is constructive developmentalism.” Rather than simply eliciting opinion, transformative learning requires students to examine topics and concepts which are complex and challenging which essentially require students to demonstrate a level of critical and creative thinking. Social learning theory (Bandura, 1978) also plays a significant role in transformational learning. Social learning theory posits that “new patterns of behaviour can be acquired through direct experience or by observing the behaviours of others” (Bandura, 1977).To facilitate the process of transformative learning “educators must carefully design stimulus materials, activities and questions to prompt reflection, critique and debate, and that invite learners to consider new courses of action” (McAllister, Lasater, Stone, and Levett-Jones, 2015). This can be a challenging process for all educators, particularly in times of increased workloads, limited resources, and an increased shift from offline to online teaching methods. Furthermore, the diversity of student learning must also be considered whereby the varying pace of each individual student’s learning must be considered (Wu, Tu, Wu, Le, and Reynolds, 2012). Examples of individual barriers to learning include poor cognition skills such as attention, memory, perception, language skills etc (Fuller, Healey, Bradley, and Hall, 2004). Finally, self-efficacy (Bandura, 2010) also plays a crucial role in student learning transformation process. Self-efficacy is defined as “people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives” (Bandura, 2010, pg. 1). Students with high-self efficacy can view challenging concepts as tasks which can be mastered whereas students with low self-efficacy can avoid them and see them as personal threats. Thus, the challenge for a lecture is to recognise that an individual student’s struggle with specific concepts can be wide ranging. A key component of

transformative learning includes the assimilation of threshold concepts (Meyer and Land, 2003). This concept will be discussed in greater detail in the next section.

2.4 THEORIES OF LEARNING

Bruner (2004) provides an excellent critique and overview of the theories of learning. Table 2.2 provides an overview of the main learning theories which guided this study. It can be argued that these theories are interconnected whereby they are all focused on learning, practice and understanding. This was significant for the purposes of this study as it assisted with insights into the considerations that influenced the research interviewees' knowledge and understanding of information systems, specifically with the difficulties encountered. This section will provide an overview of each of the theories and a justification will also be provided explaining their inclusion in the theoretical framework for this study. For example, the theory of threshold concepts is presented first in conjunction with a discussion on liminal spaces. Then, the theory of troublesome knowledge is introduced. These concepts underpin research questions 1 and 2. Finally, the theories of social cultural development and communities of practice are delineated. These two concepts underpin research question 3.

Table 2.2 Theoretical Framework for this Study

Theory	Author
Threshold Concepts	Land and Meyer
Troublesome Knowledge	Perkins
Social Cultural Development	Vygotsky
Communities of Practice	Wenger

2.4.1 TRESHOLD CONCEPTS

A concept is defined as "a unit of thought or element of knowledge that allows us to organize experience" (Donald, 2001). According to Land and Meyer (2010) threshold concepts represent *conceptual gateways* and are an approach which "builds on the notion that there are certain concepts, or certain learning experiences, which resemble passing through a portal, from which a new perspective opens up, allowing things

formerly not perceived to come into view." This enables students to think about a new topic in a manner that was previously inaccessible. In other words, a transformation occurs within the student's frame of learning. If a transformation in a student's understanding fails to occur, a student's inability to understand and assimilate these aspects will impede their overall progress in that area of study. Essentially, these threshold concepts serve to block students learning.

Examples of threshold concepts across some disciplines (Land, 2011) include the following:

- Business Information Systems – Social Systems
- Physics – Gravity
- Politics – The State
- Biology/Psychology – Evolution
- Computer Science – Programming
- Economics – Opportunity Cost

Let us investigate the threshold concept of 'opportunity cost' from the economics discipline further. Opportunity cost is "choice-influencing rather than choice-influenced. Thus, if 'accepted' by the individual student as a valid way of interpreting the world, it fundamentally changes their way of thinking about their own choices, as well as serving as a tool to interpret the choices made by others" (Shanahan, Foster, and Meyer, 2006). From a business information systems student perspective, information systems as 'social systems' can represent a salient threshold concept. Students often find it challenging to conceptualise the human side of the business information system that they are developing.

There are specific similarities between the thresholds concept perspective and extant research involving transformational learning. For instance, seminal papers written by Mezirow's (1978, 1990) introduced the concept of 'perspective transformation'. Perspective transformation is defined as the process of "becoming critically aware of how and why our presuppositions have come to constrain the way we perceive, understand, and feel about our world; of reformulating these assumptions to permit a more inclusive, discriminating, permeable and integrative perspective; and of making decisions or otherwise acting on these new understandings" (Mezirow, 1990, pg. 14).

According to Kitchenham (2010) Mezirow's work on transformative learning is largely influenced by Kuhn's (1962) work on paradigms, Freire's (1970) research on conscientization and Habermas's (1971, 1984) work on domains of learning. According to Land and Meyer, (2010, pg.12) Mezirow's perspective transformation concept embodies a number of resonances with "with the instigative effect of threshold concepts, the liminal phase of thresholds theory and the process of integration it entails." These phenomena will be discussed in greater detail later in this section.

Having discussed threshold concept antecedents, it is now necessary to introduce a framework around which threshold concepts can be defined and conceptualised. The threshold concepts framework is based on the works of Meyer and Land (2003,2005,2006). The authors provide a research-based rationale for deciphering and comprehending specific aspects of educational topics and disciplines that are inherently challenging or problematic. The threshold concepts framework comprises core eight characteristics:

1. **Transformative:** This specific characteristic changes the way students view a topic (e.g., identity shift)
2. **Integrative:** This characteristic provides students with a roadmap which links other topics within the discipline
3. **Irreversible:** This characteristic ensures that once learned the student cannot unlearn the knowledge acquired
4. **Troublesome:** This characteristic includes knowledge which seems alien, complex and counterintuitive
5. **Bounded:** This characteristic encompasses limits to what students can explain which can result in new learning thresholds emerging.
6. **Discursive:** Threshold concepts encompass the enhanced use of language.
7. **Liminality:** A liminal space through which learners' traverse. Each learner traverses this space in their own manner.
8. **Reconstitute:** This characteristic relates to both discursive and transformative characteristics and encompasses the abandoning of prior conceptual beliefs regarding a topic.

A core characterise which underpins the threshold concept, and which is also a focus of this study, is the notion of students traversing a *liminal space* when crossing a

threshold concept (Land and Vivian, 2014). With regards to liminal spaces, during this process, the student experiences uncertainty when attempting to comprehend a new topic. When entering a liminal space, the student must reassess their conceptions and undergo a transformation that encompasses the acquiring of new values and understanding. Each student will traverse the liminal space differently and experience affective dimensions of learning. While some students will pass through the liminal space quickly, other students may navigate the liminal in stages as outlined in Figure 2.3. In other words, students navigate through the liminal space at their own pace and from different directions. A student's experience of the liminal space can be characterised by states of feeling confused, threatened, and uncomfortable (Land and Vivian, 2014). According to Moeller and Fawns, (2018) "as learners progress through the liminal space, they not only internalize threshold concepts but also become more engaged in the discourse of their discipline, learning to think like an expert." Understanding the how and why questions of why some concepts are troublesome are key to assisting educators and curricula to help students through the liminal space. From a business information students' perspective, along with the viewer voting app example presented in the glossary, an additional 'social systems' liminal example would be the specific algorithms underpinning facial recognition technologies. If the student cannot grasp the ethical tensions that arise from the idea that a small cohort of developers can create an algorithm which could be potentially (ab)used to identify millions of citizens around the world with the potential for bias, the student will not be able to traverse the liminal space to enhance their learning. Failure to traverse the liminal space can result in challenges emerging for the students if they are tasked with developing or creating similar algorithms. If a lecturer can identify that this topic is a significant threshold concept prior to lecturing it, they can assist the students in traversing the liminal space by using case studies which highlight the dark side of algorithms or by presenting the students with ethical dilemma tasks orientated around the creation of algorithms that will be widely used by consumers. Having discussed threshold concepts and liminal spaces, the next section will provide an overview of the theory of troublesome knowledge.

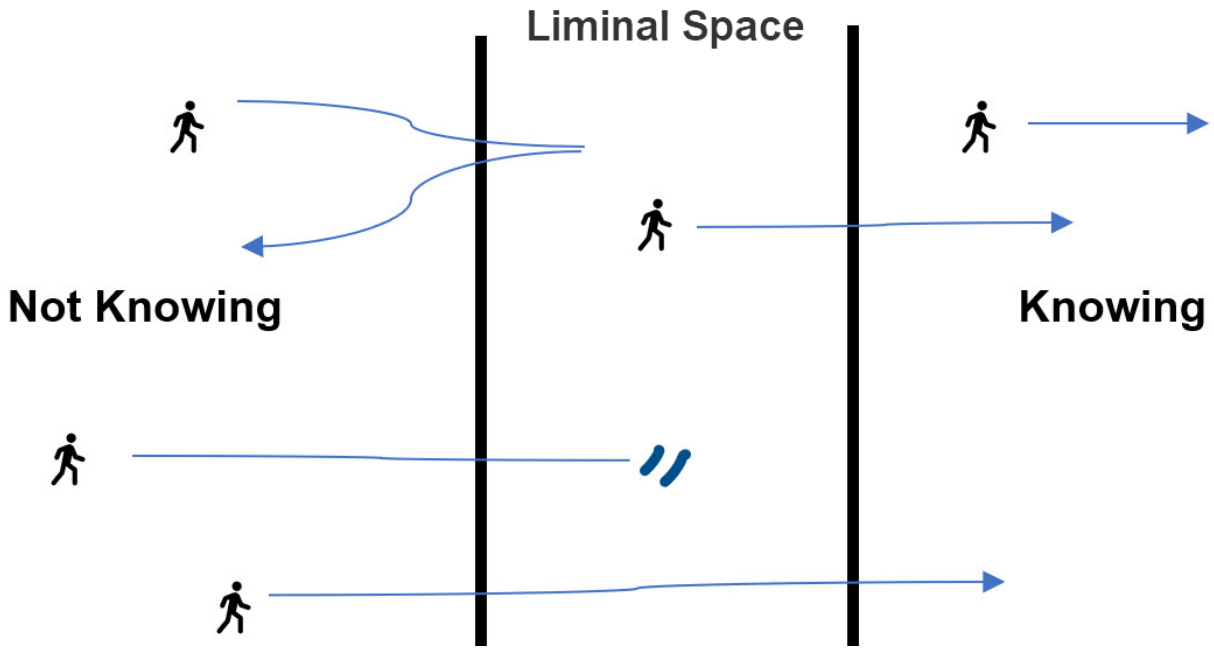

Figure 2.3: Learner Liminal Space

2.4.2 TROUBLESOME KNOWLEDGE

Another characteristic which is significant to threshold concepts is troublesome knowledge (Perkins, 2006). Recent research on threshold concepts has included the dimension of troublesome knowledge (See Baillie, Bowden, and Meyer, 2013). It has been argued that the inclusion of this dimension represents a significant step (Bajada, Trayler, Jarvis, and Bui, 2016). Moeller and Fawns (2018) defines the main types of troublesome knowledge which are associated with threshold concepts which include ritual knowledge (e.g., routinely used for specific tasks), inert knowledge (e.g., rarely used out of a specific context), conceptually difficult knowledge (e.g., challenging to comprehend on a specific level), alien knowledge (e.g., arising from an alternative perspective), and tacit knowledge (e.g., used subconsciously). Perkins (2006) argues that such troublesomeness is purposeful as it can instigate an ontological shift and new learning. Furthermore, the main purpose of third level education institutes is to require students “to venture into new places, strange places, anxiety-provoking places” (Barnett 2007, pg.147). However, troublesome knowledge can lead to learner resistance that can result in students failing to move beyond the preliminal mode (discussed in the next section). Consequently, the teaching of subjects which comprise troublesome knowledge “may require pedagogic approaches that move away from the

didactic and support students in dealing with this troublesome knowledge" (Meyer and Land, 2006, pg.20).

However, from an education perspective, it has been declared (See Baille et al., 2013; Bajada et al., 2016) that contemporary subject assessment techniques have evolved which enable students to pass without having to 'deal' with threshold concepts troublesome knowledge (e.g., gain marks for demonstrating partial or full knowledge of a topic). Consequently, students can pass a module with part marks without ever having fully comprehended the core topics embedded within the module. Bajada et al., (2016) argue that "the student should demonstrate a complete understanding of any core capability and not doing so will adversely affect their capacity to build upon this knowledge in subsequent subjects or in the workplace." For example, a business information systems student may be able to write a piece of structured query learning (SQL) code but be unable to interpret the lines of code they have just written. The question then arises should the student be awarded part marks for the lines of code they have written (e.g., partial understanding of a concept). Bajada et al., (2016), argue that students should not be awarded part marks as it can result in the following outcomes:

- Students failing to acquire essential knowledge and foundation knowledge that are required in subsequent subjects.
- Students passing subjects with assessment criteria which embed part-marks will result in them achieving a false sense of academic capabilities.
- Assessment evaluating criteria (e.g., marking guides) may pose a greater emphasis on non-threshold concepts (e.g., learning of facts). The awarding of part-marks for demonstrating knowledge of these facts can result in students passing a subject without having ever comprehended the threshold concepts.

Land et al.,(2005) suggest that in other circumstances troublesome knowledge is linked to language (e.g., specific ways of understanding and ways of seeing). They use the example of the use of the word 'cost' and 'acquisition value' in accounting. They argue that while it seems logical that the word acquisition value could be used interchangeably with the term cost, it cannot, because of the inherent troublesome nature of the terms value and cost which can have multiple interpretations and

calculations. How troublesome knowledge manifests in an information systems context is discussed in section 2.6.

2.4.3 SOCIAL CULTURAL DEVELOPMENT

Russian psychologist Lev Vygotsky was the first to apply sociocultural approaches to learning and development in the 1920s and 1930s and is credited with the creation of the concept of social constructivism (Steiner and Mahn, 1996). In contrast to traditional theories which took a much simpler approach to rationalising learning and development, Vygotsky's work, particularly with students with special needs, emphasised a more "rich and multifaceted theory through which he examined educational learning and development" (Steiner and Mahn, 1996, pg.191). Vygotsky's (2012) theory of social cultural development was underpinned by the notion that human development, particularly in an educational sitting, was dependent on the collected experiences of others. This process of social cultural development, through social interaction, encompasses a journey for students, whereby, at the beginning of the journey they are largely dependent on others who have gained experience and a competency in the subject matter to guide them. Over time, students begin to take responsibility for their own learning and participation in the subject matter. Central to this process is the concept of a zone of proximal development (ZPD) in which students are guided through their learning with the assistance of a more knowledgeable other (Vygotsky, 1978). The concept of ZPD has been extended to develop new perspectives such as the situated learning and legitimate peripheral practice theory (Lave and Wenger, 1991), the concept of boundaries within communities of practice theory (Wenger, 1998), and the concept of liminal spaces within threshold concepts theory (Meyer and Land, 2005). The latter theory and concept have already been discussed in the previous section.

In conjunction to a more knowledgeable other, language also has a pivotal role to play in a student's learning (Vygotsky, 2012) whereby through a "process of 'internalization', 'external', or 'social', speech, is transformed from a directly interpersonal, communicative means of regulating and directing the [learner's] behaviour into 'inner speech'…Roughly speaking, the main idea is that we have to first learn to do things publicly – 'externally' – with others before being able to do them

‘internally’” (Jones, 2009, pg.167). As stated by Vygotsky (1986) “humans master themselves from the outside – through psychological tools…these psychological tools master natural forms and of individual behaviour and cognition”. For example, when business information systems students are first introduced to the process of data flow diagrams, they are asked to take out a pen and paper and to jot down their representation of what they think the flow of data from one system to another looks like. Following a period of practice students can ‘mentally’ map out their diagrams without the need for pen and paper. Vygotsky’s conceptualisation of inner speech was underpinned by the importance of honing this form of ‘inner language’ through practicing it by engaging in dialogue externally with others. Reverting to the business information systems student data flow diagram example. For students to hone their inner speech, once they have been guided by their lecturers and peers, it is important for the student to practice and experience how the data flow diagrams manifest in industry. Work placement provides a cogent environment for the business information systems students to develop their skills by engaging in dialogue with knowledgeable others who are working in industry. Consequently, it is important that lecturers not only teach students how to use information technology and information systems tools but also focus on how language can be used to facilitate student learning. It would also be important for lecturers to equip students with the ‘linguistic tools’ that are used across various professions in the industry or what is refered to in this thesis as the community of practice which will now be discussed in the next section.

2.4.4 COMMUNITIES OF PRACTICE

Wenger’s (1998) concept of communities of practice, which has evolved from Vygotsky’s (1978) social theory of learning and the situated learning and legitimate peripheral practice theory (Lave and Wenger, 1991), has gained widespread recognition across disciplines in the last two decades. According to Land et al., (2005, pg.55) “sometimes the troublesome nature of knowledge stems from it being tacit – that which remains mainly personal and implicit at a level of practical consciousness though its emergent but unexamined understandings are often shared within a specific community of practice”. The community of practice is an interesting concept which this study will focus on from the perspective of business information systems students. A community of practice is defined as “groups of people who share a concern or a

passion for something they do and learn how to do it better as they interact regularly" (Wenger, 1998, pg.1). Wenger (1998, pg.4) outlines how communities of practice view higher education as a broader learning system which is based on the following salient questions which must be posed along three dimensions:

- "Internally: How to create educational experiences that cement school learning in practice through participation in communities around subject matters?
- Externally: How to connect the experience of students to actual practice through peripheral forms of participation in broader communities beyond the walls of the school?
- Over the Lifetime of Students: How to serve the lifelong learning needs of students by organizing communities of practice focused on topics of continuing interest to students beyond the initial schooling period?"

These several questions which encompass elements of social participation, interaction and development when learning echoes Vygotsky's (1978) theory of social cultural development and identity. Specifically, they embody Vygotsky's concept of ZPD and the use of language which were described earlier. For the purposes of this study, the theory of communities of practice is highly appropriate to a business information systems student's relationship with the communities of business information systems practitioners they encounter on work placement or following their graduation when they commence working for a company. These business information systems practitioners themselves are working in diverse, multifaceted, and complex communities within the business and IT industry. It also should be noted that business information systems students also operate in a higher education community of practice in which their learning is influenced by knowledgeable others in the form of lecturers and their student peers. The juxtaposition of the different expectations across these two distinct communities of practice can often manifest as boundaries (Wenger, 1998) Oftentimes these boundaries can have both positive and negative implications for learning. From a positive aspect these boundaries, once framed and marked, can serve as creative spaces for learning. However, these spaces can also manifest in significant challenges for learners. For example, lecturers in higher education may use language to describe a concept which differs from the language that is used to

describe the concept in industry. This varying conceptualization may constrain a student's ability to discard their previous conceptualisation of a concept once they enter their professional community of practice. This framing of boundaries for learning is of interest to this study as it resonates with the concept of liminal spaces within the threshold concept theory. However, unlike threshold concept theory, which focuses on the individual learner's liminal space experience, the socio cultural development theory, and the communities of practice theory both place an emphasis on the social nature of teaching, learning and practice. This aspect is core to this study in terms of understanding research question 3 which investigates if information systems as social systems represent a threshold concept for business information students? This aspect is further explored in section 2.6.

The next section provides an overview of the teaching and learning implications of the threshold concepts, troublesome knowledge, socio cultural development, and communities of practice concepts presented in the preceding sections of this chapter.

2.5 TEACHING AND LEARNING IMPLICATIONS: CREATING AN ONTOLOGICAL SHIFT FOR STUDENTS

This study's literature review has demonstrated that with transformational learning, threshold concepts and troublesome knowledge empirical evidence has exponentially increased across many disciplinary contexts in higher education internationally. This research has enhanced educationalist "understanding of transition, liminality and the developmental process of learning, of conceptual structure, of how students experience difficulty, and how higher education institutes might both render conceptual understanding visible and assess it in a more dynamic fashion" (Land and Meyer, 2010, pg.10). Schwartzman, (2010, pg.24). says that threshold concepts are "generally understood to mean an orientation toward supporting student learning of deeply challenging material. He continues "a concern for student learning, and an emphasis on teaching to support that learning, operate as defining characteristics of [the education] community".

Land and Meyer (2010, pg.78) pose the question of "how we might construct a meaningful assessment process for students for whom, in many instances, what is to be assessed lies outside their prior knowledge and experience, or beyond their

ontological horizon." The authors call for new and creative means of assessment, which are conceptually underpinned, which provide new methods of making conceptual challenging learning visible. They conclude that the benefit of engaging with this process is that it can "inform course (re)design in a generative and sustainable fashion."

Figure 2.4 highlights the relational dynamics of threshold concepts through preliminal, liminal and postliminal states (Land and Meyer, 2010). This perspective of transformational learning builds on the work of Kegan's (1982) concept of 'shifts of consciousness', Boyd and Meyers' (1988) framework which emphasizes affective processes, and Mezirow's (1978, 1990) work on 'perspective transformation'. The latter involves a person triggering a learning transformation when first encountering a disorientating dilemma or a challenging concept (Mezirow, 1990). Mezirow's concept of perspective transformation contains a number of transformative phases which are like the 'type of features' depicted in Figure 2.4. In the Land and Meyer (2010) model a student's journey towards the acquisition of a threshold concept begins with encountering troublesome knowledge in the preliminal state. This "troublesome knowledge serves as an instigative or provocative feature which provokes a state of liminality" (Land and Meyer, pg. 11). Within the liminal state mode "an integration of new knowledge occurs which requires a reconfiguring of the student's prior conceptual schema and a letting go or discarding of any earlier conceptual stance" (Land and Meyer, 2010, pg.11). This integration/reconfiguration results in an ontological and epistemological shift which is categorised as a reconstitutive feature of the threshold concept. The instigative and reconstitutive features enable the student to cross a conceptual boundary into a postliminal mode and bring about the required new understanding. This postliminal phase manifests a process where the learning and student are both transformed. This change which is marked by a change of discourse is irreversible. These features of the postliminal phase are categorised as consequential features of a threshold concept.

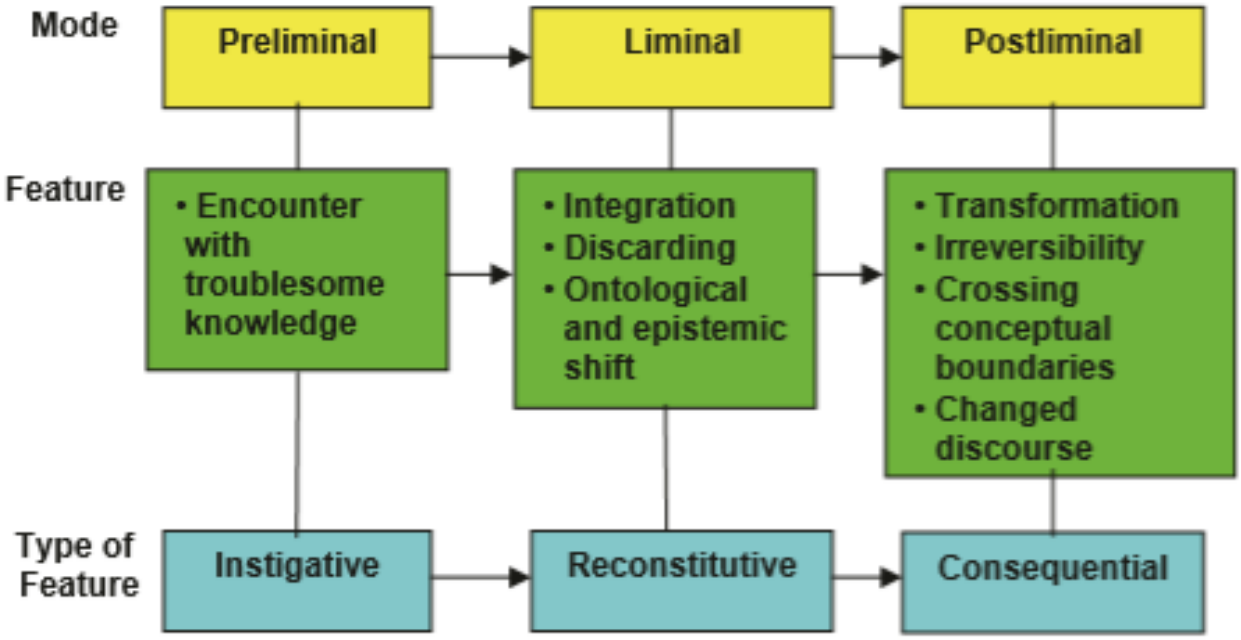

Figure 2.4: A Relational View of the Features of Threshold Concepts (Land and Meyer, 2010)

This study will focus on both the **preliminal instigative mode** and **liminal reconstitutive mode features** in the context of the teaching and learning of information systems. Ultimately, studying these two modes will identify how BIS students arrive at the **postliminal consequential mode**. The reasoning for this is further explored in the next section.

2.6 INFORMATION SYSTEMS: ILLUMINATING THE BLIND SPOTS

Information systems modules form core components of business information systems (BIS) undergraduate degrees. Information systems are viewed as socio-technical systems (Galliers, 2003; Beyon-Davies, 2016). From a social systems perspective BIS "are systems of people performing purposeful organisational activity, supported by embedded Information Technology (IT). The IT provides support to the people by enhancing the storage, maintenance, selection, organization, presentation, and communication of all data required for effective decision making." (Cope and Staehr, 2008, pg. 350). For instance, IT systems can produce comprehensive business intelligence (BI) reports. However, these reports have no meaning until a human reads the reports and assigns organisational context to the figures contained within the reports. For example, a BI report may identify that sales margins for a client have

diminished over the last quarter. The decision maker reading this report can immediately interpret the figures and conclude to discontinue further dealings with the client because of the attributed meaning. However, on further analysis, a BIS analyst deciphers that the client has had a number of technical issues with their payment systems software which have not been resolved which have led to the poor sales margins. The decision then transforms to repair/upgrade the clients payments system. From a technical perspective, Information systems are viewed as computational data manipulation systems (Benbasat and Zmud, 2003). Massey, Wheeler, and Keen (2001, pg.27) argue that "although information systems researchers have rightly concluded that the meaning of technology is socially constructed…our discipline's unique contribution to the broader field of social science requires that we understand technology as well as the organizational and individual issues surrounding its use." Students enrolling in a BIS degree with expectations of studying technical aspects such as hardware, software and cloud technologies will find it challenging and often counterintuitive to study information systems as social systems. According to Cope and Staehr (2008, pg. 351) "this view of Information systems is highly likely to be beyond the life experiences of undergraduates, and, consequently, Information systems as social systems represent an alien, qualitatively different view of information systems. Further, the discipline specific language associated with data, information, systems, database design, business processes, and decision making, for example, needs to be acquired." Ultimately, information systems viewed as social systems exhibit the characteristics of threshold concepts presented in the previous section (e.g., conceptually challenging, troublesome and irreversible) and represent a significant learning threshold for BIS students.

From a curriculum development perspective, the threshold concepts discussed in the previous section are integrated throughout BIS curriculum and an understanding of them is pivotal to students' successful transition from novice to expert. This transition is significant and is in line with Vygotsky's (1978) theory of learning. BIS curricula that are content dense can often result in philosophies that are integral to Information systems being hidden or overlooked. Teaching threshold concepts that are transformative can, therefore, be challenging and requires educators to engage in creative approaches that inspire and resonate with students. This is compounded by the fact that educators can sometimes encounter difficulties in bringing threshold

concepts such as socio-technical systems to life (Cope and Staehr, 2008). A study by Cope and Prosser (2005) identified six hierarchical levels of understanding for BIS students. As highlighted by Table 2.3 levels (1-4) have a technical focus while levels (5-6) contained some limited understanding of social aspects. Using Table 2.3 the researchers reviewed 32 business information students' level of understanding of the information systems concept over a year and identified that only 2 students displayed a level of understanding of Information systems which encompassed social system aspects. It was identified that the students investigated found the transition in understanding from IS as a technical system to IS as a social system difficult to achieve (Cope and Prosser, 2005, pg. 357).

Table 2.3 Levels of Understanding of the Concept of an Information System (Cope and Prosser, 2005)

Level	Meaning
6	A number of communicating information systems within a single organisation
5	A computerised data manipulation system and people gathering data, disseminating information and communicating to support a single organisational function.
4	A computerised data manipulation system supporting many people within a single organisational function.
3	A data manipulation system supporting an individual within a single organisational function
2	A simple information retrieval system.
1	A personal search of a static information source

Furthermore, BIS students must also be able to see the immediate relevance of their learning to practice and their conceptualisation of IS. For instance, BIS students are often employed in the information systems development (ISD) industry. ISD often takes place within complex organisational settings and as a result, there is a high failure rate of ISD projects (Conboy, 2010). It has been argued that key reasoning for this failure is that IS developers fail to see and experience BIS as social systems.

Consequently, Cope and Staehr (2008) conclude that “it would seem important that IS students encounter the notion of IS as social systems during their education if they are to think and act in practice in a manner likely to lead to the successful development of IS.” Having lectured IS for the past decade I would wholly agree with this statement. Unfortunately, the social system aspect is often neglected in the curriculum.

Learning to be a BIS professional requires students to be willing to engage in self-examination. Recent research (Land et al. 2018) has called for an increased examination of the role of ‘affect’ in liminal states in terms of whether it impedes or accelerates learning or impedes transformation. This is significant in a BIS context due to the rapid developments in IS and technologies. For instance, some professions BIS students would have traditionally entered are now becoming automated with advances in Artificial Intelligence, smart algorithms and blockchain technologies (Clohessy, 2019). Consequently, because of this uncertainty, questions then arise as to whether BIS curriculum should adopt open/flexible ontologies rather than fixed ontologies? (Barret, 2004). These advancements are challenging professional ontologies.

According to Land et al., (2018) “we need to try and produce learners, professionals, whose ontologies remain open to some extent rather than becoming closed off.” In other words, a lot of BIS programmes bring an element of closure, you are now a qualified information system analyst: you’re not a qualified software engineer. One final point to note is that BIS programmes often fall under the umbrella of a business school. There have been global calls for business schools to “move away from the siloed approach of producing the so-called “I-shaped” graduate to a “T-shaped” graduates – that is, a graduate with specialist knowledge that is capable to think outside of the silo through a more “interdisciplinary” approach to problem solving” (Bajada and Trayler, 2016). This call for change has enhanced the relevance of threshold concepts as a method for delivering sustainable transformation. Subsequently, this study will investigate the following research questions:

RQ1: What threshold concepts and troublesome knowledge do business information systems undergraduate students encounter when learning about information systems?

RQ2: How do business information systems undergraduate students manage the liminal space when they encounter threshold concepts and troublesome knowledge?

RQ3: Do information systems, as social systems, constitute a threshold concept for business information systems undergraduate students?

2.7 CONCLUSION

This chapter provided an overview of the core concepts which underpin this study. The literature review revealed that much is unknown pertaining to the teaching and learning of information systems within BIS degrees from a threshold concepts perspective. While research suggests that specific teaching strategies can enhance student learning, there is little consensus on what teaching strategies are most effective for teaching information systems. Additionally, there is a dearth of research which has explored how BIS students experience learning about information systems or why they find the concept challenging. Chapter 3 will provide an overview of the research methodology that was operationalised to answer the study's several research questions.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 INTRODUCTION

The research methodology section is an integral component in social science research (Kaplan, 2004). Its main aim is to provide a precise and concise overview of the "research strategy, methods and data that offer the prospect of providing needed information of good validity and reliability" (Taylor, Sinha, and Ghoshal 2006, pg.10). Core to this statement is the nuanced distinction between data and information. According to (Jantsch, 1967, pg.95) "data in itself is silent, it is the use to which it is put, in terms of inferring, projecting, analysing, manipulating, computing and decision making, that it important". The conversion of data into information requires methodology (Taylor et al., 2006). This process is depicted in Figure 3.1.

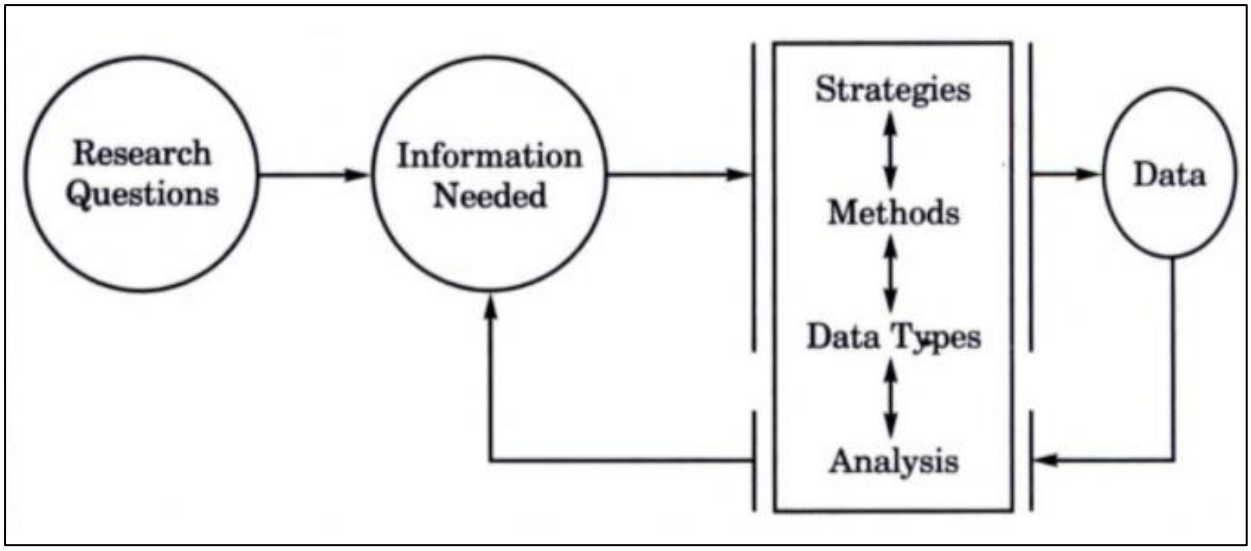

Figure 3.1: Suggested procedure of research methodology in the data to information conversion process (Taylor et al., 2006).

Consequently, this chapter describes the research methodology that was operationalised in the following study to answer research questions posed at the end of chapter 2:

RQ1: What threshold concepts and troublesome knowledge do business information systems undergraduate students encounter when learning about information systems?

RQ2: How do business information systems undergraduate students manage the liminal space when they encounter threshold concepts and troublesome knowledge?

RQ3: Do information systems, as social systems, constitute a threshold concept for business information systems undergraduate students?

The chapter is structured as follows. First, the philosophical assumptions and philosophical stance underpinning the study are presented in section 3.2. In this section an overview of the ontological research context is discussed. The concept of constructivism is introduced and then segways into a discussion on social constructivism which represents the main philosophical stance of the study. Next, the research methods used to recruit participants and the data collection methods deployed are discussed along with a rationale for their selection. In these sections a rationale for a case study approach (section 3.2.2) and overview of the mixed methods approach (section 3.2.2) is presented. Information pertaining to how the case site and case study research participants were recruited are also outlined in section 3.3.1. Further details with regards to how the questionnaire, focus groups and interviews were created, operationalised, and analysed are delineated in sections 3.3.3 and 3.3.4. Then, ethical considerations are presented in section 3.4. Finally, in section 3.5 a summary of the main topics covered in the chapter is presented.

3.2 RESEARCH METHODOLOGY

A research methodology is “the logical sequence that connects the empirical data, a study’s initial research questions and, ultimately its conclusions…every empirical study as an implicit, if not explicit, research design” (Yin, 2014, pg.19). Table 3.1 states the main research methodology pillars operationalised for this study in terms of the philosophical assumption, research stance, research strategy and research choice. These four pillars will now be discussed in greater detail in the next sections.

Table 3.1 Research Methodology

Philosophical Assumptions	Philosophical Stance	Research Strategy	Research Methods
Epistemology and Ontology	Social Constructivism	Case Study	Mixed Method • Interview • Questionnaire • Focus Group

3.2.1 PHILOSOPHICAL ASSUMPTIONS AND STANCE

This study is embedded in the social sciences which has implications for the philosophical assumptions and stances adopted. According to Myers (2019, pg. 24) every research project is underpinned by philosophical assumptions "about the nature of the world and how knowledge about the world can be obtained". Often these assumptions can be implicit and stored in a researcher's mind, however it is recommended that researchers make their assumptions explicit (Myers, 2013). Additionally, social science research places a strong emphasis of having the researcher at the foreground of the research (Bechhofer and Paterson 2000). In this context, the researcher brings prior knowledge with them when exploring the nature of reality and experiences. This is significant as the research participants' experiences, and interpretations of reality is core to understanding the several research questions posed in this study.

Ontology and epistemology reflect the different manners with which one can view a research philosophy and are the main assumptions which underpin research. While they are "related they need to be separated. To put it crudely, one's ontological position affects, but far from determines one's epistemological position" (Marsh and Furlong, 2002, pg.18). Figure 3.2 provides an overview of the interrelationships among the main building blocks of research. The nuanced differences between ontology and epistemology and their relevance to this study will now be discussed.

It has been argued that ontology, which originates from two Greek words on(being) and logia (study), is the starting point of all research (Grix, 2002 pg. 177). According to Crotty (1998, pg.10) "ontology is the study of being. It is concerned with 'what is',

with the nature of existence, with the structure of reality as such." Furthermore, Guba and Lincoln (1994, pg. 108) describe how ontological questions answer, "what is the form and nature of reality and, therefore, what is that can be known about it?" The several research questions posed in this study seek to address the nature of reality with respect to learning about information systems and as observed via the experiences of lecturers and students in the final year of their business information systems degree.

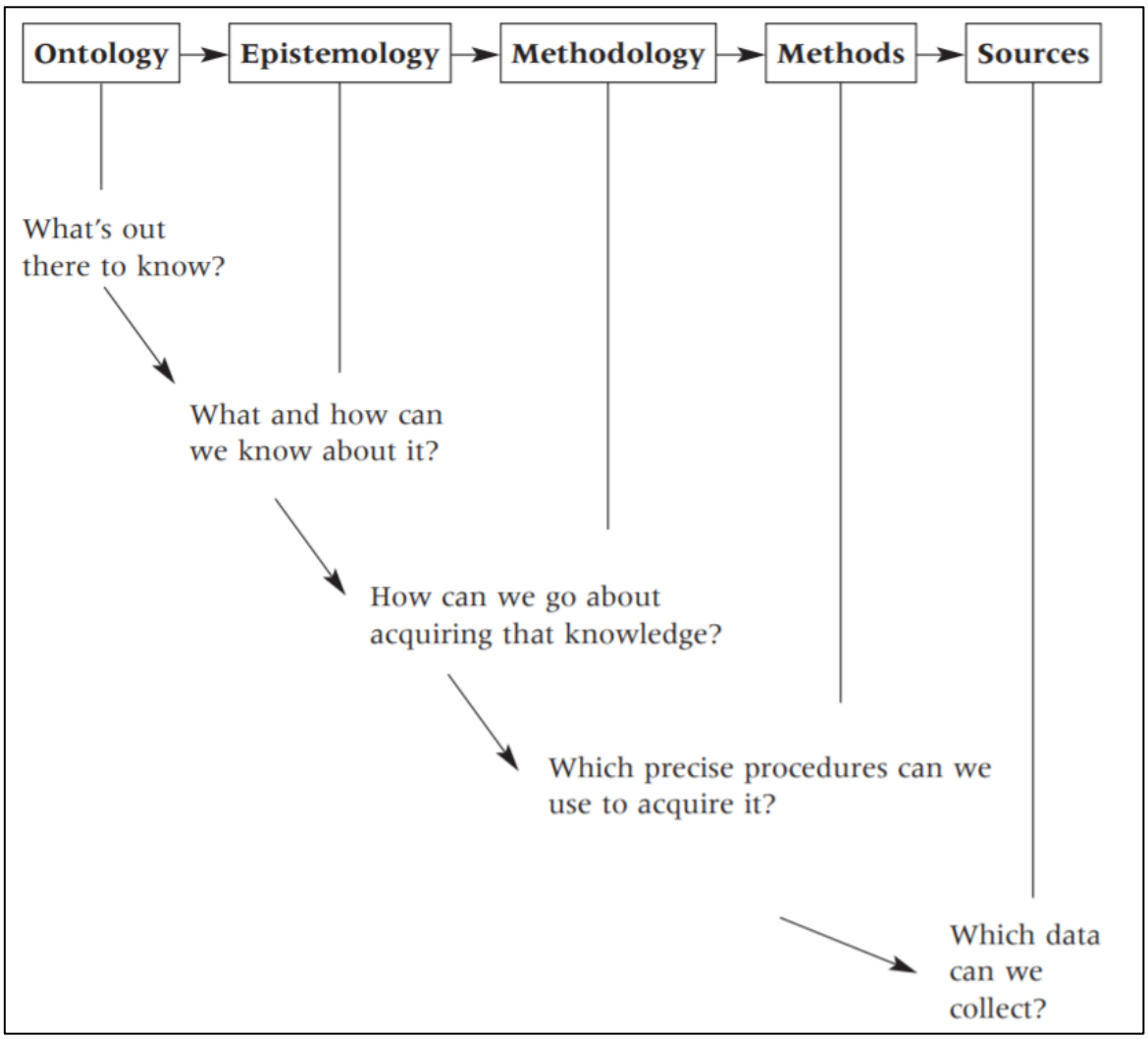

Figure 3.2: The interrelationships amongst the building blocks of research (Grix, 2002)

Originating from the Greek word episteme (knowledge), epistemology is referred to as the "theory of knowledge" (Marsh and Furlong, 2002). It is mainly concerned with how knowledge can be harnessed, its underlying assumptions and the premise that knowledge is not static and is constantly changing (Hirscheim, 1992). Epistemology is

also concerned with the processes of learning and knowing about social reality (Guba and Lincoln, 1994). It has been argued that all researchers should understand "the grounds of their knowledge and the limits of their knowledge, especially with reference to the validity and scope of the knowledge they obtain" (Myers, 2019, pg.36). Consequently, the knowledge-gathering process is an integral component for all research whose aim is to create new knowledge which ultimately scaffolds new platforms to existing models and theories. This knowledge-gathering process will be discussed in greater detail from section 3.2.2 onwards.

Three philosophical stances that can be taken under an epistemological worldview are objectivism, positivism, and constructivism (Guba and Lincoln, 1994). Objectivism is concerned with the exploration and revelation of objective truth. Researchers adopting this view must "not include their own feelings or values…they can study people's subjective views but must do so objectively" (Gray, 2013). Closely related to the concept of objectivism is a theoretical stance called positivism which posits that "reality is objectively given and can be described by measurable properties, which are independent of the researcher and their instruments" (Myers, 2019). In contrast, constructivism "rejects this view of human knowledge. Truth and meaning do not exist in some external world but are created by the subject's interactions with the world" (Gray, 2013). Constructivism is concerned with the relationships between individuals, material objects, institutions, and language (Fletcher, 2007). The concept of constructivism, which is based on the works of Berger and Luckmann (1966) and Piaget (1972) and which has its roots embedded in "Kantian epistemology" (Tynjälä, 1999), is epistemological in nature and is concerned with the sociology of knowledge (Cunliffe, 2008). From an educational perspective Packer and Goicoechea (2000, pg. 228) argue that constructivist theories are underpinned by epistemological assumptions that "focus on the active character of the learner; interacting with the environment either singly or with others; learning is the resulting construction and qualitative reorganisation of knowledge structures." Ashwin, Boud, Calkins, Coate, Hallett, (2020, pg. 24) discus how constructivist approaches have been fundamental in elucidating how students engage in the process of learning when attending University. Rather than viewing learning as a passive process, constructivism views learning as embodying constructive mechanisms which facilitate the acquisition of knowledge (Tynjälä, 1999). This process is underpinned by the idea that students'

prior knowledge and expertise mould the way they approach new concepts which impacts the manner with which they shape their understanding of these new concepts (Ashwin et al., 2020). Consequently, "constructivist pedagogy is grounded on students' previous conceptions and beliefs about the topics to be studied. It emphasizes understanding instead of memorizing and reproducing information, and it relies on social interaction and collaboration in meaning making" (Tynjälä, 1999, pg. 364). With this in mind, constructivist perspectives on education assert that lecturers should embed reflective continuous assessment elements (e.g., assignments) which complement their lectures slides so that the students must incorporate the new information given to them (Tynjälä, 1999). Furthermore, lecturers can facilitate enhanced conceptual understanding by embedding active engagement elements within their modules. Ashwin et al. (2020) provide a cogent example of this in their discussion of peer instruction. They highlight how this technique is used in physics and engineering to enhance students' engagement with core conceptual topics. Lecturers pose live multiple-choice poll questions in class and students have access to an electronic voting device where they can cast their vote. Prior to casting their vote, the students must provide the rationale to their classmates as to why they are selecting their allocated answer. The student can then decide whether to change their selection or not prior to the lecturer providing the correct answer and providing a rationale for the correct answer. This form of peer instruction is a prime example of "learning as acquisition through active construction" in higher education from a student learning perspective (Ashwin et al., 2020, pg. 25).

Building on the concept of constructivism, Vygotsky (1978) coined a new concept called social constructivism which viewed learning as a collaborative process. This approach is concerned with how knowledge and reality are constructed through discourse or conversations (Cunliffe, 2008). This is significant for BIS's understanding of information systems is dependent on the knowledge which is co-constructed in the classroom between students and lecturers. This knowledge is also underpinned by the language used to describe information systems. Consequently, this research will be informed primarily by a social constructivism approach. Guterman (2006, pg.13) provides an overview of the nuances that exist between constructivism and social constructivism: "although both constructivism and social constructionism endorse a subjectivist view of knowledge, the former emphasizes individuals' biological and

cognitive processes, whereas the latter places knowledge in the domain of social interchange." For instance, whereas "constructivist researchers focus on what is occurring inside the minds of individuals, social constructivists researchers focus on what is happening between individuals when they come together and create realities" (Flanagan and Flanagan, 2019). In other words, while there is overlap between both perspectives, social constructivism places an enhanced focus on learning via social interaction and collaborative environments. Specially, Cunliffe (2008, pg.128) refers to social constructivism as "how people shape meaning between themselves in responsive dialogue." Social constructivism guided the selection and application of the research methods and data analysis process. Ultimately, social constructivism supplies the context with which to investigate the specifics of how business information systems students develop their understanding of information systems.

3.2.2 RESEARCH STRATEGY: CASE STUDY

The research strategy selected for the study is a case study. According to Starman (2013, pg.29) "case studies have been largely used in the social sciences and have been found to be especially valuable in practice-oriented fields such as education." It has been argued case studies represent an essential pedagogical research tool for informing for educational best practices (Ruzzene 2015). The concept of a case study can potentially contain multiple meanings (Myers, 2015). However, a widely accepted definition is that a case study is an empirical inquiry that "investigates boundaries between the phenomenon and context are not clearly evident" (Yin, 2014, pg.13). Myers (2013, pg.78) argues that this definition however is too broad and provides a narrower and more specific definition: "case study research uses empirical evidence from one or more organisations where an attempt is made to study the subject matter in context…multiple sources of evidence are used". Stevenson (2004) and Myers (2019) provide an overview of the three main case study research strategy approaches: positivist, interpretive, and critical theory. These approaches are classified by the philosophical stances that guide them. The first two approaches will now be juxtaposed as critical theory is not within the scope of the study. Positivist case study approaches are used to test and/or refine propositions/hypotheses in real world settings (e.g., usually embedded within single or multiple settings). Validity and reliability measures are core to the positivist case study approach. Interpretative case

study research “relies on an underlying interpretive, constructivist and social constructivist epistemology” (Myers, 2019). The nuanced differences between this approach and a positivist case study approach are that interpretivist case studies “define quality in terms of the plausibility of the story and the overall argument” (Myers, 2013, pg.80).

For the purposes of this study a case study, which was informed by an interpretivist approach to research, was selected “to gain a rich understanding of the context of the research and the process being enacted” (Saunders Lewis, and Thornill 2016, pg.146). Furthermore, interpretive case studies enable researchers to “generate answers to questions such as the ‘why’ as well as the ‘what’ and ‘how’ questions…[thus] the case study strategy is most often used in explanatory and exploratory research” (Saunders et al., 2016, pg.146). Consequently, for these reasons an interpretive case study approach would adequately elucidate the several research questions posed in the study. Case study research is also well suited to social constructivist empirical investigations (Amineh and Asl, 2015) whose aims are deciphering how social reality is socially constructed by attempting to “understand phenomena through the meanings people assign to them”. This is important in the context of this study which will explore how business information systems students assimilate knowledge when learning about information systems and how their social environment impacts this.

While there are a multitude of advantages for using a case study research strategy (See Yin, 2014) there are also disadvantages which must be considered. First, case study research can take a long time to complete. Gaining access to organisations, recruiting participants, conducting, and transcribing interviews, coding transcripts and write up and so on requires researchers to draw up project schedule to ensure that all work is completed on time. The second disadvantage relates to the level of control of the researcher. Where the case study is focused on external organisations, the researcher may have no control over the situation. For instance, access may be withdrawn by the case study organisation at any moment. The corollary is also true where the researcher is investigating a phenomenon within their own organisations. This may lead to researcher insider bias and researcher-employee power imbalance ethical tensions. Ultimately, a researcher must ensure a level of appropriate critical

distance and ethical considerations (Cassell, Cunliffe, and Grandy, 2017). These tensions are addressed in section 3.4. The final disadvantage relates to the generalisability and transferability of case study research findings. While case studies are suitable “when the case is critical to confirming, challenging, or extending the examined theory” (Cassell et al., 2017, pg.23) and can be rich in detail, this study is based on a single-case study. This can lead to issues pertaining to the generalisability and transferability of the research findings (Yin, 2014). However, the motivation for a single-case study research strategy in this context is aimed at deriving research findings which facilitate naturalistic generalisation and transferability (Tracey, 2019). Also, it is hoped that this study will contribute further to research in the area.

3.2.3 RESEARCH METHODS: MIXED METHODS

The primary research method selected for this study was mixed method research. A mixed method study can be defined as one which combines both quantitative and qualitative data collection techniques to report findings based on a single study (Creswell and Clark, 2017). The quantitative phase (e.g., questionnaire) in this study was used to establish patterns and frequencies, and the qualitative phases (e.g., interviews and focus groups) were used to give a voice to the research participants’ perspectives. The qualitative phase of the research also enabled the in-depth investigation of the contradictions which emerged from the questionnaire data analysis.

Despite considerable debate in the literature pertaining to qualitative versus quantitative research approaches and the differing epistemological and ontological assumptions underpinning the two methods mixed method research has forged its own identity over the past decade and with its inherent capability to enrich empirical investigations has emerged as a rapidly favoured approach amongst educational researchers (Cassell et al., 2017). The mixed methods research approach was selected for this study for the following reasons. Firstly, the study’s several research questions can be investigated via qualitative (open-ended) and quantitative methods (close-ended). Furthermore, previous studies which have investigated the concept of threshold concepts in educational settings have also used mixed methods (Northcote, Gosselin, Reynaud, Kilgour, and Anderson 2015; Martindale, Land, Rattray, and Anderson, 2016). For instance, Northcote et al., (2015) identified that the quantitative

and qualitative components of their mixed methods research were “mutually illuminating” in identifying threshold concepts which led to the development of a bespoke professional learning program. In line with Patton’s (2014) concept of ‘paradigm of choices’ which favours methodological appropriateness over methodological orthodoxy, the research methods adopted for this study was determined by the research questions and the research context.

Second, mixed method approaches can lead to a “broader and deeper understanding of complex human phenomena” (Doyle Brady, and Byrne 2016, pg. 632). The manner with which threshold concepts manifest in an educational setting has been described as complex (Meyer and Land, 2005). Subsequently, the use of mixed methods can enrich our understanding of how business information students experience threshold concepts when learning about information systems.

Finally, mixed method research techniques also assist researchers with triangulation, generalizability, and diversity. In social science “triangulation can be defined as the mixing of data or methods so that diverse viewpoints or standpoints cast light on a topic” (Olsen, 2004). Furthermore, the ability to integrate qualitative and quantitative findings facilitate validity and mutual confirmation (Cassell et al., 2017). Saunders et al.,(2016) also highlight how mixed methods research can concrete the generalizability of a study and achieve a diverse range of views and perspectives in the study to be reflected. However, it should be noted that this is largely dependent on how the data is analysed.

There are two notable risks to using mixed methods. First, the use of mixed method emphases a greater use of resources, time, and effort on the part of the researcher. In the context of this study, this risk was minimised given the fact that this study is based on a single-case study and the researcher had access to the case study sample cohorts. Second, the researcher must be comfortable using both quantitative and qualitative data collection and analysis techniques. This risk was minimised as the researcher has conducted previous studies using qualitative and quantitative data collection and data analysis techniques. Furthermore, all research instruments were piloted and reviewed by knowledgeable others in the social science research discipline.

3.3 RESEARCH DESIGN

The following section provides an overview of the mixed method techniques used to answer the several research questions posed. A research design can be defined as a plan for an entire research project (Myers, 2019). Essentially, the research design is a road map which provides a thorough overview of the entire project lifecycle. It is recommended that the research design is updated in an iterative matter to allow for unforeseen circumstances that may emerge. According to Myers (2019) the research design encompasses decisions regarding the various phases of a project: the philosophical assumptions, research strategy, sampling approach, data collection techniques, and data analysis approach. Having already discussed the first two phases, this section will focus on justifications for the selection of choices for the latter three phases.

3.3.1SAMPLING: CASE STUDY SITE SELECTION

The site selection for a study is always guided by the research questions (Marshall and Rossman, 1989). The case study setting for this research is the Department of Enterprise and Technology contained within the Business Department of the Galway-Mayo Institute of Technology, Galway, Ireland. The study focused on the Bachelor of Science in Business Information Systems. Further details regarding the modules in which information systems is taught during this degree is outlined in Table 3.2.

Table 3.2 Information Systems Modules Contained within the BIS Degree

Year	Module	Topics Covered
1	Introduction to Information Systems	Programming techniques, information technology, data security, databases, uses of information systems business contexts, cloud computing, collaboration tools, and computer networks.
2	Business Information Systems	Programming techniques, databases, information technology, cloud technologies, excel, computer networks,

		hardware, software, data analysis, and uses of information systems business contexts.
3	Business Information Systems Work Placement	Application of theory and practical skills in a work setting.
4	Business Information Systems Final Year Project	Application of theory and practical skills in a project setting.

3.3.2 SAMPLING: STUDENTS AND LECTURERS

A purposeful sampling strategy was used for this study to identify the cohorts to investigate. Purposeful sampling enables the researcher to make use of their own judgement to identify research participants. For example, I contacted all lecturers who have been or are currently involved with teaching of information systems topics to students. According to Tracey (2019) “researchers should strive toward a purposeful sample, in which data and research questions/goals/purposes complement each other”. Purposeful sampling strategies are well suited for mixed method research studies (Palinkas, Horwitz, Green, Wisdom, Duan, and Hoagwood, 2015) and involves selecting cohorts that are knowledgeable and have expertise in the area(s) being researched (Creswell and Clark, 2017). Purposeful sampling enables the qualitative component of mixed methods to reveal the depth of understanding from the research participants (e.g., knowledge within specific information systems concepts), while the quantitative component is intended to facilitate a breadth of understanding (e.g., knowledge across information systems concepts) research participants (Palinkas et al., 2015). For the purposes of this study, final year business information systems students and lecturers were selected as a purposive sample so that the several research questions posed in this study could be answered. Final year students were selected as a study cohort because they have completed work placement in the 3rd year of the degree and were able to provide nuanced industry insights pertaining to threshold concepts and troublesome knowledge. Also, having covered the main information systems specific modules, they more than likely will have mastered the relevant concepts will have developed some perspective. Lecturers were selected to

provide some rich and contextual data relating to the several research questions. Additionally, the data obtained from lecturers assisted with the triangulation and validation of the data obtained from the student cohort. There are two challenges which must be acknowledged with the purposeful sampling strategy (Palinkas et al., 2015). Firstly, the selection of an exact sample size and variation of the sample size is problematic (Creswell and Clark, 2017). Miles and Huberman (1994) advise that a process of sampling and re-sampling is carried out until theoretical saturation is achieved. Second, purposeful sampling strategies are not without their critics in the academic literature (Patton, 2014). Critics often refer to the limiting nature of the approach (Palinkas et al., 2015). However, purposeful sampling strategies are underpinned by robust rationales as to why specific cohorts are being selected for investigation and subsequently are justified for inclusion in a study research design.

3.3.3 RESEARCH INSTRUMENT DESIGN

The primary cumulative objective of the research instruments was to identify how the findings from each instrument overlapped in attempt to answer the several research questions posed in this study. Table 3.3 provides an overview of the number of participants who completed each of the research instruments, the timeline of when they completed them and the previous research on which they several research instruments are based. The research instruments operationalised in this study have been adapted based to ensure that the several research questions could be answered.

As can be seen there were several phases. Each phase followed a logical sequence with the results from the previous phase informing the next. For instance, the lecturer interviews served the basis for identifying specific challenging concepts and further insights which were then used to develop the questionnaire instrument and focus group interview discussion guide. Additionally, the focus group discussion guide was also created following an analysis of the questionnaire results. Each phase of the analysis was exited once a point of theoretical saturation was identified and encompasses a point where no new insights were being discovered in the data (Strauss and Corbin, 1998).

Table 3.3 Research Instrument Overview

	Phase 1	Phase 2	Phase 3
Research Instrument	Interview	Questionnaire	Focus Group
Cohort	Lecturers	Students	Students
Number of participants	8	20	8
Time Frame	November 2020	December 2020	January 2021
Adapted and based on the work of	Hatt, L. (2020). *Using the threshold concept framework to enhance entrepreneurship curricula in higher education* (Doctoral dissertation, Durham University). Nicola-Richmond, K., Pépin, G., Larkin, H., and Mohebbi, M. (2019). Threshold concept acquisition in occupational therapy: A mixed methods study of students and clinicians. *Australian occupational therapy journal*, *66*(5), 568-580. Moeller, J. J., and Fawns, T. (2018). Insights into teaching a complex skill: Threshold concepts and troublesome knowledge in electroencephalography (EEG). *Medical teacher*, *40*(4), 387-394 Cope, C., and Staehr, L. (2008). Improving Student Learning About a Threshold Concept in the IS Discipline. *Informing Science*, *11*.		

Study participants were ensured anonymity across all phases of the study. Subsequently, a code has been prescribed for each participant for identification purposes. In the next section an overview is provided of each research instrument and a justification of why it was selected and the process of how it was operationalised in the study.

3.3.3.1 INTERVIEWS: LECTURERS

The first stage of the study incorporated the use of interviews with lecturers. Interviews are considered one of the most effective and widely used techniques in case study research (Myers, 2015). Interviews can be classified as structured (use of preformulated questions), semi-structured (mixture of pre-formulated and questions which emerge during course of the interview), and unstructured (few if any preformulated questions). This study used a semi-structured approach which is situated somewhere in the middle of structured and unstructured. The primary advantage of using a semi-structured approach is that it harnesses the benefits of a structured and unstructured approach while minimising the risks associated with both approaches (Myers, 2015). The interview guide was created (Appendix A) using an adapted mix of questions used in previous studies outlined in Table 3.3. The interview guide was piloted with 3 BIS lecturers and updated and revised prior to being deployed. For example, the original interview guide contained the wording “troublesome” concept(s) in certain questions. Due to the inherent complexity of this term, this was changed to the word “challenging” concept(s). Another example would be that the original guide contained the following question:

Q5. What are the main objectives/goals of your teaching in information systems?

This question was updated to the following question in the revised interview guide to allow for a more comprehensive answers and reflection from the lecturers:

Q5. What are the main (a) educational and (b) personal goals of your teaching in information systems?

Lecturers who teach information systems subjects to business information students were interviewed. These semi-structured interviews were selected as a form of “expert interviews” with participants who held authority and expertise in a specialised area

such as information systems (Cousin, 2009). This process of interviewing lecturers also facilitated with the development of the student questionnaire and a student focus group and the triangulation of the data which was obtained from these research phases. Furthermore, having an academic perspective allowed the harnessing of the passion of the interviewees for their subject areas which added to the richness of the data and provided greater insights into threshold concepts. Finally, the inclusion of lecturers facilitated the connection between theory and practice which is significant when researching threshold concepts in an educational setting (Barradell and Jones, 2015). The individual expert interview has been used in previous threshold concept studies carried out in educational settings (Barradell 2013; Moeller and Fawns, 2018).

An email was sent to lecturers providing an overview of the study's objective (Appendix B). Ten invitations were sent out and eight lecturers agreed to take part in the study. A participant information sheet (Appendix C) and study consent form (Appendix D) were then sent to the cohorts who agreed to take part in the interview. The duration of the Interviews ranged from 60 minutes to 80 minutes and were conducted using the interview guide via Microsoft Teams. Prompts were used to provide additional insights in instances where interviewee responses where either brief or in instances where their answer was interesting and merited further exploration.

3.3.3.2 QUESTIONNAIRE: BUSINESS INFORMATION SYSTEMS STUDENTS

A questionnaire is an approach which encompasses a group of research methods which emphasizes quantitative analysis (Gable, 1994). The primary aim of a questionnaire is to identify causal relationships and correlations, identify patterns of behaviours in the data and produce descriptive statistical analysis. While questionnaire approaches possess a number of advantages (e.g., data generalizability, identification of causal relationships, controllability), they also are susceptible to a number of weaknesses (Tracy, 2019). One of the main weaknesses of the questionnaire approach is discoverability of meaning. That is questionnaires can sometime be inflexible and only produce a snapshot during a time period and yield "little information on the underlying meaning of the data" (Gable, 1994). For example, while the questionnaire used in this study broadly revealed information systems concepts which students found challenging, it lacked the required depth that would be

required for answering the several research questions. Subsequently, qualitative approaches (e.g., focus group, interviews) were included in this study to overcome this limitation. These approaches will be discussed in the next section. Given the inherent inflexibility of questionnaire, it is crucial that the questions contained in a questionnaire are rigorously tested prior to being deployed (Creswell and Clark, 2017). For the purposes of this study an online questionnaire was created using Microsoft Forms. The questionnaire was created and adapted based on the previous research highlighted in Table 3.3 and from the analysis of the interviews conducted in phase 1 with information systems lecturers. The questionnaire was piloted to ensure its usability, reliability, and validity (Creswell and Clark, 2017). Pilot respondents were asked to comment on the flow, structure, terminology, grammatical and spelling issues, and timing aspects of the questionnaire. While pilot respondents noted that all the aspects were suitable, it was identified that the terminology used in question 22 was confusing which asked, “What topic did you find transformative”. In this instance, an explanation of the word transformative was included which satisfied the pilot respondents. The pilot questionnaire results were not included in the main dataset for analysis.

An email (Appendix F) was sent to 4th year business information systems students which contained a link to the online questionnaire (Appendix E) and a participant information sheet (Appendix C). In total 20 questionnaires were completed and analysed. The data analysis results of phase 1 and phase 2 were used to create a focus group discussion guide (Appendix G).

3.3.3.3 FOCUS GROUP: BUSINESS INFORMATION SYSTEMS STUDENTS

For the final phase of the data collection process a focus group was used to collect data that would elucidate the several research questions. Once again, an email (Appendix H) was sent to 4th year business information systems students which contained a brief description of the focus group intentions and a participant information sheet and participation consent form (Appendix I). In total 8 students volunteered to take part in the focus group. Focus groups are a valuable category of interview which and are categorised by group discussion stimulated via questions and answers, interactional dialogue, and other activities (Tracy, 2020). Focus groups, which are a

widely accepted mixed method research approach (Creswell and Clark, 2017), was selected for the following reasons. First, focus groups can elicit unique insights because of group dynamic and behaviour. According to Lindlof and Taylor, (2019, pg. 234) focus groups facilitate “a kind of ‘chaining’ or ‘cascading’ effect in which each person’s turn of the conversation links to, or tumbles out of, the topics and expressions that came before it”. In doing so focus groups can reveal insights which are more revelatory in comparison to one-on-one interviews (Tracy, 2020). For instance, a focus group participant can answer a question and a fellow participant can add, support, or argue with that contribution. Having conducted focus groups in previous research projects I can attest to this phenomenon. Second, because of the cascading effect, “focus groups are also valuable for generating a wealth of vernacular speech in vivo, which is specific to the group at hand.” (Tracy, 2019). This benefit is significant in the context of this study in terms of deciphering how business information systems students talk about information systems. This can assist with the formulation of effective language or terminology for teaching the concept of information systems. Furthermore, it enables the researcher to observe how students articulate and grapple with each other’s understanding of information systems. For example, some students may conceptualise information systems through different lenses or traverse threshold liminal spaces using different strategies. Delving deeper into the why and how can add rich detail to the several research questions posed. Finally, the focus group approach was selected to provide follow up insights to the lecturer interviews and student questionnaire. The data obtained from these research phases was analysed and the results used to develop a focus group interview guide (Appendix G). This scaffolding of research findings approach has been recommended for conducting mixed methods research (Tracy, 2019).

The focus group was conducted on Microsoft Teams. This virtual setting for focus groups was deemed suitable due to inability to stage a face-to-face focus group session because of Covid-19. Each focus group was 60 minutes in duration. The focus group session was audio recorded with the express consent of the interviewees. The focus group and interviews were both audio recorded and transcribed. All transcribed data was then stored in a qualitative data analysis database called Quirkos which can be used to organize and find insights from unstructured qualitative data. Quirkos has

been widely used in research to organize and analyse qualitative data into thematic bubbles (Harvey and Powell, 2020).

3.3.4 DATA ANALYSIS

For the online questionnaire, Microsoft forms was used to collect and analyse the data. Microsoft forms enables the identification of actionable insights from the data collected through cross distribution analysis, association rule analysis, correlation analysis, and sentiment analysis. The data was also imported to excel to run tests that were not available in Microsoft forms (e.g., pivot tables). As highlighted in Chapter 4, the data is visualised as either bar charts or tables. Once all the data was imported, a two-stage coding process was carried out incorporating initial coding and axial coding as per the guidelines outlined in Saldana (2015). The first stage of the coding process involved initial or open coding which involves breaking the data down into individual fragments and juxtaposing each fragment for similarities and differences. The primary objective of the initial coding stage is to "remain open to all possible theoretical directions indicated by your readings of the data" (Charmaz, 2006, pg.46). Each interview and focus transcript were coded line by line. Unique keywords were identified which provided an initial summary of the data (Charmaz, 2014). Next axial coding was used to strategically rebuild the data (e.g., unique keywords) that was fragmented during the initial coding process (Strauss and Corbin, 1998). The primary objective of this process is to remove redundant codes and to identify which codes which are dominant throughout the data. Akin to the axis of a wheel and the spokes which extend from the axis, axial coding determines primary themes and relates them to subthemes. This coding process continued until saturation had been achieved and no new themes were being identified. That is, no new information was emerging from the coding process (Strauss and Corbin, 1998). A sample of the data was re-analysed by another experienced qualitative researcher using the same analysis techniques as the primary researcher to ensure trustworthiness and rigour. No conflicts emerged during this peer-debriefing analysis (Saldana, 2015). Appendix J contains examples of the coding process that was carried out in Quirkos. Analytical memos were also used to by the researcher to reflect on all stages of the coding process (Appendix K). The primary aim of the analytical memos was to allow the researcher to jot down musings, challenges, obstacles, hunches, etc. that were encountered during the coding stages

(Saldana, 2015). As a concurrent data analysis technique, the analytical memos assisted with the illumination of new insights and were most beneficial when returning to the data for reanalysis.

3.4 RESEARCH ETHICS

According to Mertens and Ginsberg (2009) there are two dimensions of ethics which must be considered when using qualitative research methods:

1. Procedural ethics: Approval sought from a research ethics committee.
2. Ethics in practice: Day-to-day ethical issues or ethical tensions which emerge during research.

With regards to number 1, a research ethics proposal was drafted, reviewed, and approved by the GMIT ethics review committee. In terms of number 2 this study encompassed a number of ethical tensions. Firstly, I am a lecturer of the students from whom I collected data from. Therefore, this presents an ethical tension relating to undue influence, voluntariness, and confidentiality and anonymity. The risks of undue influence and voluntariness were mitigated by operationalising a number of steps such as explicitly stressing the voluntary nature of the research in all communications with students. In terms of confidentiality and anonymity, all research participants have been allocated specific codes to ensure their anonymity in the study. Additionally, a participant information sheet and informed consent form was distributed to all participants to ensure that they were fully aware of what participating in the study would entail. The detailed information contained within these documents assisted with the participant's decision as whether to participate in the study or not.

3.5 CONCLUSION

The objective of this chapter was to provide a detailed overview of the research methodology used to decipher the three research questions posed in this thesis. First, the philosophical assumption and stance underpinning the study were delineated. Next, an overview of the research strategy and research methods were discussed. Benefits and disadvantages associated with these approaches were also highlighted. Then, the data analysis techniques used for both the quantitative and qualitative data

sets were outlined. Finally, an overview was provided of the main ethical procedures operationalised in the study were discussed. The study findings are presented in the next chapter.

CHAPTER FOUR: RESEARCH FINDINGS AND ANALYSIS

4.1 INTRODUCTION

The findings of the study being reported here are presented in this chapter. The primary objective of this study is to identify and explore final year business information systems undergraduate students understanding of information systems using two main parameters: threshold concepts and troublesome knowledge. This study explored this objective by examining several research questions using Galway-Mayo Institute of Technology as a case study. Insights were gathered from both lecturers and 4th year business information systems on the business information systems programme who agreed to be research participants. The first research question examined the threshold concepts and troublesome knowledge students encounter when learning about information systems. The second question explored how students manage the liminal space when they encounter threshold concepts and troublesome knowledge. The final research question investigated if social systems represented a threshold concept for business information students when learning about information systems. The findings and analysis which follows juxtapose both student and lecturer perspectives. The findings concerning the three research questions will be presented sequentially (e.g., research question 1, research question 2, and research question 3). Chapter 5 will discuss the main themes arising from these findings. Before presenting the findings, the next section will provide an overview of the profiles of the research participants.

4.2 RESEARCH FINDINGS

4.2.1 RESEARCH PARTICIPANT PROFILES

For the first phase of the study, interviews were conducted with 8 lecturers who had an average experience of 10 years lecturing information systems modules. The research participants have been assigned specific codes to ensure anonymity (e.g., L1, L2, L3, etc.). For the second phase of the study, an online questionnaire was used to elicit responses from the students. A total of 20 students completed the online questionnaire. This quantified a high response rate given that there are 25 students in

the class. The questionnaire was anonymous, and each student has been given a code of S1, S2, S3, etc. For the final phase of the study, a virtual focus group was conducted with a total of 8 business information systems students. The students who participated in the focus group have been assigned specific codes to ensure anonymity (e.g., F1, F2, F3, etc.).

4.2.2 RESEARCH QUESTION 1 FINDINGS:

What threshold concepts and troublesome knowledge do business information systems undergraduate students encounter when learning about information systems?

4.2.2.1 LECTURER PERSPECTIVE: INTERVIEWS

This section will provide an overview of the results of the interviews with lecturers which proved invaluable in gaining insights into specific threshold concepts and troublesome knowledge their students had encountered when learning about information systems. Each lecturer found the study very intriguing as it was the first time that they had been asked about their experiences of threshold concepts and troublesome knowledge. At the macro-level, there was general agreement amongst the lecturers that from their experiences students found the theoretical, technical aspects, and terminology used within the discipline relating to learning about information systems challenging (Table 4.1).

Table 4.1 Macro Level Student Learning Challenge Themes

Higher Level Macro Themes	Lecturer Example Quotes [SIC]
Theoretical	*"They seem to skip over the theoretical aspects of information systems. They just want to learn how to use the technology or information system rather than learn about why and how they should use it, and this generally results in the poor exam and continuous assessment performance"* (L3).
Technical	*"I quickly learned over the years that when teaching the technical aspects of information systems that I have to simplify it down to the basics for the students and must spend a number of weeks covering the topics. If I do not the students struggle with the concepts and ultimately end up failing the practical exam"* (L7).
Terminology	*"The terminology used in the discipline is absolutely a stumbling block for students when learning about information systems. One minute I could be talking about databases and the next I will be talking about normalization and entity relationship diagrams. The terms used come from computer science and can in some instances can be used interchangeably. While some business information students with proficiency for technical aspects of the module might get it immediately other students cannot wrap their heads around it"* (L5).

From a theoretical perspective the following observations were made:

"The students find theory difficult. They struggle a lot with the theory behind the concept, so for instance, they might know what a supply chain is, but they might not know how a supply chain system works. And if you show them the process, they still will not get it until you know, break it down to the individual parts" (L1).

From a technical perspective the following comments were made:

"Students struggle with the technical aspects of information systems. Particularly when learning about programming languages or technical infrastructure (e.g., networks, servers, remote desktops). Some of them get it instantly while others struggle throughout the degree" (L4).

Finally, there was extensive discussion on the challenges which manifested for students because of the complex nature of the terminology used when learning about information systems.

"The business information systems discipline is relatively a young discipline. It borrows a multitude of concepts and terminology from a broad range of disciplines such as marketing, business, computer science, and economics. Consequently, students find it challenging to get their heads around all these terms. I have seen this repeatedly over the past years" (L3).

Distilling down to the micro-level, the results revealed that database design and business process modelling were identified as threshold concepts. These concepts were identified in every interview and contained the eight fundamental characteristics of threshold concepts as outlined by the work of Meyer and Land (2006) (See Section 2.3.1). Encompassed within each of these threshold concepts were issues relating to specific troublesome knowledge. The lecturers discussed the role threshold concepts and troublesome knowledge could play in the student learning process and the barriers that they could encounter. These will now be discussed in turn.

Broadly defined, a database stores data, usually electronically, which can be retrieved to create information. Databases represent a crucial learning aspect of information systems in that every information system requires a database. Companies can store customer, product, and employee data in their databases. This data can be converted to valuable information usually in the form of business intelligence insights (e.g., best performing customer bases, etc.). Business information systems students are usually involved in the design, creation, and day-to-day running and maintenance of databases. The lecturers outlined that while students cope well with basic theoretical and practical design elements, they often struggle with more complex and abstract database design elements:

"The initial stages of teaching databases are often the easiest. They just get it. But as soon as I introduce more complex database design concepts such as agile, DevOps, etc. It flies over their head. They do not absorb it as readily. At times it can be painful to teach." (L6)

Two other themes that emerged from the analysis of the lecturer interviews could be categorised as troublesome knowledge for students: entity relationship theory and normalization. The former is an illustrative approach to designing databases where students must create a diagram that maps out the specific relationships contained within the database. This can serve as a blueprint for designing the actual database. Normalization principles ensure that the database redundancy is avoided so that it makes it easier to modify the table. The data revealed that both aspects were fundamental to the understanding of database design with an understanding of entity relationship theory being a crucial pre-requisite for a student's ability to fully understand referential integrity.

"Entity relationship theory and referential integrity are crucial for understanding how to create databases. Students struggle firstly with conceptually depicting what a database should look like, this then leads to more frustration when trying to normalise the tables and identifying the specific relationships and between the tables and assigning keys to join them together…this frustration usually comes to a head with students just coming to me saying they cannot do it." (L8)

Lecturers also identified that there was problematic language related to databases. Terminology like referential integrity and data consistency are used when referring to the design of optimal performing databases. Referential integrity is concerned with deciphering how tables within a database which contain data are linked together throw primary and foreign keys. Data consistency is concerned with ensuring that the data contained within the database is accurate and measures exactly what it should. Many lecturers observed that students interpret these concepts differently which often leads to the development of databases which are subpar. Two lecturers commented that student's inability to correctly understand these concepts can lead to a superficial understanding of databases:

"When I have incorporated these definitions into an exam or continuous assessment, I am amazed by the varying incorrect meanings that students often assign to them. These concepts are essential to understanding databases…students who struggle with these concepts often submit databases which are poorly designed." (L2)

There was an insightful discussion with all lecturers when probing about why databases may serve as a threshold concept. There was consensus that because of its foundation in computer science some students have an innate fear of technical subjects which prevents them from fully engaging and mastering databases:

"Most database textbooks and online examples are inherently technical. They are very few pictures or everyday use cases provided. Students can feel intimidated and don't allow themselves to become fully immersed in the area" (L7)

Figure 4.1 provides a graphic illustration of how database design was identified as a fundamental threshold concept. Inherent to developing an understanding of how databases are designed, students need to first understand entity relationship theory which is crucial for understanding normalization.

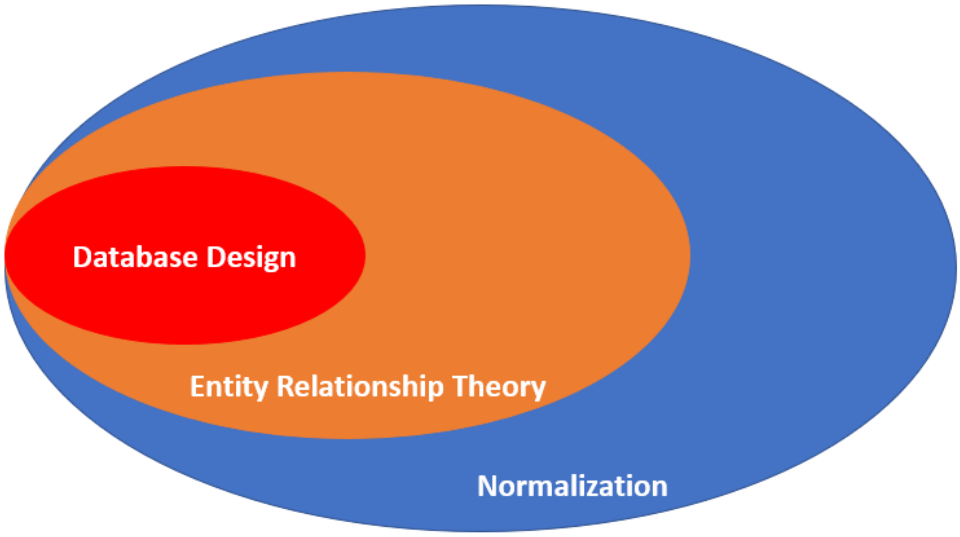

Figure 4.1: Databases Threshold Conceptualization

The next threshold concept identified relates to business process modelling which entails the graphical representation of what an organization's information system does on a day-to-day basis. Students must use sophisticated techniques (e.g., flow charts, data flow diagramming, Gantt charts, PERT diagrams, etc.) to model specific business processes and data flows that occur within the information system and how this system interacts with its internal and external organizational environment. Business process modelling represents a core aspect of every student's learning as it is required in every aspect of a business information system graduate's day to day work activities.

However, there was consensus amongst the lecturers that this concept was challenging for students:

“I have only had a few students over the years who that I can say have had a deep understanding of the concept. Often the students that struggle are focused on the end-product and cannot conceptualise how all of the interconnected data pipes fit together.” (L8)

Lecturers identified that there was also troublesome knowledge relating to business process modelling. Specifically, they identified the data flow diagramming technique as troublesome. This technique is used to visualise the way data flows within an information system in terms of inputs and outputs. There are several levels of abstraction that data flow diagrams can represent. The first is level 0 which is a higher-level contextual overview of the information systems and their data flow processes. Level 1 and level 2 go into more detail and are inherently more complex requiring the students to break the level 0 diagram into sub-processes. An understanding of this technique is crucial for business information systems students as it is the primary technique used for business process modelling.

“The second core competency that I think they need is the ability to be able to abstract at different systems. What we mean by that is to be able to use the core tools, such as the data flow diagrams, all the different process and flow diagrams that are required to map out what the organisation and systems look like in reality.” (L3)

It was also interesting to note that several lecturers identified business process modelling as a threshold concept that they had also encountered**:**

“*The biggest challenge for students is that the concept of business process modelling is alien to them, and this would have been their first encounter with the topic. It does not help that the concept comes from software engineering. Even I struggled to get my head around it as I am not a software engineer.”* (L7)

We will now present the findings from the student questionnaire in the next section.

4.2.2.2 STUDENT PERSPECTIVE: QUESTIONNAIRE

This section will provide an overview of the results of the questionnaire which was completed by students. The overall results of the questionnaire suggested once again that theoretical, practical, and terminology aspects of learning about information systems were challenging. Figure 4.2 shows that 40% of the students found information systems theory challenging (10% ranked it number 2), while 20% found information systems analysis and development difficult (35% ranked it number 2), and 15% found databases challenging (25% ranked it number 2). Interestingly 45% of students indicated that working with data was the least challenging.

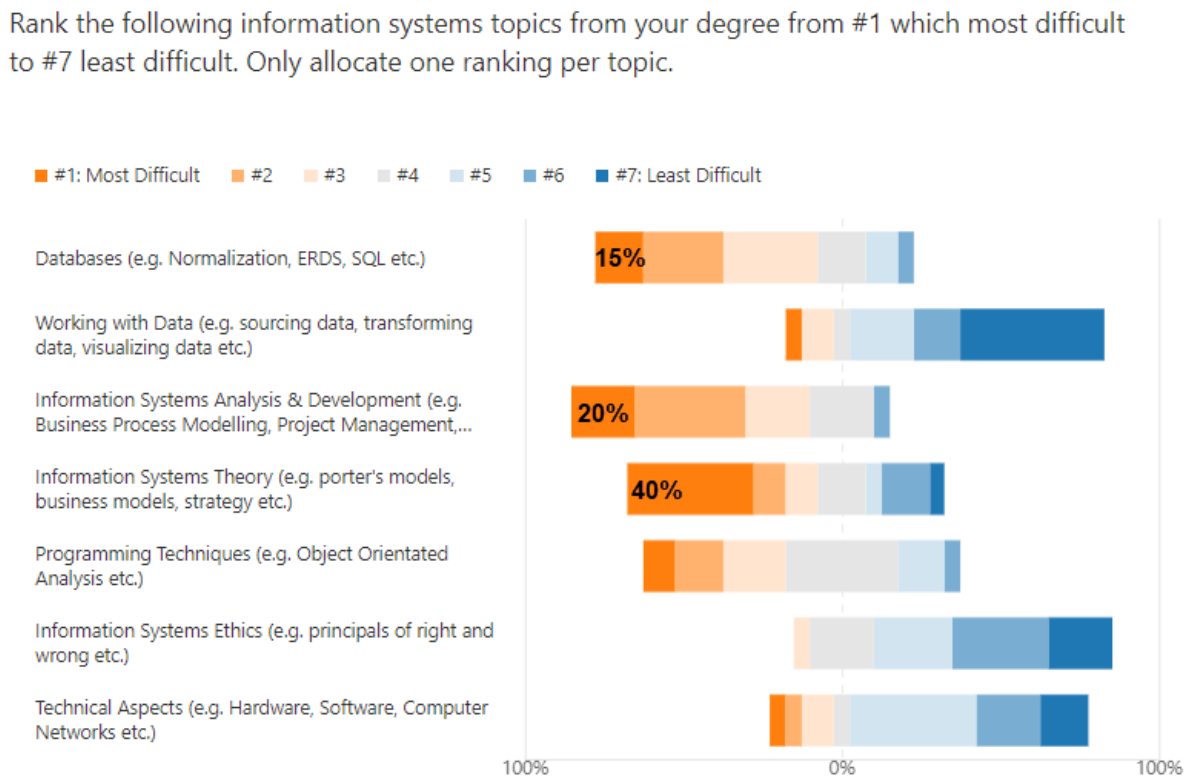

Figure 4.2: Most Difficult Topics

When probed why they had selected the topic for their number 1 choice for most difficult, the students discussed the challenging, applicability and repetitive nature of learning about the theoretical aspects of information systems:

"I think the theory was hard for me as usually working with a lot of theory I seem to lose interest and then it's hard to pick back up. There's not one particular section that

I found hard but the whole theory is kind of hard and then the fact that a lot of the modules repeated us learning this same theory each time felt a bit repetitive." (S4)

"Information systems theory caused me a lot of challenges. I fail to see why frameworks from the 80s and 90s can be used in modern organizations." (S1)

"The theory aspects were very confusing. We would be presented with multiple theories and would have to see how to use them in the real world. I tried my best to get my head around it over the past four years but none of it stuck." (S17)

With regards to information systems and analysis the students identified that business process modelling, and data flow diagramming techniques required a lot of time to learn the core aspects of the concept, they found the terminology confusing and finally found data flow diagramming very difficult, specifically conceptualising the more detailed aspects of how information systems work:

"Business process modelling required a lot of time and effort and it was my worst grade I had received in GMIT. Very interesting subject, but very hard all the same." (S7)

Finally, in terms of databases, students identified that entity relationship management theory constituted a challenging topic. They also alluded to normalization as being troublesome.

"My head works in a practical way. I do not like being asked to create diagrams to show how a database can work. I know that it is important to first design a database on paper by mapping out the relationships, but I found the whole process extremely frustrating." (S9).

We will now present the findings from the student focus group in the next section.

4.2.2.3 STUDENT PERSPECTIVE: FOCUS GROUPS

This section will highlight the findings that emerged from the focus group discussion. The eight students that took part in the study confirmed that they all had completed the questionnaire from the previous phase. Six of the students also confirmed that they had never participated in a research focus group before with two students confirming that they had an experience of taking part in a focus group. All the students confirmed that they were taking part in the focus group to assist with the study's aims and

objectives by sharing their experiences of learning about BIS. Mentimeter (interactive presentation software) was used during the focus group by the researcher to poll the students on various aspects of the course. Extracts from various polls will be used throughout the focus group analysis for the several research questions.

In terms of findings concerning research question 1, the students identified again that business process modelling, and data flow diagramming techniques represented conceptually challenging aspects when learning about business information systems. It was also interesting to note how remote learning compounded the problem:

"Creating data flow diagrams for business process modelling. Especially in the 4th year as the class was 100% online so the interaction between lecturer and students was limited. Preferably this module needs to be face-to-face in the labs like had been previously done." (F5)

In terms of the databases, the students once again entity relationship theory and normalization were problematic from a learning perspective:

"I found entity data relationship modelling very challenging in terms of populating tables with the correct information and then linking these tables together in the database. It can be quite abstract, and I just don't feel confident that I can design a database correctly." (F2).

Finally, the students alluded to the negative impact Covid-19 was having on their learning:

"Group projects is one area which I am finding challenging. Especially last year during COVID-19 as I struggled to get other members to participate. At times when completing projects, it was difficult to understand requirements or expectations when remote learning. Having the lecturer in the classroom or lab is invaluable." (F7)

"Remote has made some subjects definitely hard. Because you do not have the benefit of just turning up to your lecture and asking questions. Whereas now, if you want feedback from the lecturer, you must send them an email. You could get back an email

back in 10 minutes, or it could take a day or two. So, some modules work better online learning in terms of recorded lectures, but for some practical subjects, like systems analysis, I think you really need to be in the same room as the person who's teaching it." (F4)

Table 4.2 provides a summary of the main themes that were discussed in this section in relation to answering research question 1. Having presented the research findings for research question 1, we will now present the findings for research question 2 in the next section.

Student Learning Challenge Themes	Lecturer Example Quote(s) [SIC]	Student Example Quote(s) [SIC]
Troublesome Concept: Databases Design **Troublesome Knowledge:** Normalization Entity Relationship Theory	*"**Database design** is very frustrating to teach. That has been my experience over the past 5 years. Particularly with the iterative nature of database design. They know that databases are used to store data and are needed in everyday life, but often struggle with identifying what is required to design an effective database."* (L1) *"**Normalization**, which is the organization of data into logical groupings, is really troublesome for students…the problem is that if they do not get it following my module, they will struggle with database design in the workplace."* (L10)	*"I found **normalisation** challenging. Especially when we first started it as we had to go step by step through 1NF, 2NF and 3NF. I found at this stage I kept skipping to 3NF without doing the steps for 2NF."* (S13) *"We have been taught that to design a database correctly you have to be good at **normalization**. The lecturer also says that to learn it we must practice it repeatedly but I just find it boring and the there is so much theory associated with it."* (F3)
Troublesome Concept: Business Process Modelling **Troublesome Knowledge:** Data Flow Diagramming	*"The students struggle with the theoretical and practical elements of **business process modelling**. You are challenging them to sit between the business and technical side of the organization and to produce an accurate depiction and visualization of what the information system does. I have found that even the most technically proficient students struggle with the simplest business aspects and vice versa with the business proficient students."* (L6).	*"I struggled to break down information systems from the higher levels the lower levels using the **data flow diagramming**. I could never get the lower levels right."* (S10). *"While the topic itself is very interesting and practical, the diagrams that are needed for **BPM** have a lot of information being presented to you which can be a little overwhelming. This has really caught up to me in the final year especially when not being able to see how it is done in a traditional class."* (F8)

Table 4.2 Student Learning Challenge Themes: Lecturer and Student Perspectives

4.2.3 RESEARCH QUESTION 2 FINDINGS:

How do business information systems undergraduate students manage the liminal space when they encounter threshold concepts and troublesome knowledge?

Table 4.3 provides a summary of the main themes that will be discussed in this section in relation to answering research question 2.

4.2.3.1 LECTURER PERSPECTIVE: INTERVIEWS

Continuing from the threshold concepts and the troublesome knowledge identified in research question 1 this section will highlight the findings in relation to research question 2. As previously identified in section 2.5 a student's understanding of a threshold concept can be thought of as a relational journey through several phases. A student's first encounter with troublesome knowledge can be categorised as a preliminal phase. The troublesome knowledge serves as a trigger whereby the student attempts to combine this new knowledge with their prior knowledge of a concept. This occurs in a phase referred to as the liminal space. Should a student undergo a successful ontological and an epistemological shift in this phase of liminality they will successfully cross a boundary into a post liminal phase. Consequently, they will have traversed the liminal space with a new understanding and transformed from 'not knowing' to 'knowing' (Land and Meyer, 2010).

Traversing the Liminal Space Themes	Lecturer Perspective Example Quote(s) [SIC]	Student Perspective Example Quote(s) [SIC]
Peer Learning	*"Whenever I have struggled with topics, I have always asked colleagues for help to improve my understanding. The same works with students who work in project groups. The students will be working in project groups when they leave so it is of paramount importance that we embrace them also for continuous assessments so that all students within the group can derive the benefits of peer learning."* (L8)	*"Lecturer support was fantastic in information system topics that I struggled with throughout GMIT. I also took online courses to help me. However, if it wasn't for the knowledge that I got from my teammates working in project groups there is no way I would have the level of understanding that I have now."* (S10) *"The importance that GMIT put on group projects helped me to overcome challenging topics that I came across. Whenever I or anyone else was struggling we brought all our strengths together to work more efficiently."* (S8)
Practical Application	*"I think the students learn more by implementing, you know, so I'd be a big believer of driving the key learnings in a more applied way. I am not a big believer in presenting, you know, 60 or 80 slides, and just talking about the theory, I am very much about going into the lab and getting students to do exercises, getting them to follow along with the lab practical to reinforce learning. And it works. I have seen students with very little technical knowledge at the start of the semester propel to having satisfactory competency which prepares them for the next module."* (L5)	*"The teaching was very good, and the lecturers did their very best to help us understand the topics. In terms of learning I would like to see less theoretical aspects and more focus on the technical aspects from first year onwards."* (S2) *"It has already impacted me from a professional perspective. During my internship, I was asked by the company to design a database. The stress of the internship was unbelievable as I did not know how to design one correctly. I always struggled with normalisation and entity relationship diagrams so not knowing this led to the creation of a database by me which wasn't great."* (S19)

Table 4.3 Factors Enabling Students to Traverse the Liminal Space

Traversing the Liminal Space Themes	Lecturer Perspective Example Quote(s) [SIC]	Student Perspective Example Quote(s) [SIC]
Independent Learning	*"Using the engagement analytics on Moodle I can see that the students that engage with external learning resources that I recommend always fare better with challenging topics such as data flow diagramming. Students who do not engage or students who just memorise my slide deck for an exam always tend to demonstrate superficial learning."* (L3)	*"I normally look for online resources to help. Whether that be an article or YouTube video. But at the end of the day if you want to improve at something, you just need to practice more questions. The old cliche of practice makes perfect."* (F3) *"I spent additional time learning by myself and took a different approach to database development by doing the suggested practical extra exercises provided by the lecturer and doing exercises on websites such as Wise Owl. Over time I improved and was able to keep up with the class lecturer."* (S4)
Lecturer Support and Experience	*"When I first inherited this module, I struggled with the practical implementation of abstract concepts such as normalization and entity relationship diagramming. I do not have a technical background, so it took a few years of teaching the module to become comfortable with the topics. With experience comes understanding…because is struggled with these concepts I ensured that I teach them in depth."* (L6)	*"I found for practical subjects having weekly lab classes with smaller class sizes beneficial because I could ask lecturers questions in person or show them issue, I was having."* (F7) *"Group members or a lecturer who understood the concept and could clearly explain the problem I found challenging was so beneficial in seminars and labs. 1 to 1 teaching like that helped me to understand tricky aspects."* (F5)

Table 4.3 Factors Enabling Students to Traverse the Liminal Space (Continued from previous page)

Students who fail to cross this boundary must reengage with the pre-liminal and liminal phases. As indicated by Land and Meyer, (2010) some students may never enter the post liminal phase. It was interesting to note that all lecturers (n=8) expected their students to undergo learning transformations during their information systems modules:

"*Yes. I would hope that all the students undergo a learning transformation when they encounter specific challenging topics in my module. The prospect of this is what motivates me at the start of every semester. For example, there is always a cohort of non-technical students who you know, this is all very new for them. I would love all of them to get that eureka moment at the end of the semester."* (L5)

"*I would like all my students to undergo a transformation in their learning. That is the goal I set out with. However, from experience, it is usually only a small cohort of students that transform their learning every year. I want to make a difference for students, I know that certain teaching styles are not going to suit everybody, but I am constantly learning and evolving my teaching style so that I can reach out to those students I couldn't the year before*." (L8)

The lecturers also provided an overview of how students successfully traversed the liminal space when encountering the troublesome topics of entity relationship theory and normalization in the case of database design and data flow diagramming in the case of business process modelling. The first aspect which was spotlighted by the lecturers was the importance of peer learning:

"Peer learning is key for students overcoming challenging concepts. My continuous assessment strategy for my module always comprises group work. For technical aspects, I like to pair technical students with those who are struggling with the basics. It's amazing to see when the students begin to grasp the basics and advanced elements with the help of their peers." (L1)

"When I started my career as a lecturer, I would have students completing individual assignments. A large proportion of them would struggle with their assessments. Once I started incorporating student group work, I began to see vast improvements in learning and understanding. One useful method I use is getting students to critique

and grade each other work. Based on the student feedback that I have received these assist students in their understanding of challenging topics." (L7)

Next, the lecturers identified practical application as important whereby theoretical concepts are applied in real life scenarios and examples:

"I try to translate the concepts into formats that students understand. So, bringing it back to real world examples in the form of case studies is important. You can see that lightbulb go off when you present the theory in a manner with which they understand, and it reflects what they do in their everyday life." (L1)

Finally, they highlighted the significance of independent student learning:

"Students that enhance their understanding of a topic like normalization are open to advancing their learning through external resources. They challenge themselves by completing tasks other than the one I have assigned them. There seems to be an inherent drive or motivation to do this so that they become familiar with the topic." (L4)

"I am always fascinated by students that possess tremendous potential but who often struggle with basic concepts. When you dig deeper, they just do not engage with the module 100% for some reason or another. They do not have an interest in the supplementary learning materials or resources." (L8)

The analysis also identified how a lecturer's experience of encountering a threshold concept was crucial in signposting the possibility that the concept may also be troublesome for students:

"I struggled with business process modelling during college myself, so I know where the students will struggle, and I know how to simplify the concepts into something relatable and easy to understand." (L2)

We will now present the findings from the student questionnaire in the next section.

4.2.3.2 STUDENT PERSPECTIVE: QUESTIONNAIRE

Before delving into the results of the questionnaire to determine how students manage the liminal space when encountering threshold concepts and troublesome knowledge a discussion pertaining to the most transformative subjects that the students

encountered during the 4 years will be presented. Figure 4.3 presents an overview of the student's perception of what was the most transformative subject that they encountered. Interestingly 40% of students ranked databases as the most transformative topic. Information systems analysis and development was second with 25% closely followed by working with data (15%) and programming techniques (15%).

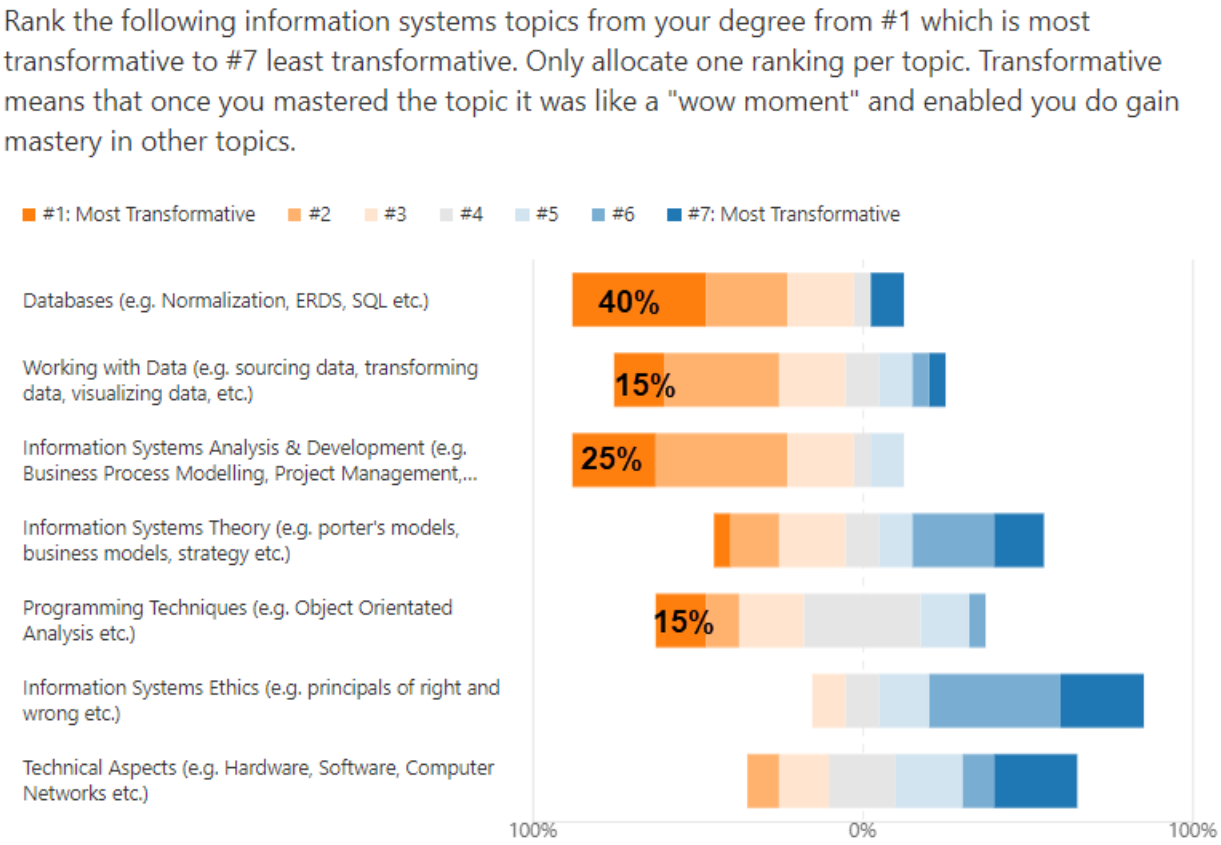

Figure 4.3: Most Transformative Topics

When asked to provide reasoning for their most transformative selection the students made the following statements which complement the findings from research question 1:

"Normalization gave me great insight on how to work with data. Before this degree, I did not know the process even existed but now it has helped me develop clear concise and relevant data in all aspects of work in this degree. It has also had a knock on effect for areas such as entity relationship diagrams." (S6)

"I found creating databases the most transformative as you start with just tables and data and by the end, you have a fully functioning database that could be used in a real world business." (S8)

"Entity relationship diagrams and normalisation seemed complicated and not useful but once understood them fully, I realised how useful they were in the database design process." (S9)

"When I finally cracked business process modelling it made me realise why these things are so important. To develop a well functioning system, we need to model all of the processes and understand the way people work." (S11)

Figure 4.4 highlights that 14 students overcame the troublesome knowledge and threshold concepts challenges that they encountered while studying information systems.

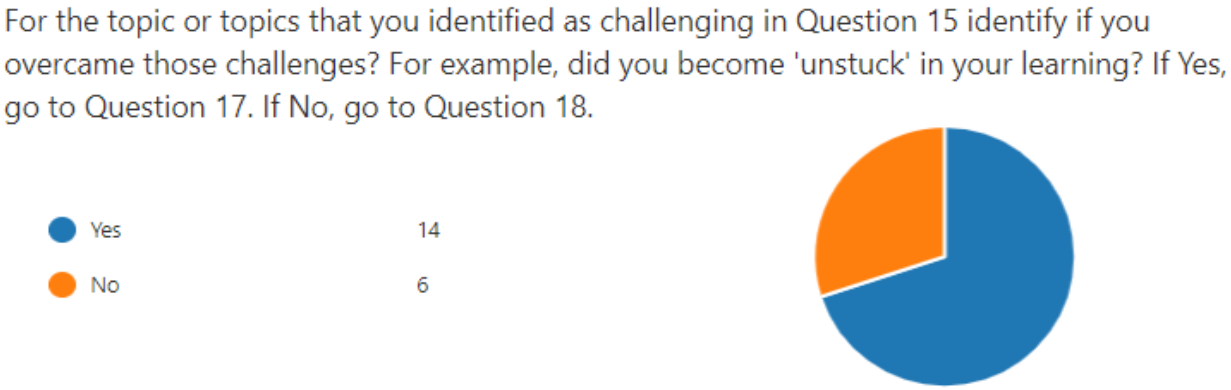

Figure 4.4: Overcoming Challenges

When quizzed about how they overcame those challenges the students identified self-learning, lecturer support, and group project work as being fundamental components. Once again, these findings supplement the results for question 1:

"Self learning played a key role along with support from my group. I found that team project work enabled me to ask my friends within the project team questions if I became stuck. The lecturers also helped me when they provided practical examples and simplified the topic." (S2)

Students also alluded to the advantages of remote learning which enabled them to overcome troublesome knowledge and threshold concepts:

"I have found it much easier to learn from home. There are recorded lectures, which means they can be watched whenever the student is available, the lectures can be paused and played back. This helps for note taking or even practicing exercises." (S7)

With regards to the six students who identified that they had not overcome the troublesome knowledge or threshold concepts that they encountered it was interesting to note their reasons and the impact that they felt that this might have on them once they graduate:

"Unfortunately, I did not overcome the challenges that I came across when studying business process modelling. I have even tried websites such as khan academy but still have not got my head around it. As a result, I won't be applying for technical analyst roles." (S9)

"Although I struggled with the business process modelling, I don't think it will impact my career unless I get a job in the systems modelling field. I don't think any specific things would have helped me master the topic as it is just not something, I am good at, sometimes some topics not everyone will be good at." (S4)

Finally, the students were asked what aspects of information systems they would have liked to have had more help with. It was interesting to note that they would like to see a more dedicated teaching focus on the technical aspects of information systems which started straight away in the first year:

"I would try and incorporate a small bit more of the technical subjects into our first two years. Learning about normalisation in its most basic form in my first year I felt would have helped me up to final year." (S5)

We will now present the findings from the student focus group in the next section.

4.2.3.3. STUDENT PERSPECTIVE: FOCUS GROUPS

In relation to research question 2, the focus group identified a number of aspects that students used to manage the liminal space when encountering troublesome concepts when studying business information systems. These aspects identified aligned with

the results which emerged from the student questionnaire. First off, self-learning with external resources emerged as a theme to assist students to traverse the liminal space:

"YouTube, chat forums, other students, just simple google searches because you usually aren't the only one who encountered that specific problem." (F8)

Lecturer support was also identified as a core aspect for assisting students. The students noted how seminars and laboratory practical enabled them to understand and practice with troublesome knowledge and challenging concepts. These support mechanisms however had been hampered by the emergence of Covid-19 and remote learning. In the case of remote learning, the supportive environments of the laboratory practicals and seminars were difficult to emulate, and the students felt that they had lost that close connection with the lecturers which enabled them to overcome the challenges posed by conceptually difficult concepts.

"I would have either asked the lecturer or completed research into the topic myself through google. Especially if it were a project, I would have done my research to further understand the topic. Remote learning made it more difficult to ask lecturers." (F1)

Next, the students were asked about what additional supports would they have liked to have had access to in order to help them with challenging concepts and troublesome knowledge. The students identified that pre-Covid19 that they would have liked to have more 1-1 interaction with lecturers. They also felt that seminars and laboratory practical should have smaller groups attending so that each group could have availed of the lecturer for support when learning:

"Weekly drop in sessions would be great. Any additional student queries could be covered in 1 on 1 or small group sessions every week. I feel 1 on 1 or small group learning can be especially beneficial when teaching technical aspects of a course vs theory topics." (F2)

The students also identified additional supports that they would like now that they are engaged in remote learning during Covid-19 in terms of additional live tutorials, increased feedback from lecturers, and lighter workloads:

“Lighter workloads, as some theoretical subjects can be very tough to understand leading students not fully understanding what they are doing.” (F8).

“We need home licenses for programs instead of having to use eLabs. Live classes for every module would really help interaction and allow us to ask questions when we are having difficulties when tough subjects are being introduced in the lecture.” (F4)

Finally, it was interesting to note the wide ranging set of skills that the students identified that they feel that they have mastered (Figure 4.5). These skills identified are fundamental to becoming a competent business information systems graduate, and it was great to see that the students felt that after 4 years that they had acquired the requisite knowledge in these areas.

Figure 4.5: Student Skills Sets

In the next section the results in relation to research question 3 are presented.

4.2.4 RESEARCH QUESTION 3 FINDINGS:

Do information systems, as social systems, constitute a threshold concept for business information systems undergraduate students?

The data revealed that information systems as social systems do in fact represent a threshold concept for business information systems students. Table 4.5 provides a summary of the main troublesome knowledge themes associated with social systems. These will be discussed in this section in relation to answering research question 3.

4.2.4.1 LECTURER PERSPECTIVE: INTERVIEWS

There was general agreement amongst all the lecturers interviewed of the importance of incorporating learning outcomes within information systems modules aimed at enhancing student's understanding of information as social systems from development (building systems) and end-user perspectives:

*"From my experience, the students have difficulty seeing why they need to care about the social side of information systems. For example, they might want to be a business analyst and then struggle with the specifications of the job (e.g., incorporating end user information system requirements)." (*L6)

"*If you develop an information system, and you have people there, and you do not understand what motivates them, it's very hard to develop an information system successfully. There is a long history of information system and technology development failures which can be pinned down to not including people as part of the development process. I have to ensure that I can get this across to my students."* (L5)

Social System Troublesome Knowledge Themes	Lecturer Perspective Example Quote(s) [SIC]	Student Perspective Quote(s) [SIC]
Communication Considerations	*"They also have difficulty in understanding why a business analyst must mingle back and forth between the project team members. Surely, we are doing technical development only they might exclaim. So, I try to show them many examples of the human side of information systems and technical systems and the negative consequences that can occur if they are not considered."* (L6).	*"I found communicating with others a bit tricky, as they have been in the company for x number of years and they rather keep an eye for themselves. Not everyone of course, but I noticed that they tend to look out for themselves more."* (F1)
Technical System vs Social System Differentiation	*"It can be quite challenging for students to differentiate the technical and social aspects of information systems. When I first started lecturing on this topic, I neglected the social aspects and placed core focus on the technical side. But students only then get one half of the picture."* (L7)	*"A bank would have an IS within it but it is not an IS. The ATM could probably be described as an aspect of an IS, but my understanding is that an IS is a large group of systems used to process data for the good of an organisation."* (S5)
Ethical Considerations	*"I think the ethical side of information systems as social systems should be given more prominence in the curriculum. We seem to just skim over it and the students struggle with that aspect. Even though they are going to be involved in the design of information systems and technology we need to drive home the message that ethical aspects are critical to their future employment."* (L8)	*"GDPR is a big concern for companies. But its such a big document that I have not researched it in full detail. I don't think it will impact me in the workplace as I plan to work with cloud technologies."* (F8) *"I am only concerned with software coding. I am assuming that it will be the responsibility of my manager to deal with the ethical side of the product that I am developing."* (F4)

Table 4.5 Social System Troublesome Knowledge Themes

In fact, all lecturers agreed that the social system side (some lecturers referred to this as the human side) of information systems was central to enhancing students understanding of the more complex and technical aspects of the information systems module:

"You have to drive home the that organizations comprise networks of people where information goes back and forth to make decisions. Information systems complement this decision making process. Humans still must read the output of information systems and act on that data. Sometimes it can take students the entire 4 years to absorb this, and some instances they never do." (L3)

It also emerged that segmenting information systems modules into social and technical aspects represented a core aspect of facilitating students learning (See Table 4.4.). An interesting aspect of social systems which the lecturers identified as being troublesome for students was the ethical aspects of information systems as social systems:

"When we cover new information systems advancements like artificial intelligence, blockchain, big data the students are excited about covering these aspects. When I bring up the ethical dimensions, they struggle to come to terms with that aspect of new technological developments in terms of why they should care about how the technology could impact people. Even when I break it down into relatable examples only some get it." (L2)

Distilling further into the ethical aspect a few lecturers identified the general data protection regulations (GDPR) as being troublesome for students:

"We need to embed more aspects relating to GDPR into the curriculum. We also need to expose them to cases where there are big data disasters, for instance, like, you know, releases of data, and appropriate releases of data or inappropriate use of data mining or something like that. And things like Wikileaks, which will be some people think a disaster or something, people think that the best thing that ever happened to human beings, you know, so that might be useful, but I don't think we should be lecturing them on ethics." (L8)

I will now present the findings from the student questionnaire in the next section.

4.2.4.2 STUDENT PERSPECTIVE: QUESTIONNAIRE

To elucidate research question 3, the students were asked specific questions which were tailored to decipher the students' level of knowledge with regards to the social aspect of information systems. These questions were concerned with information system definitions, information systems examples, and scrutinising the output of an information system. Firstly, the students were presented with six standard definitions for an information system (Table 4.4). The aim of this question was to identify a student's broad understanding of what an information system is. An understanding of levels 1-6 is hierarchical and are inclusive of lower levels (Cope and Prosser, 2005). Four of these definitions (levels 1-4) were focused solely on the technical aspect of information systems while the remaining two definitions (levels 5 and 6) contained limited social aspects of information systems. It was these two latter definitions that were deemed more attractive in terms of learning outcomes for students. As can be seen from Table 4.4 10 students selected level 5 and 7 students selected level 6. Both these levels demonstrated a level of understanding of the social aspects of information systems. It can also be seen that 3 students selected a technical focus for the definition.

Table 4.4 Information Systems Definitions

Level	Meaning	Student Selection (n)
6	A number of communicating information systems within a single organisation	7
5	A computerised data manipulation system and people gathering data, disseminating information, and communicating to support a single organisational function.	10
4	A computerised data manipulation system supporting many people within a single organisational function.	3
3	A data manipulation system supporting an individual within a single organisational function	0
2	A simple information retrieval system.	0
1	A personal search of a static information source	0

The students were then probed further to provide a ranking for what they thought were the most and least appropriate definitions for an information system. As can be seen from Figure 4.6, 65% of students selected level 5 as their most appropriate definition and 80% selected level 1 as their least appropriate definition.

When asked why they had selected their choice for the least suitable definition there was a consensus amongst students that the definition was too simplistic, narrow and was devoid of the social aspects of information systems:

"Firstly, an information system is not typically designed and developed for a single individual. Secondly, an information system is very rarely a static information source. An information system is dynamic, constantly updating, transforming, and manipulating the data. Finally, people are core for all of the aspects that I have mentioned." (S6)

"A personal search of a static information source is ranked number 6 as an information system is much more than that. It involves all individuals and groups, not just one personal search. The information will always be updating." (S10)

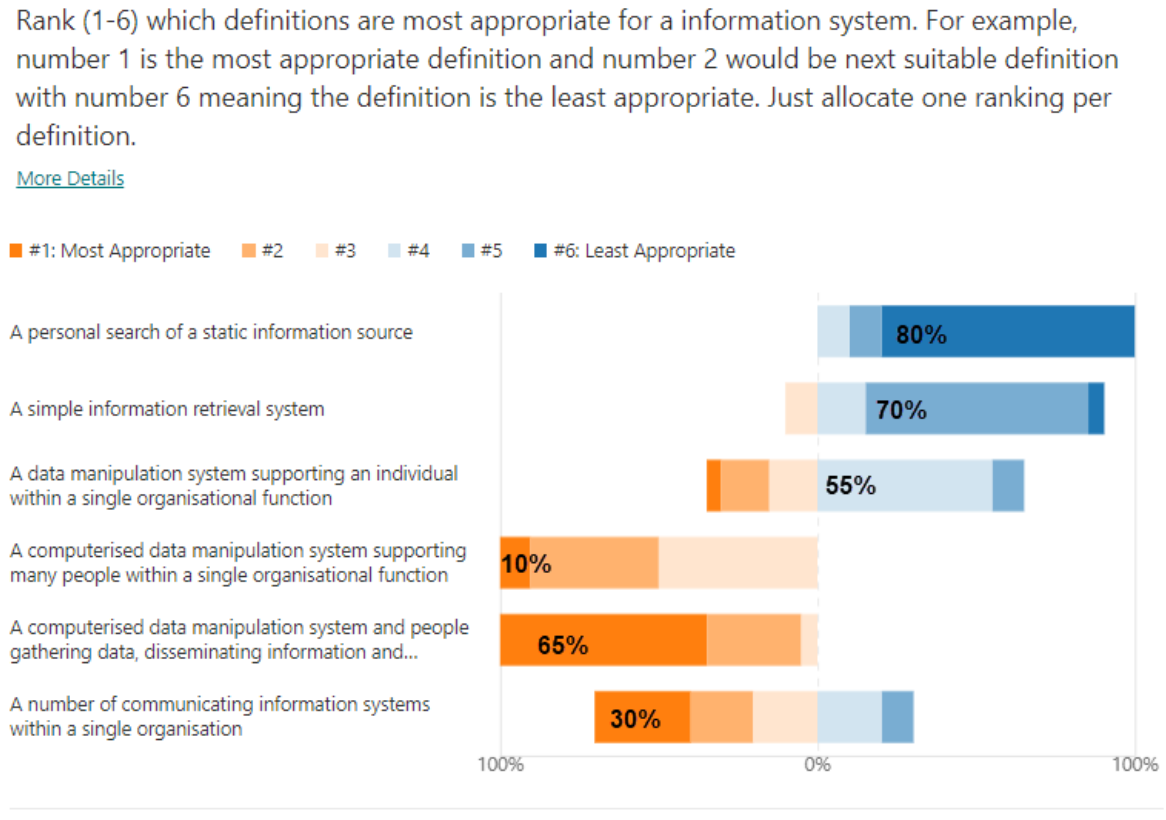

Figure 4.6: Most Appropriate Definitions for an Information System

Figure 4.7 highlights the number of selections for specific examples of information systems. Only 1 student selected the only incorrect answer which was ‘A tutorial group involved in a class discussion’. Interestingly only 12 students selected the ‘An ATM’ as an example and only 9 students selected the ‘A large bank’ as an example. Both examples represent entities which utilise sophisticated information systems as part of the day to day operations. The students’ justifications for not selecting actual examples highlighted a level of uncertainty in their understanding as to what an information system was:

“A student enrolment procedure where there is no system mentioned means it could just be written by hand manually. A large bank as a whole is an organisation that may contain various information systems but it, itself is not an information system.” (S13)

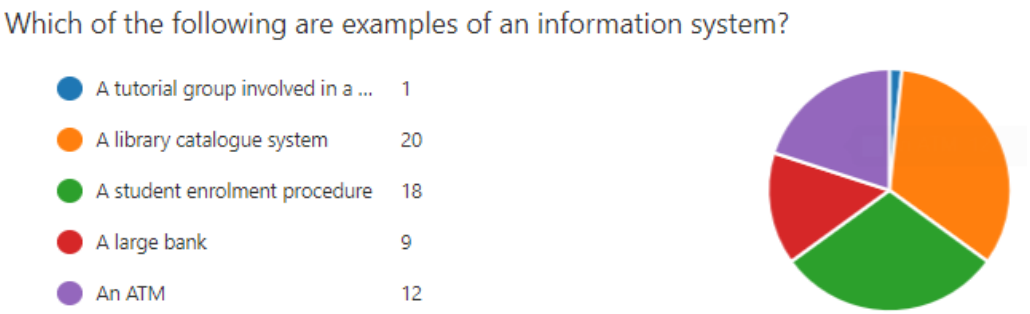

Figure 4.7: Correctly Identifying an Information System

Figure 4.8 depicts the table output of a specific parcel delivery information system. This table is intended to be used by customers to calculate the cost of sending letters and parcels. The two determining factors for determining the cost are parcel weight and the distance the parcel is to be mailed. As can be seen, the table is purposely nebulous pertaining to the calculations of the total price for sending the parcel. The students were tasked with calculating the cost to send a parcel weighing 150gms a distance of 375kms. The correct answer is €16.00. The main aims of this task were to first determine if the students could correctly calculate the cost of a specific parcel delivery. Second, the students were asked where the table would likely have come from. In this case, the correct answer is an employee for the company who has used an information system to create the table which contains embedded calculations. With regards to the first task, only 8 students correctly answered 16. In terms of the second task while the majority of students guessed that the table was associated with a

delivery company only 3 students alluded to the specific information system that may have created (e.g., excel, database, decision support system) the table with only 1 student alluding to the possibility that an employee would have created the table as an information source for customers to make decisions.

Using the Table below calculate how much would it cost to send a parcel of weight 150gms a distance of 375kms? Enter your answer below. *

Postal rates for parcels

Distance (kms)	Weight (gms)			
	Up to 50	125	250	500
Up to 50	1.70	3.40	6.00	10.50
250	2.25	4.50	8.00	14.50
500	4.50	9.00	16.00	28.00
1000	7.50	15.00	26.00	46.00

Figure 4.8 Student Information Systems Challenge

The students were also asked if the table was well designed. 14 students acknowledged that the table was not well designed. Most of these students also offered recommendations on how the table could be improved:

"It would make more sense to make the fields 50-125, 125-250, etc. Errors could easily occur with this table." (S8)

"One improvement that could be added is arranging specific ranges e.g., 50-125gms, 126-249, etc same for each distance." (S12)

However, none of the students recommended that the table should have been user tested involving a sample of the demographic that would be using the table. This is a core facet of developing information systems outputs to ensure that they can be used correctly and efficiently.

Finally, the students were asked if the human side of information systems is important. 18 students answered yes to this question. When asked why they had selected that option there was a consensus that humans design and use systems and therefore are important aspects:

“Humans must design the system properly for it to work well and input the right type of data. The system is only as good as the people who are using it.” (S8)

The findings from the student focus group are now presented in the next section.

4.2.4.3. STUDENT PERSPECTIVE: FOCUS GROUPS

To elucidate research question 3, the focus group participants were asked a number of specific questions relating to their work placement experience which provided insights into their understanding relating to their understanding of the social aspects of information systems. Firstly, the students were asked if anything had caught them by surprise during their placement when working with information systems development teams. It was interesting to note that socialization, and specifically the communication, was identified by all participants as being troublesome:

*“I enjoyed the experience, although I did find it hard sometimes to communicate and integrate with those working in the company.” (*F8)

Once again it was interesting to note the impact of Covid19 which seemed to exacerbate the focus group participants communication issues with other teams’ members:

*“Communication and teamwork in a virtual office was tricky as we could no longer work in the same room in a casual or informal way that we had gotten used to pre-covid.” (*F4)

Next, the focus group participants were also asked how they found working with other professionals for the first time. As highlighted by Figure 4.9 communication skills were once again identified.

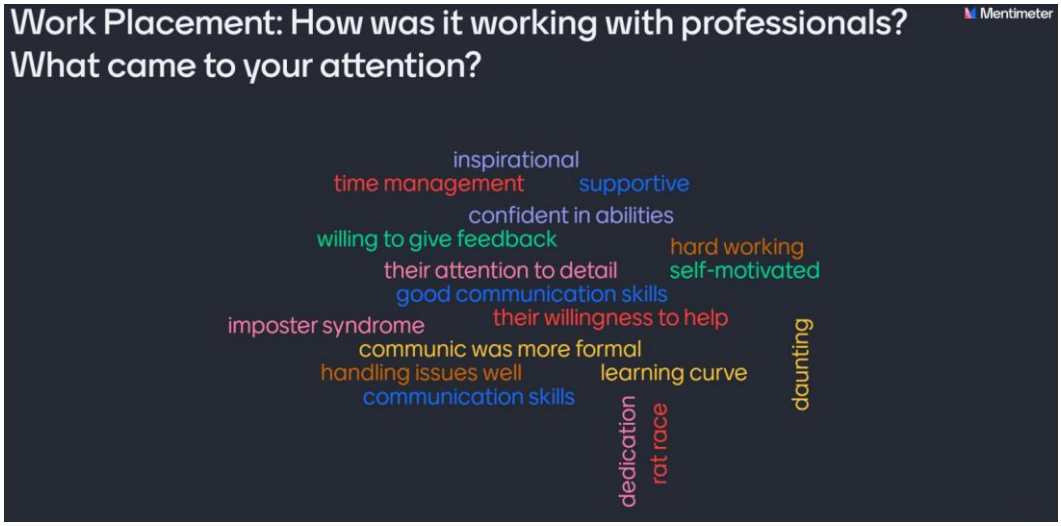

Figure 4.9: Working with other information systems professionals

When they were asked how they could be best prepared for honing their skills for the social aspects of working in information systems development teams, communication skills, networking, and conflict resolution were identified (Figure 4.10).

Figure 4.10: Student Workplace Preparation Skills

Delving deeper into this question revealed the various additional supports that the students identified that they would have liked to have received before commencing their work placement such as having a buddy system in the work placement and regular meetings with other students to report on each other's experiences:

“I was appointed a buddy on day 1 of my work placement and he really helped me settle in quickly. I know this was not the case for everyone so I would strongly recommend this should be a mandatory approach for future work placements.” (F5)

“A regular meeting with everyone else in the class on work placement in different companies to compare experiences.” (F7)

“A learning support point of contact in my team. Someone who could aid in where I should focus my learning attention to get up to speed with the team's processes.” (F2)

When probed about ethical considerations, the students acknowledged that they struggled to get their heads around how the technologies or information systems that they would be developing in the future would impact the end-user:

“We briefly covered ethics during the four years of the course. However, if I am being paid to develop software for a product it should not be my role to justify the ethics of it. That should be the company’s role. I did not encounter anything to do with ethics during my work placement.” (F3).

Ultimately, the data revealed while the students were aware of specific ethical aspects such as GDPR they were unaware of the potential ethical ramifications that could manifest because of their involvement in the design of an information system or technology. The majority of the students assigned the ethical responsibility to their future manager or their future employer. This finding was somewhat surprising as one of the core features of information systems development is human-centred design which has ethics as a core foundational underpinning.

4.3 CONCLUSION

The objective of this chapter was to provide a detailed overview of key research findings which emerged from the lecturer interviews, student questionnaire and student focus groups in relation to all the research questions posed in this study. The research findings were detailed in a sequential manner starting with research question 1 and ending with research question 3. The findings in relation to research question 1 revealed macro issues which manifested for students when learning about information systems from a threshold concepts and troublesome knowledge perspectives. On a macro level these issues related to technical, theory and language aspects. At a micro level database design and business process modelling were identified as topics which students encounter difficulties with when learning about information systems. In terms of research question 2 the findings highlighted how students used peer learning, lecture support and self-learning to traverse the liminal space when encountering threshold concepts and troublesome knowledge. Finally, the findings in relation to research question 3 identified the significance of learning about the social aspects information systems. On a positive note, the students were able to acknowledge the importance of the social aspects when learning about information systems. However, the data also revealed issues relating to communication, networking, and conflict resolution which students encountered when working in information systems development teams during their work placements. Finally, it was interesting to note how Covid19 had hindered the learning experiences of students over the past 12 months. The next chapter will discuss how the key findings presented in this chapter align with the extant literature and the study's overall research objective. This chapter will also recommend areas for future research.

CHAPTER FIVE: RESEARCH DISCUSSION, CONTRIBUTIONS, LIMITATIONS AND CONCLUSION

5.1 INTRODUCTION

This study was tasked with identifying and exploring Galway-Mayo Institute of Technology (GMIT) final year business information systems (BIS) undergraduate students' understanding of information systems using two main parameters: threshold concepts and troublesome knowledge. This research objective was examined using several research questions. The study used a case study approach comprising a mixed method research approach using three research phases. Lecturer interviews were conducted in phase 1, the results of this phase were used to develop a questionnaire which was administered to BIS students in phase 2. The final phase 3 involved the use of an online focus group interview with BIS students. This final chapter is structured as follows. Section 5.2 discusses and aligns the main findings for the several research questions in relation to the extant literature. Section 5.3 outlines the study's theoretical and practical contributions. Section 5.4 provides a summary of possible future research which could be operationalised based on this study. Section 5.5 outlines study limitations and finally the study concludes in section 5.6.

5.2 DISCUSSION

Figure 5.1 reintroduces the relational view of the features of threshold concepts model which was introduced in Chapter 2 in Figure 2.4. The model is used again for Figure 5.1, but this time its main role is to summarize the main study findings around which the following discussion will be scaffolded.

In terms of the findings in relation to the preliminal mode, several threshold concepts were identified which included database design, business process modelling, and social systems. Within each of these threshold concepts, the study identified specific troublesome knowledge relating to each of these several threshold concepts. To recap, the preliminal mode represents a student's first encounter with a threshold concept and the troublesome knowledge associated with it (Land and Meyer, 2010). For example, this study has demonstrated that when BIS students first encounter the threshold concept of database design, the troublesome knowledge of normalization

and entity relationship theory embedded within the threshold concept "serves here as an instigative or provocative feature which unsettles prior understanding rendering it fluid and provoking a state of liminality" (Land and Meyer, 2010, pg.,9). This process of provoking a state of liminality also occurs for students when encountering the threshold concepts of business process modelling and social systems.

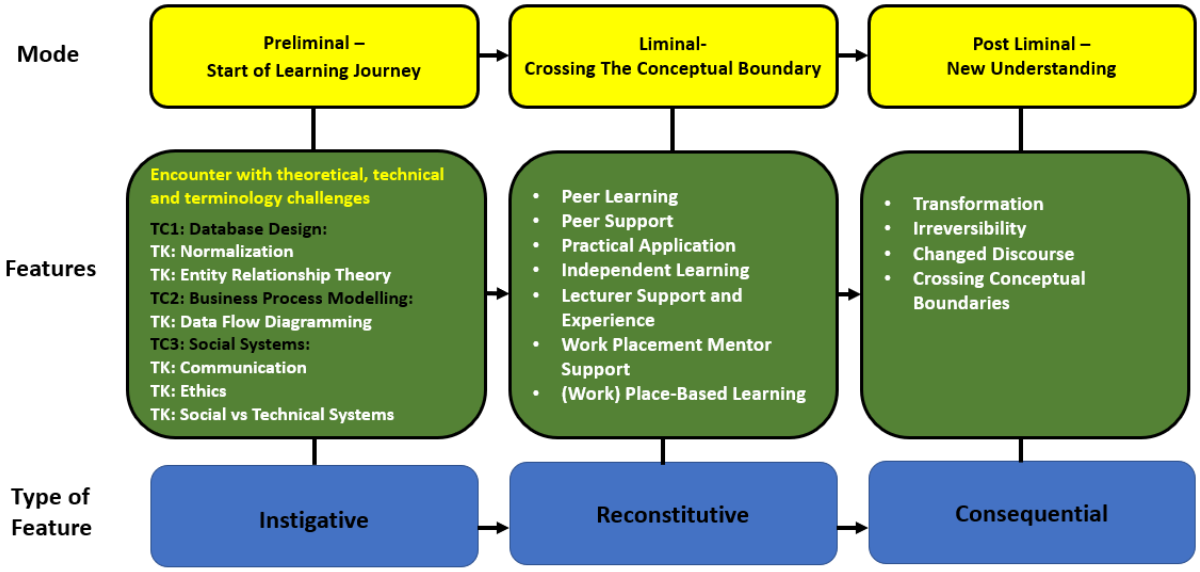

Figure 5.1: Study Findings (TC= Threshold Concept, TK= Troublesome Knowledge)

Next, the learner enters what is known as a liminal mode where the student uses a multitude of learning supports to integrate new knowledge with existing knowledge. In this process a learner's previous understanding of a concept(s) may be discarded (Land and Meyer, 2010). In the context of this study, the data analysis revealed how threshold concepts which the students encountered in the preliminal mode fell under the umbrella of **theoretical aspects, technical aspects, and the terminology** used within the discipline relating to learning about information systems. From a theoretical and technical aspects point of view, **peer learning and support** (e.g., teams-based continuous assessments), **practical application** (e.g., project that mirrors real life industry projects), **independent self-learning** (e.g., reading supplementary materials) and **lecturer support and experience** (e.g., real time feedback, more experienced other) play crucial roles in enabling students to overcome the troublesome knowledge associated with threshold concepts. This findings are significant as there is a dearth of extant research which has focused on how BIS students cope with threshold concepts and troublesome knowledge and students' approaches to learning plays a

significant role in their ability to traverse the liminal space (Perkins, 2006). Additionally, some students “will resort to rote memory and routine procedures as a way of coping. They will try to learn enough about ideas, explanations, and alternative perspectives to pass the test without developing and real insider feel “(Perkins, 2006, pg. 37). This “real insider feel” refers to a student’s ability to operate within their community of practice. This process can be discussed through the lens of Vygotsky’s (1978) concept of ZPD, in which students are guided through their learning with the assistance of a more **experienced other**, it is also important for educators to consider the two aspects of learner development associated with ZPD: the natural line (e.g., intelligence quotient) and the schooled line of development (e.g., what is learned in the community or from an expert other). For example, with regards to the former natural line, it would be important for a lecturer to teach the theoretical and technical aspects of IS in a way that would enable the BIS students to traverse the liminal space. This would involve the students transforming from novice to expert with the assistance of the experienced lecturer. However, the teaching must be appropriate to the student’s innate level of intelligence. In other words, a lecturer would not teach 4th year theoretical and technical concepts to 1st year students. Thus, there must be a scaffolded approach to the student’s learning. An experienced work placement mentor also has an important role to play in assisting a BIS student traversing the liminal space and this will be highlighted later in this discussion.

The data also revealed that the **terminology** (e.g., language) used within the discipline is important and highlighted the need for the development of a lexicon of terms which are troublesome for BIS students. This lexicon will also be beneficial for lecturers in that it will educate them and remind them that every subject within the BIS discipline has its own language and discourse. This resonates strongly with the work of Vygotsky (1994) who states that “thought development is determined by language i.e., the linguistic tools of thought and the sociocultural experience of the [learner].” For instance, words and terms that are introduced by the lecturer in class (e.g., outer speech) are then used and practiced by the BIS students and becomes internalized (e.g., internal speech) which helps them to shape their understanding of a threshold concept and troublesome knowledge. **Language is key to this transformation** of outer speech to internal speech (Vygotsky, 1994). This process also holds true for BIS students who are on work placements where their manager and work colleagues now

become the vehicles for outer speech. However, the data revealed that the ability of a BIS student to internalise new learning may be comprised due to specific social system threshold concept troublesome knowledge which we will now discuss.

It was interesting to note the troublesome knowledge features (e.g., ethics, social vs technical systems, and communication considerations) which manifested for the threshold concept of social systems. The **troublesome knowledge consideration** of communication manifested strongly for the BIS students during their remote GMIT learning and work placement experiences because of Covid19. This consideration resonates not just for BIS students, but for all students in general. From a GMIT remote teaching and learning experience, the students had to acquaint themselves with the nuances of online learning (e.g., working from home, working with peers on projects remotely) over the past 12 months. The data revealed that students often struggled with these nuances and this impacted on their ability to traverse the liminal space when encountering threshold concepts and troublesome knowledge. Consequently, the flexibility of learning and the manner with which language is used in a remote teaching and learning environment becomes important and should be considered by lecturers when teaching IS to BIS students.

From a work placement perspective, the students' new remote working environment required the students to communicate, network, and socialize (virtually) with new colleagues. According to Vygotsky (1986; pg.108) this form of new socialization is significant for learners whereby, "The tasks with which society confronts a [learner] as he or [she] enters the cultural profession undoubtedly become an important factor in the emergence of conceptual thinking." The students were also tasked with new challenges and work practices which in most cases would have been alien to them. This can lead to the manifestation of **professional troublesome knowledge** (Perkins, 2006) considerations which can inhibit a student's ability to learn the language associated with being a professional. The manner with which students can overcome these troublesome knowledge considerations can be assisted with the introduction of a designated experienced mentor in work placements who can guide BIS students through the liminal space so that they learn the language of the profession and the creation of a [work] place-based learning specific module(s) within the curriculum. This new module would involve "a shift in learning from the traditional content and instead looks at a [helping] students build on content knowledge while also developing

empathy and social-emotional learning skills…these opportunities foster student agency" (Dene Poth, 2019). The emphasis here would be to incorporate specific socialization learning outcomes with this module(s) which would prepare students for their work placements which would enable them to **know the language** of the community and assist them to **talk the talk** within the community while on work placement. Furthermore, the addition of ongoing supports (e.g., peer meetups) for students while they are on work placements would be beneficial. This [work] place-based learning module(s) would answer the questions posed by Wenger's (1998) several dimensions for preparing, connecting, and sustaining a student's learning within their professional community of practice.

Once a learner successfully crosses the conceptual boundary of the liminal space, they will have undergone an ontological/epistemological shift (e.g. the understanding of knowledge, and figuring out what is important) in their understanding of a threshold concept and they will arrive at a new conceptual space referred to as a post liminal phase (Land and Meyer, 2010) which comprises the consequential aspects of threshold concepts: transformation, irreversibility, changed discourse, and crossing of conceptual boundaries. For example, once a BIS student is first introduced to the threshold concept of database design, they will encounter the troublesome knowledge of entity relationship modelling and normalization. Using the liminal phase features identified in Figure 5.1 their conceptual understanding of how databases can be designed will be changed irreversibility and they will be able to use a new and changed discourse within their community of practice. Failing to cross the conceptual boundary may result in the student be constrained or inhibited with the community of practice (e.g., poor database design methods).

One caveat that must be noted for the relational view of threshold concepts depicted in Figure 5.1 is that "the acquisition of threshold concepts often involves a degree of recursiveness, and of oscillation, which would need to be layered across this simple diagram" (Land and Meyer, 2010, pg.,9).

That is for students to traverse the liminal space successfully and repeatedly when encountering threshold concepts and troublesome knowledge throughout their professional and academic learning that a **structured approach is taken to curriculum development** that embodies:

- consistent use of discipline and professional language,
- practice and repetition of threshold concepts and troublesome knowledge;
- exposure to environments where the threshold concepts and troublesome knowledge can be teased out and questioned;
- exposure and refinement of skills within a community of practice.

There is also an underlying game inherent to the model which is often required for entering a community of practice (Land and Meyer, 2010). This underlying game "in which ways of thinking and practising that are often left tacit come to be recognised, grappled with and gradually understood. This underlying game is a common feature of the processes of entry, meaning making and identity formation typically required for entry to a given community of practice" (Land and Meyer, 2010). Returning to our example of students encountering the troublesome knowledge of normalization and entity relationship theory when they are first introduced to the concept of database design, their journey as a class cohort may not be universally linear in progression as depicted in Figure 5.1. Some students may go back and forth between the preliminal and liminal spaces. Furthermore, some students may progress faster than others (e.g., learning pacing) through (refer to Figure 2.3) their learning journeys (Wu et al., 2012) and some students may have varying levels of self-efficacy (Bandura, 2010). It is important for lecturers to know that a **student's experience of the liminal space can be characterised by states of feeling confused, threatened, and uncomfortable** (Land and Vivian, 2014). A lecturer's experience in identifying when a student is struggling with the troublesome knowledge associated with a specific threshold concept becomes of significant importance. Failure to do so may constrain a student's ability to cross the liminal conceptual boundary which may have knock-on consequences being part of their community of practice.

5.3 FUTURE RESEARCH

The case study reported in this research contains rich findings, which were explored from the merging perspectives of both lecturers and students, it only focused on GMIT 4th year BIS students. It does not consider other Irish or International third level higher education BIS programmes, and modules. Consequently, one area ripe for future research could be to replicate this study within another Irish third level institution. This would enable the comparison of the findings at an Irish third level education context. It would also be interesting to replicate the study at a third level education institution outside of Ireland. As stated earlier in the literature review there is a dearth of research which has examined threshold concepts and troublesome knowledge from a BIS perspective. There is also an opportunity to replicate this study using the same case study approach which would add a longitudinal dimension element to the research. It would also be interesting to analyse the research objective and several research questions in a non-covid19 environment and juxtapose the findings of this new study with the findings of this study. On a personal note, I intend to incorporate the research findings from this study into my own discipline. This will take the form of (1) the development of a glossary of challenging BIS concepts within the discipline and (2) the identification of how threshold concepts inform continuous assessment tasks.

5.4 STUDY LIMITATIONS

Section 1.4 outlined the main study limitations that were considered prior to the commencement of the study including the generalizability of a case study approach, the possibility of biases occurring (e.g., insider bias), limitations associated with a mixed method research instruments approach and the complexity of the terminology associated with threshold concepts and troublesome knowledge. Protocols were used through the study to control the impact of these limitations on the findings. For example, the insider bias was limited by ensuring a level of appropriate critical distance and ethical considerations (Cassell et al., 2017). Following a post study critical reflection, I have outlined some possible additional limitations that merit consideration. Once again, protocols were put in place to ensure that their impact was minimal.

First, I would like to acknowledge the possible impact of Covid-19 on the research process. For instance, traditionally I would have conducted the lecturer interviews and the student focus group interviews face-to-face. This was not possible because of

government Covid-19 restrictions. In terms of the lecturer and student focus group interviews, they were conducted on Microsoft Teams. Both I, the lecturers and the students were comfortable using Microsoft Teams and no learning curve was needed to administer the interviews. According to Deakin and Wakefield (2013) conducting online interviews have the following benefits which include enhanced accessibility and freedom for research informants to participate in a study as they do not need to travel to a specific location. The research participants may also feel more comfortable in their own surroundings and this can have a positive impact in terms of elucidating research findings. There are also logistical and budget benefits from a researcher perspective. However, there are also some disadvantages when conducting online interviews which must be considered. According to Lo Lacono, Symonds, and Brown (2016) it can be difficult for researchers to create a rapport with research participants which could impact the richness of the interactions. To counteract this limitation, I used my experience as a qualitative researcher to make all the research participants feel comfortable before diving into the main study questions. For example, when conducting the student focus group interview, I used ice breaker questions which were deployed on Mentimeter to make the students comfortable in their online focus group setting.

Second, I would like to acknowledge the impact of Covid-19 on the findings. From March 2020, all GMIT Staff and students operated online in line with Government mandated Covid-19 restrictions. There was a period of online training for both staff and students so that they could become accustomed to this new form of teaching and learning. For some staff and students this shift to online teaching and learning was significant as most of them would not have taught or learnt online before. As indicated by the findings the students identified that they missed the personal connection between themselves and the lecturer in a traditional classroom environment where they could get assistance if they encountered a challenging topic in real time. For example, in some cases, the students found the use of pre-recorded videos and having to communicate with lecturers via email and waiting for a response frustrating. This lack of teaching in traditional classroom environments may have resulted in a student's encounter with a threshold concept or troublesome knowledge becoming exacerbated and prolonging the time it took them to cross the liminal space. In some cases, they maybe still encountering challenges with threshold concepts and

troublesome knowledge because of online teaching and learning. Additionally, it is important to consider the impact Covid19 would have had on the students' work placement experience which was once again replaced with a remote online working experience. This led to the emergence of novel threshold concepts and troublesome knowledge, as indicated in the findings, that the students may not have been prepared for such as communicating with work colleagues in an online setting and using tools and technologies for facilitating the online work practices of the teams that the students would have been working with. Ultimately, it is important to acknowledge the impact of Covid19 on both the findings and the research process as aspects arose during the study which may not have arisen if the Covid19 global pandemic had not occurred.

5.5 CONCLUSION

This case study explored both staff members' and students' perspectives of threshold concepts and troublesome knowledge when teaching and learning about BIS. Staff identified a number of macro level higher level threshold concept's themes which were associated with the teaching and learning about BIS. These themes could be categorised as being theoretical, technical, and terminological based. Within these categorizations the staff identified specific threshold concepts and troublesome knowledge. These findings were used, in conjunction with extant research, to elicit the perspective of students on challenging topics contained with the BIS programme and identify how they overcome these challenges (e.g., traverse the liminal space). The students identified specific threshold concepts and troublesome knowledge contained within the programme at a module level and at a work placement level. These findings will be used to enhance individual BIS course design and the development of awareness initiatives which spotlight these threshold concepts and troublesome knowledge so that staff can share a common understanding of them which will ultimately enhance the teaching and learning of BIS throughout the department. The researcher also intends to use the study findings to develop a pilot lexicon of terminology relating to threshold concepts and troublesome knowledge. For example, the findings in relation to the threshold concept of database design necessitates that this pilot lexicon of terminology will need to include descriptions relating to entity-relationship theory and normalization. Flagging these terms to both lecturers and students at the start of a semester will bolster their ability to overcome these

challenging concepts by putting in place supports to assist students with their learning. Ultimately, threshold concepts have the potential to assist departments to (re)design curriculum, particularly during programmatic review and new programme development, and assist with a shared understanding amongst staff and students of their existence which will enhance staff teaching and student learning.

CHAPTER SIX: BIBLIOGRAPHY

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APPENDICES

Appendix A: Lecturer Interview Guide

Semi-structured Interview Questions
Introduction:

- Welcome and thanks for participating
- Questions about study
- Recording Consent
- Format of Interview

Study Questions:

Orientation and Teaching Experiences

I would like you to reflect on your career as a business information systems teacher. As part of that reflection, I would like to explore your teaching experiences with students in the context of information systems.

Q1. For how long you have been teaching?

Q2. For how long you have been teaching information systems?

Q3. How do you define the concept of information systems? For example, one widely accepted definition from the literature is that an information system is "a formal, sociotechnical, organizational system designed to collect, process, store, and distribute information. In a sociotechnical perspective, information systems are composed by four components: task, people, structure, and technology." (O'Hara et al., 1998).[2]

Q4. How would you describe yourself as a lecturer in information systems to someone who is not familiar with the area?

Q5. What are the main (a) educational and (b) personal goals of your teaching in information systems?

Q6. What concepts are essential to the understanding of information systems?

Q7. What concepts do students become stuck in/find challenging to grasp? In your opinion, why do the students find them difficult?

Q8. [for each concept in Q7] Specific to these areas that you have identified, how have you observed learners begin to understand these difficult ideas/concepts?

a. How has the process taken place (gradually or suddenly)?

[2] O'Hara, M. T., Watson, R. T., & Kavan, C. B. (1999). Managing the three levels of change. *Information Systems Management*, *16*, 63-70.

b. How have you supported their learning (e.g., help them become unstuck?)
c. What else has been helpful in getting them to understand these difficult ideas/concepts? (e.g., aspects of the learning environment, teaching strategies, curriculum that are most helpful).
d. What are the cognitive difficulties for them in understanding these difficult ideas/concepts?

Q9. What concept(s) are challenging to teach? For example, for me it was teaching data flow diagrams and the ability to break simple business processes systems down into more complex diagrams. How did overcome your understanding of that concept(s)? For me, it was developed through experience over the years of teaching different case studies.

Q10. Are you expecting any great gains or breakthroughs in understanding concepts in information systems from your students? If Yes, what kind?

Q11. From an intellectual skills perspective, what differentiates top performing information systems students from other information systems students?

Specific categories [use only if not addressed with answers to questions above]
Please consider challenging concepts and teaching strategies in the following areas:

- Technical aspects of information systems
- Social system aspects of information systems
- Use of terminology in information systems

Conclusion:

- Would you like to make any additional comments about information systems learning, challenging concepts, etc.?
- Thanks for participating

Appendix B: Email sent to Lecturers

From: Trevor Clohessy <Trevor.Clohessy@gmit.ie>
Sent: Tuesday 10 November 2020 16:36
To: Anonymised
Subject: Study Information Sheet and Consent Form

Dear Anonymised,

I hope all is well.

Following up for our initial conversation regarding my MA in Teaching and Learning study I would like to say many thanks again for your interest in the study. I have attached a study information sheet and a study consent form. If you could read the study information and consent forms email me back a signed consent form and your availability to conduct the interview, I will be able to schedule a time and date. In the meantime, if you have any questions regarding the study please do not hesitate to contact me via email or Microsoft Teams.

Thanks a million again it would be great to get your insights,

Best Regards,

Dr Trevor Clohessy,

Department of Enterprise and Technology,

Galway Mayo Institute of Technology,

Republic of Ireland.

Appendix C: Participant Information Sheet

PARTICIPANT INFORMATION LEAFLET

1. Working Title of the Study:

Identifying threshold concepts and troublesome knowledge in information systems: Insights from a business information system community of practice.

2. Introduction to the Study:

I am currently conducting research for the MA in Teaching and Learning in Galway-Mayo Institute of Technology (GMIT), Galway. The purpose of the research is to determine final year business information systems attitudes to the teaching and learning of information systems. I invite you to participate in a research study entitled 'Identifying threshold concepts and troublesome knowledge in information systems: Insights from a business information system community of practice.'

3. Research Procedures:

GMIT final year business information systems students have been chosen for this research because of their knowledge and experience of being taught information systems over the course of their degree.

Lecturers have been selected for this research because they will be able to provide knowledge of the teaching related information systems issues that occur in the classroom that will have relevance to the manner with which information systems is taught.

Participation for lecturers involves taking part in an interview which will take approximately 30-60 minutes. A copy of the interview questions and an information consent form will be sent to all participants.

4. Benefits of the Research:

It is hoped that the research can produce insights that will allow for the (re)design of the manner with which information systems is learned (student benefits) and taught (lecturer benefits) within the business information systems curriculum.

5. Risks of the Research:

There are no physical risks from participating in this study. There is an ethical tension that exists because the data is being collected from students that I am currently teaching. Mechanisms will be put in place to ensure that protective measures will be put in place for all research procedures so that they are conducted with integrity.

Appendix C: Participant Information Sheet

1. Exclusion from Participation: Your participation in this research project is completely voluntary. You may decline altogether or leave blank any questions you do not wish to answer.

2. Confidentiality: No identifying factors relating to participants will be in evidence in the final thesis report and/or any disseminated research (i.e. conference papers and/or presentations, publications, etc.). Those who will have access to your identity include members of the Research Advisory Panel, internal examiners and external examiner(s). Your responses will remain confidential and anonymous. Data from this research will not be available to anyone but myself.

3. Compensation: This study is covered by standard institutional indemnity insurance. Nothing in this document restricts or curtails your rights.

4. Voluntary Participation: You have volunteered to participate in this study. If you wish to withdraw, please contact the researcher within one month of initial participation. If you decide not to participate or if you withdraw you will not be penalised and will not give up any benefits that you had before entering the study.

5. Stopping the Study: You understand that the researcher(s) may withdraw you from participation in the study at any time without your consent.

6. Permission: This research has approval from the MA in Teaching & Learning Research Ethics Committee, GMIT.

7. Further Information: You can get more information or answers to your questions about the study, your participation in the study and your rights, from Dr Trevor Clohessy who can be e-mailed at trevor.clohessy@gmit.ie

8. New Information Arising: If the researcher or members of the Research Advisory Panel learn of important new information that might affect your desire to remain in the study, or if any conflicts of interest emerge during the course of the study, you will be informed at once.

Appendix D: Study Consent Form

INFORMED CONSENT FORM 1:

INDIVIDUAL RESEARCH PARTICIPANTS

Working Title:

Identifying threshold concepts and troublesome knowledge in information systems: Insights from a business information system community of practice.

Principal Researcher: Dr Trevor Clohessy

Background to the Study:

This study will investigate:

) how the teaching and learning of information systems as a topic can be challenging.
) the information systems teaching related issues in classroom.

The study will explore how final year business information students encounter and manage challenging concepts and knowledge when learning about information systems. Interviews will also be conducted with lecturers. It is hoped that these insights from the two cohorts mentioned will assist with the (re)design of how information systems are taught throughout the business information systems degree. Data will be gathered from students via a questionnaire and a focus groupg. Data from lecturers will be collected using interviews.

Participant Declaration (Tick 'Yes' or 'No', as appropriate.)

I have read or have had the information sheet read to me and I understand the contents.	**Yes**	**No**
I have been given an opportunity to ask questions and am satisfied with the answers.	**Yes**	**No**
I have given consent to take part in the study.	**Yes**	**No**

I understand that participation is voluntary and if I wish to withdraw, I can do so within one month of initial participation.	**Yes**	**No**
I understand that withdrawal will not affect my access to services or legal rights.	**Yes**	**No**
I consent to possible publication of results.	**Yes**	**No**
I (the participant) give my permission for the data obtained from me to be used in other future studies without the need for additional consent.	**Yes**	**No**
Researcher Declaration (Tick 'Yes' or 'No', as appropriate.)		
I have explained the study to the participant.	**Yes**	**No**
I have answered questions put to me by the participant about the research.	**Yes**	**No**
I believe that the participant understands and is freely giving consent.	**Yes**	**No**

Participant Statement:

I have read or had read to me this consent form. I have had the opportunity to ask questions, and all my questions have been answered to my satisfaction. I freely and voluntarily agree to be part of this research study, though without prejudice to my legal and ethical rights. I understand I may withdraw from the study within one month of participation. I have received a copy of this consent form.

Participant Name:

Contact Details:

Participant Signature:

X

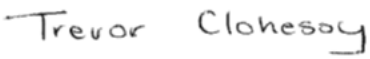
_____

Date: xy/11/2020

Researcher Statement:

I have explained the nature and purpose of this research study, the procedures to be undertaken and any risks that may be involved. I offered to answer any questions and have fully answered such questions. I believe that the participant understands my explanation and has freely given informed consent.

Researcher Signature:



_____

Trevor Clohessy

Date: 09/11/2020

Appendix E: Questionnaire used in Study

Information Systems Study

This questionnaire asks you to describe your personal experiences of learning about information systems during your business information systems degree. Please provide thoughtful and detailed answers to each question.

Section 1

Background Information

1

I have read the participant information sheet and I understand the contents

- Yes
- No

2

I consent to take part in this study

- Yes
- No

3

I understand that participation is voluntary, and I can withdraw at any time

- Yes
- No

4

I consent to the possible publication of the results *All data will be anonymized*

- Yes
- No

5

Gender

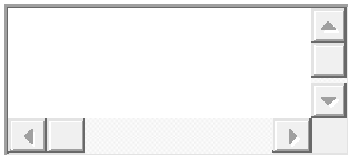
- Male
- Female

Section 2

Part A

6

Why did you decide to do a degree in Business Information Systems? What was your motivation?



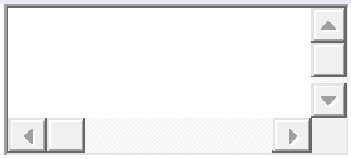
7

Which of these descriptions best define what an information system is?

- A personal search of a static information source
- A simple information retrieval system
- A data manipulation system supporting an individual within a single organisational function
- A computerised data manipulation system supporting many people within a single organisational function
- A computerised data manipulation system and people gathering data, disseminating information and communicating to support a single organisational function
- A number of communicating information systems within a single organisation

8

Give a detailed reason for your selection in Question 7 above.



9

Rank (1-6) which definitions are most appropriate for a information system. For example, number 1 is the most appropriate definition and number 2 would be next suitable definition with number 6 meaning the definition is the least appropriate. Just allocate one ranking per definition.

	#1: Most Appropriate	#2	#3	#4	#5	#6: Least Appropriate
A personal search of a static information source	○	○	○	○	○	○
A simple information retrieval system	○	○	○	○	○	○
A data manipulation system supporting an individual within a single organisational function	○	○	○	○	○	○
A computerised data manipulation system supporting many people within a single organisational function	○	○	○	○	○	○
A computerised data manipulation system and people gathering data, disseminating information, and communicating to support a single organisational function	○	○	○	○	○	○
A number of communicating information systems within a single organisation	○	○	○	○	○	○

10

Provide a detailed reason why you deemed one of the definitions above to be the least suitable (ranked number 6) of all for an information system.

11

Which of the following are examples of an information system?

- [ ] A tutorial group involved in a discussion
- [ ] A library catalogue system
- [ ] A student enrolment procedure
- [ ] A large bank
- [ ] An ATM

12

For the items that you did not select in Question 11, explain why they are not an IS.

13

After studying business information systems for the past 4 years: (a) What do the words 'information system' mean to you? and (b) provide the best example of an information system that you learned about during the course.

Section 3

Part B

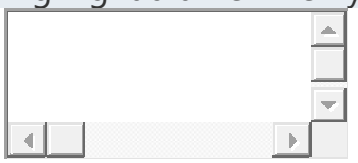
14

During your 4 years, what has been your most favourite topics/aspects in terms of learning about information systems? Explain why.

15

During your 4 years of learning about information systems what has been the most challenging topic or topics that you have encountered. Provide an

explanation for your answer highlighting how it was challenging? For example, highlight a time when you became 'stuck' when learning.



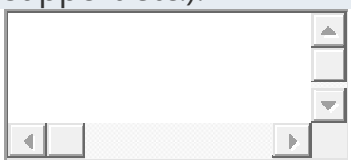
16

For the topic or topics that you identified as challenging in Question 15 identify if you overcame those challenges? For example, did you become 'unstuck' in your learning? If Yes, go to Question 17. If No, go to Question 18.

- Yes
- No

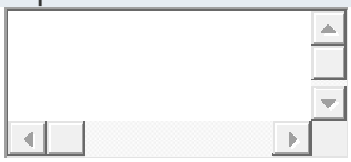
17

For the topic or topics that you identified as challenging in Question 15 how did you overcome those challenges (e.g. self-learning, student support, lecturer support etc.).



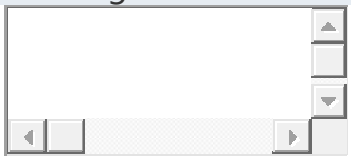
18

What has been the impact of you being unable to get your head around a specific challenging topic or topics? Please outline (a) whether you think this will have an impact on your career as a information systems practitioner and (b) the learning supports that you think would have allowed you to master the topic or topics.



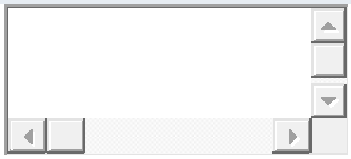
19

What would you change about the degree with regards to (a) teaching and (b) learning about information Systems?



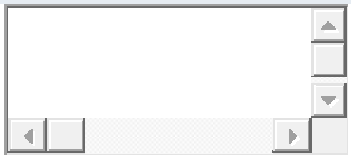
20

Which aspects of information systems would you say you would like more help with?



22

For the #1 most difficult topic that you outlined in Question 21 what aspect of the topic did you find challenging? For example, if you select databases, some students find the concept of normalization challenging.

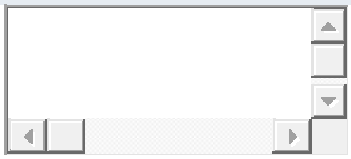


23

Rank the following information systems topics from your degree from #1 which is most transformative to #7 least transformative. Only allocate one ranking per topic. Transformative means that once you mastered the topic it was like a "wow moment" and enabled you do gain mastery in other topics.

24

For the #1 most transformative topic that you outlined in Question 23 what aspect of the topic did you find most transformative? For example, if you select programming, some students find that when they master SQL it enables them to create better databases.



Section 4

Part C

25

Using the Table below calculate how much would it cost to send a parcel of weight 150gms a distance of 375kms? Put your answer into Question 26 below.

Postal rates for parcels

Distance (kms)	Weight (gms)			
	Up to 50	125	250	500
Up to 50	1.70	3.40	6.00	10.50
250	2.25	4.50	8.00	14.50
500	4.50	9.00	16.00	28.00
1000	7.50	15.00	26.00	46.00

26

Answer to Question 25

27

In relation to Question 25 Where do you think such a table would have come from?

28

Is the Table in Question 25 well designed?

- Yes
- No

29

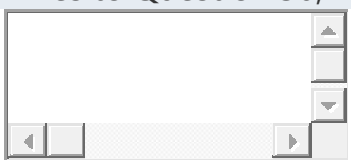
Provide a detailed reason for your answer in Question 28 above

30

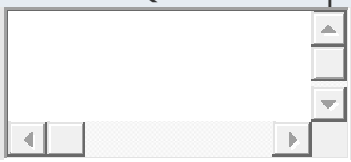
The human side of information systems is important. Do you agree or disagree?

- Yes
- No

31
If Yes to Question 30, what role, if any, do people play in an information system?



32
If No to Question 30 please explain why



Appendix F: Questionnaire Email sent to Students

From: Trevor Clohessy <Trevor.Clohessy@gmit.ie>
Sent: Monday 07 December 2020 17:10
To: Anonymised
Subject: Research Questionnaire

Dear Student,

I hope all is well.

Following up for our initial conversation regarding my MA in Teaching and Learning I have attached a study information sheet and a link to the research questionnaire. If you could read the study information form and complete the anonymous research questionnaire, I would really appreciate it.

In the meantime, if you have any questions regarding the study please do not hesitate to contact me via email or Microsoft Teams.

Thanks a million again it would be great to get your insights,

Best Regards,

Dr Trevor Clohessy,

Department of Enterprise and Technology,

Galway Mayo Institute of Technology,

Republic of Ireland.

Appendix G: Focus Group Discussion Guide

Introduction:

- Welcome and thanks for participating.
- Invite questions about study.
- Study consent and study withdrawal.
- Format of focus groupg.

Study Questions (Structure around results from Part A and Part C findings):

Motivation to Take Part in the Study

Q1. Why did you decide to take part in this study?

Work Placement Experience

Q2. Did anything catch you by surprise/you found tricky?

Q3. Were there any areas you needed additional support in? e.g., remote working.

Q4. How was it working with professionals? What came to your attention?

Q5. How best can we prepare students with the skills that they got in course for the (a) social aspects of the workplace (e.g., trickly clients) and the evolving nature of the workplace (e.g., career guidance).

Q6. What information do you think other students would find useful if going into the same placement?

Information Systems Modules Experiences: Draw from questionnaire results.

Q7. What aspects of learning about information systems did you find challenging/tricky? – Ask for Examples

Q8. How did you progress your understanding with these challenging/tricky aspects – Ask for Examples

Q9. What additional supports do you think would help students deal with these challenging/tricky aspects? – Ask for Examples

Q10. After completing your degree in BIS what do you think you can now do that you could not do at the start or early on in your degree?

Q11. For students coming onto course what advice would you give them to help them with course?

Moving into industry

Q12. Describe your feelings about your level of preparedness for transiting into industry.

Specific categories [use only if not addressed with answers to questions above]

Please consider tricky/challenging concepts and teaching strategies in the following areas:

- Technical aspects of information systems
- Social aspects of information systems
- Terminology

Conclusion:

- Any other information
- Thanks for participating!

Appendix H: Focus Group Email sent to Students (TBC)

From: Trevor Clohessy <Trevor.Clohessy@gmit.ie>
Sent: Monday 25th January 2021 16:40
To: Anonymised
Subject: Research Questionnaire

Dear Student,

Many thanks for signing up to the focus group for this Thursday at 12pm. I have emailed you a Microsoft Teams link.

I also have attached a focus group information sheet.

Could you please read and complete the form below before the meeting:

https://forms.office.com/Pages/ResponsePage.aspx?id=rs8Gj9UihEykbT2-PJNVjVIJCHcDJTNHmuJhQB0JTuhUMkZVMlEzR1VZV1czV05IVjBINjJQR1daSS4u

If you have any questions, please send me an email.

Your digital badge will be issued within 5 days of the focus group taking place.

Thanks again and looking forward to our discussion on Thursday.

Best Regards

Trevor Clohessy,
Department of Enterprise and Technology,
Galway Mayo Institute of Technology,
Republic of Ireland.

Appendix I:

INFORMED CONSENT FORM:

RESEARCH PARTICIPANTS IN FOCUS GROUPS[1]

INFORMATION SHEET	
Purpose of the research study.	The purpose of this study is to investigate: (1) how students encounter challenging concepts and knowledge when learning about information systems. (2) the information system teaching related issues that manifest in a classroom setting.
What the research study will involve.	Data will be collected using the following research instrument: Online Focus Group: These will take place on Microsoft Teams and will contain a maximum of 6 student participants. The focus group will last for 60 minutes.
Why you have been asked to take part in this research study.	Student: You have been selected to take part in this study given your experience of learning and being taught information systems as part of your busines information systems degree.

The confidentiality of your participation in the research study.	Those who will have access to the research data include: the primary researcher, members of the Research Advisory Panel, internal examiners, and external examiners.
What will happen to the information which you give?	To ensure anonymity and confidentiality all data (audio/video recorded) will be collected, analysed, and stored in line with GMIT research policies and procedures. All study participants will be anonymised in the thesis whereby each participant will receive a unique identifier. Study participants have the right to request a copy of the data that they have supplied and request the removal of their data at any time during the study.
What will happen to the results?	The findings and results will be presented in the thesis. They will be seen by my supervisor, internal and external examiners, and the research advisory panel of the GMIT MA in teaching and Learning. The thesis may be read by future students on the course. The study may be published in an academic journal and will be available to view on the GMIT online Research@THEA database.

Are there any possible disadvantages of taking part?	There are no material risks, discomforts or side effects associated with this research. A possible disadvantage of taking part in a focus group or interview is giving up your time. Further, as a result of the possibility of an ethical tension with regards to the participation and collection of data from students, mechanisms will be put in place to ensure that protective measures will be put in place for all research procedures so that they are conducted with integrity.
If a problem arises in relation to research participation.	If you wish to withdraw from this study, you are free to do so within one month of participation (without providing a reason). To withdraw, you should contact the principal researcher, Dr Trevor Clohessy who can be e-mailed at trevor.clohessy@gmit.ie
Which body has reviewed this study from the perspective of ethical clearance?	The MA in Teaching and Learning Research Ethics Committee, GMIT.
Any further queries?	If you need any further information, you can contact me:
If you agree to take part in the study, please sign below.	

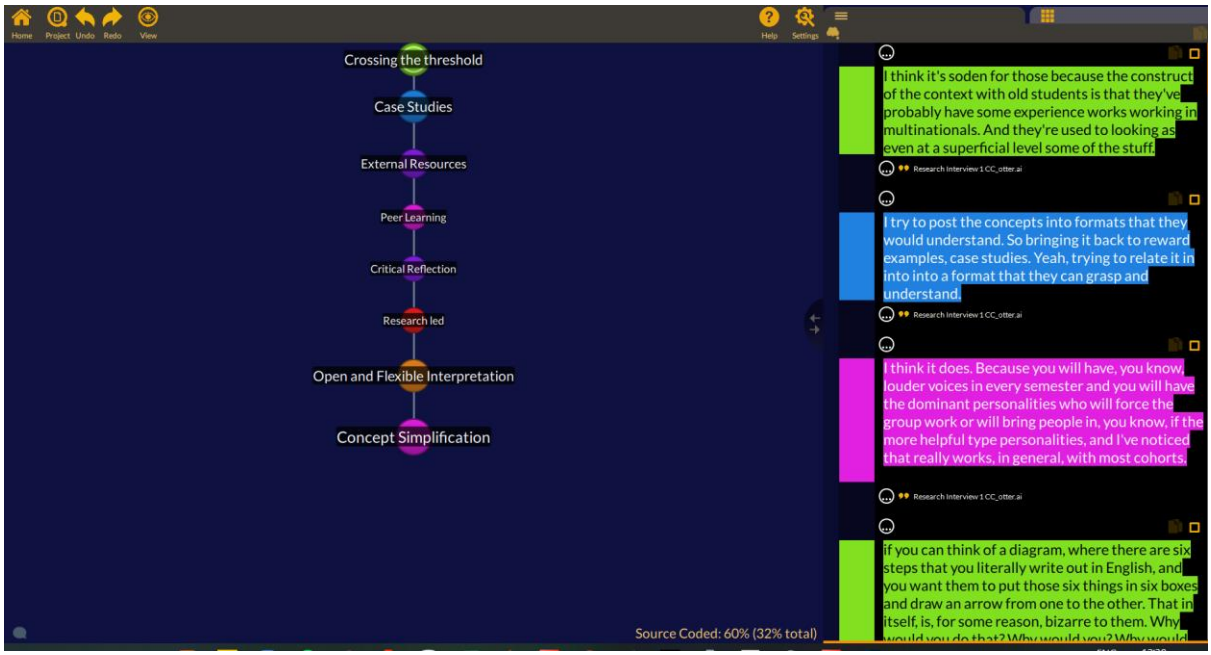
[1] The document draws extensively on a work produced by Dr R. Swain of UCC, and is used with permission. Copyright is vested in same and all rights therein remain with Dr Swain.

RESEARCH PARTICIPANTS IN FOCUS GROUPS

Date: X

Signature(s): Y

Appendix J: Thematic Analysis Examples from Lecturer Interviews



Appendix K: Analytical Memo Example from Lecturer Interview Analysis