An Exploration of Threshold Concepts in Accounting Education

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

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Declaration

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program; any editorial work, paid or unpaid, carried out by a third party is acknowledged; and, ethics procedures and guidelines have been followed.

Sonia Anita Magdziarz

March 1, 2016
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In memory of my beautiful Dad - who lost his battle with motor neurone disease in June 2015.
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Summary of Research

Using a research framework developed by Meyer and Land (2003), this study examined the perceptions of accounting academics regarding threshold concepts and the notion of threshold concepts within the financial accounting discipline of undergraduate accounting programs across universities in Australia. Threshold concepts are a relatively new area of research that has emerged from a national research project in the United Kingdom. A threshold concept is thus described as being similar to a portal in that it results in ‘opening up a new and previously inaccessible way of thinking about something’ (Meyer & Land 2003, p. 3). In particular, it involves a transformation in the way a student understands, views or interprets something. Without this transformation, a student’s learning cannot progress further. A threshold concept is seen as comprising a number of characteristics or attributes that assist in identifying what a threshold concept is but they can also be used to understand the process a learner goes through when understanding a threshold concept. These characteristics describe a threshold concept as being transformative, probably irreversible, integrative, often but not always bounded and potentially troublesome (Meyer & Land, 2003). Despite the potential for knowledge of threshold concepts to inform teaching and learning practice and curriculum development, a comprehensive review of the extant educational literature highlighted the absence of a well-developed theoretical framework underpinning research into threshold concepts and very little research within the accounting discipline.

Research was undertaken using an interpretivist paradigm to gain an understanding and interpret academics’ perspectives of threshold concepts in financial accounting subjects. Data was collected from fifteen accounting academics from Universities across Australia using semi-structured interviews and related subject documentation. An iterative process of data analysis informed by Miles and Huberman (1994) and Tracy (2012) was used to organise and examine the data. Manual coding was undertaken and use was made of cognitive displays and visual representations contributing to data immersion, development of themes and as part of primary and/or secondary level coding and analysis. In terms of reliability of the study, the researcher was the only person who undertook coding of the data and was conscious of the need for consistency in interpreting transcript data and in reliability of categorisation and thematic development. Descriptive validity was strengthened through the use of detailed quotes in reporting the views from participants in the study. In addition, the researcher, as an
accounting academic in the area of financial accounting, was cognisant of making clear her position and views around the data analysis to limit any potential biases, assumptions and perspectives brought to the study.

Three themes emerged from the analysis with the identification of two threshold concepts – ‘accrual accounting’ and ‘double-entry accounting’ – while the third theme centred on a ‘way of thinking and practising’ in the accounting discipline. The identification and understanding of these threshold concepts provides educators with a way in which to address aspects of discipline knowledge that students may find troublesome and which may transform not only their understanding of the discipline but also inform their way of thinking and practising in the discipline. The existence of the light bulb moment for students – when students finally grasped a key concept - in the accounting discipline was revealed by the academics as well as factors that can enable or inhibit the light bulb moment. The importance of student experiences in life and in teaching around life experiences was identified as an important factor making it potentially easier for students to grasp a threshold concept. Reflections by the researcher on use of the Meyer and Land Framework (2003) and the practical implications of the framework include how the irreversibility and bounded attributes of the framework could be more fully described and extended to facilitate the identification of these attributes and the complexity and amount of time needed to discern threshold concepts in a discipline if all five attributes in the framework are examined.

By identifying the threshold concepts in the financial accounting discipline of an undergraduate accounting degree, this study has added to the scant literature on threshold concepts in the accounting discipline. It has provided a vital first step in considering the design of teaching and learning strategies that may enhance student understanding across a program of study. Additionally, it has provided the impetus for further investigating the connection of threshold concepts in financial accounting with other fields of accounting such as management accounting, auditing and forensic accounting. The insights gained from the key theme – of a way of thinking and practising in the accounting discipline - could spur further research and potentially involve collection of more extensive data from academics, students and the accounting profession.

Some recent significant studies in engineering, biology and law/physics, provide some insight into how other theories such as variation and/or capability theory can be combined with the notion of threshold concepts to inform curriculum development. Further research into the
capabilities required of an accounting graduate combined with threshold concepts (using a similar study to Baillie et al (2013)) could be used to reconsider and potentially redevelop the curriculum in an accounting degree. Necessarily this would also involve an interdisciplin ary approach that involves other disciplines such as marketing, economics, information technology and management. Hence the transferability of this research extends beyond the accounting discipline and can have a pedagogical benefit that can be seen in light of its connection with other disciplines but also to broader themes in education.

Keywords:
Threshold concepts, accounting education, teaching, learning, troublesome, transformative
Chapter 1  INTRODUCTION

1.1 Threshold Concepts in Education

“In answering these questions, the focus is on students who have struggled learning accounting even though they are doing everything possible to learn it and do not have any obvious learning difficulties.” (Interviewer to Participant)

While significant research abounds that informs learning and teaching styles and approaches, why do some students still find accounting difficult to learn? The notion of threshold concepts is a relatively new development which may provide further, perhaps different, insights into student learning in a discipline and particularly, areas of a course or subject that students find particularly difficult. The grasping of such a threshold not only recognises the acquisition of knowledge but also a transformation in a student and a change in the way a student sees and thinks in the discipline. While there has been limited research into threshold concepts in the accounting discipline, there is a growing body of research into threshold concepts in disciplines such as computing, engineering and science disciplines and also in many other fields such as health, property education and geography.

The focus of this study, therefore, is on threshold concepts in the accounting discipline, in particular, to identify threshold concepts in the undergraduate accounting subject area of financial accounting, and to understand how and why threshold concepts are conceived and construed. An outcome of the identification and understanding of threshold concepts in financial accounting from this study is the potential to inform teaching and learning practices and approaches and in what ways they may contribute to enhancing the teaching and learning of undergraduate accounting students.

The notion of threshold concepts originated from a national research project in the United Kingdom. A threshold concept is regarded as ‘…. similar to a portal in that it results in ‘opening up a new and previously inaccessible way of thinking about something’ (Meyer & Land 2003, p. 412) ...it involves a transformation in the way a student understands views or interprets something. With difficulties around a precise definition, a threshold concept is

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1 Threshold concepts are not the same as the Threshold Learning Outcomes (TLO’s) prescribed by the Australian Learning and Teaching Council (2010) as TLO’s focus on the threshold (minimum) learning outcomes that graduates of bachelor and master degrees in accounting are required to have and therefore focus on capability at the end of the degree. Threshold concepts focus on aspects of a discipline that transform student learning during the degree.
frequently identified by reference to five interrelated attributes (or characteristics) described by Meyer and Land (2003) as transformative, probably irreversible, integrative, often but not always bounded and possibly troublesome. A distinctive feature of a threshold concept is that it is differentiated from a core concept as a core concept ‘does not necessarily lead to a qualitatively different view of subject matter’ (Meyer & Land 2003, p. 415). A threshold concept may therefore be identified by a combination of, but not necessarily all, of these five attributes. The Meyer and Land (2003) characterisation of a threshold concept around these attributes has been adopted as a conceptual framework in this study allowing for a more detailed examination of which, and how many, attributes are sufficient to characterise a “threshold concept”.

The integrative nature of a threshold concept refers to the interrelationship between knowledge and concepts (core concepts and/or other threshold concepts) and is an area where a student may find it difficult (or troublesome) to see these relationships. A threshold concept may also have distinct boundaries that lead to other conceptual areas or even other disciplinary areas. This attribute, however, describes a threshold concept as often (but not necessarily) bounded, hence there is the possibility that boundaries may not exist for all threshold concepts. Another attribute of a threshold concept is that it is probably irreversible in that, once it is understood, it is unlikely to be forgotten. The transformative nature of a threshold concept describes a significant shift occurring in a learner where they see the subject matter from a transformed perspective (Meyer & Land 2003). Aligned with this transformation is the notion by Entwistle (2008) that a way of thinking in the discipline assists with this transformation.

Also associated with the transformative aspect of a threshold concept, is recognition that a threshold concept is potentially troublesome. “Troublesomeness” can appear in many forms and ways. Knowledge may be conceptually difficult or be in the form of “ritual” knowledge wherein students’ rote learn or memorise concepts but do not really understand or fully grasp the application of knowledge when faced with varying or different situations. Foreign knowledge results when a student becomes confused in trying to understand why their own understanding of knowledge conflicts with the knowledge they are taught (Perkins 1999 in Meyer & Land 2003). Language may be troublesome for students where a discipline has a particular ‘language’ or terms of which students are unaware or have difficulty understanding. Tacit knowledge may also prove troublesome to a student where an academic does not make explicit to students (novices), aspects of understanding the discipline that have
become ‘second nature’ to the academic. They are linked to a way of thinking and seeing in a
discipline that is not always made explicit to students, albeit unknowingly by the educator
(Male & Baillie 2011a; Meyer & Land 2003). Fear of uncertainty can be a source of
troublesomeness where students are always seeking a right answer, for example, and can
become a barrier to student engagement (Baillie & Johnson 2008).

Davies and Mangan (2007) identify that the bounded and troublesome nature of threshold
concepts arise from a threshold concept being transformative, irreversible and integrative.
Integration of a students’ prior understanding with current knowledge is ‘more likely to be
irreversible, because it holds together a learner’s thinking about many different phenomena’
and thereby transforms student understanding (p. 712). During this transformation, a student
may be in a state referred to as liminality (Cousin 2007) where a student is trying to make
sense of new knowledge or ideas when confronting their existing thoughts and knowledge.

A range of learning theories have been linked to the notion of threshold concepts including
cognitive and social constructivism theories, humanistic theory and conceptual change
theory. Variation theory and capability theory seem to have elicited more interest in recent
studies. While threshold concepts help establish what students should learn, capability theory
can guide how students learn such concepts. Use of variation (theory) in the learning process
may help students develop knowledge capability and hence be able to deal with unforeseen
(variations in) circumstances and to see through the eyes of a professional accountant.

Much of the research into threshold concepts has been in disciplines other than the
accounting discipline. There is a wealth of research in the computing, engineering and
science disciplines particularly but also in many other fields such as health, property
education and geography and so forth. A range of philosophical positions are adopted by
various researchers evidenced by the variety of research approaches implemented in studies
into threshold concepts. A range of methods (e.g. interviews, surveys, workshops, focus
groups, observations, concept mapping activities and written reflections with interviews)
have been used to gather data from students and/or academics to identify threshold concepts
with several researchers collecting data from academics in the first instance and then
sometimes undertaking subsequent research that involves collection of data from students.

Before further investigation into threshold concepts and the potential to use them to address
curriculum change can occur, they first of all need to be explicitly identified. While research
into threshold concepts in a range of disciplines is common, there are a number of
frameworks used in the past to identify threshold concepts (e.g. Davies & Mangan (2007) Framework; Mediated Learning Experience; Meyer & Land Framework (2003) based on the Meyer and Land attributes). However, the lack of a sole framework to facilitate identification of threshold concepts and different research approaches and methods in previous studies make it difficult at the outset to determine the foremost way of identifying threshold concepts.

Some researchers have levelled criticisms at the notion of threshold concepts. For example, the vague wording of the Meyer and Land (2003) attributes (Rowbottom 2007; O’Donnell 2010), the number of attributes required for a concept to be regarded a threshold concept and the lack of rigour in discussions when accepting a theory or framework that is still developing and still has unanswered questions (Barradell 2013). While some of the criticisms may have a degree of legitimacy, continued research is providing evidence that the notion of threshold concepts may be a credible area for research.

Although a minority of researchers have been critical of the notion of threshold concepts, it can be considered useful for numerous reasons. Threshold concepts may help explain the difficulties that a student encounters when learning a subject but also provide links and relationships between the outcomes of learning and the approach to learning used by students (deep/surface) in addition to the impact on curriculum design and teaching approaches (Davies 2003). Threshold concepts offer academics the opportunity to explore, investigate and deconstruct their discipline in this study of financial accounting, and may also inform teaching and assessment approaches.

1.2 Aim and Scope of the Study

The aim of this research is to explore, identify and describe potential threshold concepts perceived to be critical to student learning in the context of the financial accounting stream of the accounting discipline in higher education. With very few studies of threshold concepts having been undertaken in the accounting discipline, a comprehensive review of the literature in a variety of disciplines was undertaken. This was considered to be highly important and valuable in ascertaining how threshold concepts have been identified in prior research and might be examined in this current study.

As the notion of threshold concepts is still evolving, this study may add to the conceptual knowledge and theory that surrounds an understanding and use of threshold concepts. While
integration and use of theory into threshold concepts is at a developmental point, recent studies in threshold concepts combined with capability theory and variation theory (as part of the Threshold Capability Integrated Theoretical Framework) potentially open the way for explaining how threshold concepts operate in the progression of student learning and how threshold capabilities relate to professional learning in a discipline. In terms of curriculum development, the scope of this study could be extended to the accounting discipline as a whole in addition to interdisciplinary curriculum development across the common core of a degree. In this way the research has the potential to contribute to the quality of teaching and learning in not only accounting but possibly other business courses as well.

In this study, the focus is on academic perceptions of students who have found learning in the financial accounting stream difficult even though the students appear to be doing everything asked of them (in terms of preparation, study, attendance and participation in classes and seeking assistance) and they have no obvious learning difficulties of which the academic is aware. It is the academics’ conception of what they perceive to be threshold concepts (generally and in relation to financial accounting) and how and why they are constituted that is of particular concern in this study.

In terms of the subject areas that constitute financial accounting, in this research it incorporates the introductory financial accounting areas such as regulation of general purpose financial reporting, double-entry accounting, journals, ledgers, balance day adjustments, closing entries, bank reconciliations, internal control, subsidiary ledgers and statements of cash flow. The financial accounting stream may also extend to corporate accounting and taxation areas such as consolidated accounts, tax-effect accounting, accounting for leases, accounting for intangible assets and accounting for property, plant and equipment.

The principal questions that this study seeks to address are:

1. What do accounting academics perceive threshold concepts to be?
2. Specifically, what are the threshold concepts in the undergraduate Financial Accounting discipline in Australia as understood by accounting academics?
3. How, and why, are these threshold concepts conceived as ‘thresholds’ in the undergraduate Financial Accounting discipline by accounting academics?
1.3 Structure of the Thesis

Following this introductory chapter, this thesis comprises four major sections. In Chapter 2, a detailed review of the literature on threshold concepts in a variety of disciplines, including the accounting discipline, is presented. A multi-disciplinary review was considered important given the relatively early stages of investigation into this phenomenon and for the potential to identify possible ways of investigating threshold concepts (methodologies and methods). Discussion of the frameworks used to identify threshold concepts is provided and developed from a synthesis of the existing literature around a number of learning theories in which threshold concepts have a foundation followed by the pedagogical and curriculum implications of threshold concepts. The ontological and epistemological dimensions of threshold concepts in the context of student learning are made clear within the literature; the definition of a threshold concept however, remains imprecise. Given this, conceptual frameworks used in previous studies are critically reviewed and attention drawn to the framework adopted by Meyer and Land (2003). In this framework, threshold concepts are frequently associated with characteristics or attributes that not only assist in identifying what a threshold concept is but they can be used to examine the process a learner goes through when understanding a threshold concept. Such characteristics describe a threshold concept as being transformative, probably irreversible, integrative, often but not always bounded and possibly troublesome (Meyer & Land 2003).

Chapter 3 details the research design chosen to determine and describe potential threshold concepts perceived to be critical to student learning. The methodology adopted was informed by the comprehensive literature review presented in Chapter 2 which led to the adoption of a qualitative (interpretivist) approach to the study; the selection of academics as the primary source of data; the use of the Meyer and Land (2003) conceptual framework as an organising and evaluative medium for data collection; and analysis and consideration of a number of theories that may be of particular interest in further researching and developing thought around threshold concepts. This chapter also details the criteria used to select participants, the demographics of the participants in this study, the preliminary information provided to the academic’s interviewed as well as the interview location and process. The procedure for transcription of interviews and issues of reliability and validity are discussed as well as a description of the iterative analysis process used to organise and analyse the data, which involved the development of a checklist matrix, and detailed individual and combined cognitive maps around key themes.
In Chapter 4, analysis and discussion around three key themes / threshold concepts are presented - accrual accounting and double-entry accounting as threshold concepts and a way of thinking and practising being a theme. They are each examined by reference to detailed cognitive maps which link together the components (or sub-themes/concepts) that combine to form each threshold concept / theme. For each threshold concept, discussion is organised around the five attributes of a threshold concept described by Meyer and Land (2003) and includes detailed comments from participants to highlight their views and conceptions on and around these attributes. Discussion and preliminary thought about the Meyer and Land (2003) framework are offered together with consideration of theories (Chapter 2) that appear to resonate with findings and potential ways of enhancing student learning.

In Chapter 5, the key findings are summarised in terms of the threshold concepts and themes identified from the study and considered in terms of findings of the cross-disciplinary literature review presented in Chapter 2. Reflections on the research approach adopted in this study are presented and the potential for incorporating more recent theories on capability theory and variation theory in both future research and in developing curriculum around threshold concepts are presented. The chapter concludes by noting the limitations of the study and discussing the implications of the findings of this study for future research.
Chapter 2 LITERATURE REVIEW

2.1 Introduction

The aims in this chapter are to critically examine the idea, definition and research studies of “threshold concepts”. Threshold concepts are viewed as critical to the transformation in student learning and a way of seeing or understanding something, yet within the accounting discipline there is very little research on this topic. Defining exactly what threshold concepts are, however, has proven to be quite challenging. In the first section of this chapter, an examination of threshold concepts is presented by considering those characteristics / attributes most frequently associated with threshold concepts and the distinction between a threshold concept and a core concept (around which there is often some confusion). Criticisms surrounding the characterisation of threshold concepts and ways in which they have been examined are identified.

Given the relative infancy of research in the area of threshold concepts, a detailed review of the literature on threshold is then presented. This involved a review of thirty-eight papers across a range of disciplines where threshold concepts had been examined and included the engineering, science and computing disciplines (where significant interest in threshold concepts has been shown) followed by a wide range of other disciplines that includes dentistry, geography, management, information systems, economics, health care, property education, law and history. A review of the literature in the accounting discipline is also provided in this chapter. The purpose of these reviews was to obtain a more complete understanding of how threshold concepts have been characterised; the theories used (if any), as well as any frameworks, to investigate or explain threshold concepts; and the data collection methods and sources used to undertake such research. Discussion of the approaches to identifying threshold concepts is then provided and is developed from a synthesis of the extant literature around a number of learning theories in which threshold concepts appear to have a foundation. The pedagogical and curriculum implications of threshold concepts are then considered in the final section.

2.2 Threshold Concepts – Descriptions and Characteristics

Threshold concepts are a relatively new area of research that has emerged from a national research project in the United Kingdom. A threshold concept is thus described as being similar to a portal in that it results in ‘opening up a new and previously inaccessible way of
thinking about something’ (Meyer & Land 2003, p. 412). In particular, it involves a transformation in the way a student understands views or interprets something. Without this transformation, a student’s learning cannot progress further. Meyer and Land (2005) believe that threshold concepts provide the potential to identify ‘troublesome aspects of disciplinary knowledge within transitions across conceptual thresholds’ (p. 386). Identification is intended to assist educators in making appropriate changes to curricula to enable students to make ontological and epistemological transitions in their course of study (Meyer & Land 2005). Specifically, Land et al (2008) suggest that it provides ‘an analytical framework for trying to understand how students learn, where the barriers to their learning lie ….and what appropriate pedagogical adjustments or modifications might overcome such difficulties’ (p. xi). Quinlan et al (2013) referred to personal communication with Meyer that threshold concepts are transformative in both epistemological and ontological ways in that ‘once a student has grasped the concepts they will ‘see’ the world differently - their way of knowing (epistemology) and related ways of being in the world (ontologically) will change’ (p. 586).

In terms of an epistemological transition, Perkins (2006) asserts that a discipline is more than just a collection of concepts but that each discipline has its own unique episteme, or way of knowing, being a ‘system of ideas or way of understanding that allows us to establish knowledge … [that provide ways of] justifying, explaining, solving problems, conducting enquiries, and designing and validating various kinds of products and outcomes’ (p. 42). Hence, epistemological transitions involve the establishment of knowledge.

An ontological transition in an educational context refers to a journey into territory that is unknown or unfamiliar to a learner (Land et al 2005, in Rust). Percy (2012) sums this up well by explaining that the portals have been conceptualised as being key points in the learning landscape through which the individual gains a greater depth of understanding beyond epistemological dimensions to a new way of seeing things that extends to ontological dimensions around personal identity, feelings and values (p. 121).

While what threshold concepts “do” in terms of student learning, i.e., the ontological and epistemological dimensions – are well noted within the literature, the definition of a threshold concept is less clear and most often associated with the characteristics or attributes of a threshold concept.
2.2.1 Characterisation of a Threshold Concept

A threshold concept is seen as comprising a number of characteristics or attributes that assist in identifying what a threshold concept is but they can also be used to understand the process a learner goes through when understanding a threshold concept. These characteristics describe a threshold concept as being transformative, probably irreversible, integrative, often but not always bounded and possibly troublesome (Meyer & Land 2003). However, there are different views regarding some of these characteristics, for instance, they are often perceived as vague, so a thorough discussion is provided shortly to examine this issue. The distinction between a threshold concept and a core concept has the potential to cause confusion. Eckerdal et al (2006) reason that core concepts can assist in determining the threshold concepts in a discipline where core concepts are seen as a subset of threshold concepts. In investigating concepts in educational research and their potential identification of a threshold concept, Entwistle (2008) offers some insight into the defining aspects of a threshold concept. He indicates that threshold concepts have a dual aspect where a threshold concept ‘must relate to a specific and important aspect of a syllabus’ but that it ‘also must be capable of opening up the subject in important ways through integrating other, lower-level concepts’ (p. 32). Meyer and Land (2003) consider that threshold concepts can be distinguished from core concepts in that a core concept helps a learner understand a subject but ‘does not necessarily lead to a qualitatively different view of subject matter’ (p. 6). They use an example of gravity as a threshold concept while citing the centre of gravity as a core concept.

In terms of the characteristics/attributes of a threshold concept identified by Meyer & Land (2003), one of these attributes centres on the integrative nature of a threshold concept. The integrative nature of a threshold concept shows how knowledge or concepts are interrelated (which are depicted in the cognitive maps in Chapter 4 and Appendices 8 & 9) where in the past it may have been difficult for the learner to see this interrelatedness. It is this integrative aspect of a threshold concept that may make ‘the world appear a more problematic and troublesome place’ (Davies 2002 in Meyer & Land 2003, p. 416). This integrative attribute is seen as critical by Coughlan and Graham (2009) for the threshold concept to be irreversible and transformative. They explain that ‘once the ideas and procedures of a subject make sense, it becomes possible to bring together different aspects of the subject that previously did not appear to be related’ (p. 191).
A threshold concept may often (but not necessarily) be bounded in that borders may exist for some conceptual areas that then lead into new conceptual areas with new thresholds and in some cases, these borders may provide distinction between disciplinary areas (Meyer & Land 2003). Coughlan and Graham (2009) support this by stating that ‘a threshold concept helps to define the boundaries of a subject area because it clarifies the scope of a subject community’ (p. 191). While Baillie et al (2013) explain that boundedness means that an individual threshold concept itself does not explain ‘the whole of the discipline, only a specific sub-domain, or related aspects’ (p. 229).

A threshold concept is also seen as probably irreversible as once it is grasped, it is not likely to be forgotten. Ultimately, Meyer and Land (2003) assert that significant effort is needed to “unlearn” the threshold concept while it is also acknowledged that it can be difficult to understand how the transformation took place. Davies (2006) in Coughlan and Graham (2009) confirms that ‘irreversibility makes it inconceivable that (the student) would return to viewing, not only the world around them, but also the subject and themselves, in the way they did before (p. 191).

A threshold concept may be transformative in that it provides a significant shift in how a subject, or part of a subject, is perceived by the learner thereby providing a transformed perspective of the subject matter (Meyer & Land 2003). Coughlan and Graham (2009) support this by stating that ‘the transformative character reflects how threshold concepts can change a student’s perception of themselves and the subject’ (p. 191). Davies and Mangan (2007) suggest that the change in a learner’s perception may result in such a transformation where the threshold concept can integrate the learner’s prior understanding of this concept thereby indicating a link between the transformative and integrative attributes of a threshold concept.

Entwistle (2008) acknowledges that a threshold concept can be experienced as a single event but that a specific way of thinking in a discipline, while transformative, tends to build up over time as students become aware of the knowledge and skills relevant to their profession. As such, the conceptions of learning and knowledge and the research on approaches to learning and teaching-learning environments, referred to by Entwistle (2008), form part of broader thresholds. Knowledge of how a student experiences a threshold concept can provide valuable information on the transformative nature of a threshold concept and assist in the development of teaching strategies. He acknowledges however that focussing on threshold
concepts within a syllabus alone may be insufficient in providing great improvement in student understanding as there are many other reasons that can provide difficulty for students such as those provided by Perkins (1999) when considering the different forms of troublesome knowledge. This will be covered shortly when the troublesome attribute is addressed. Entwistle (2008) suggests that these difficulties need to be investigated further and addressed with changes in pedagogy. Hence when investigating threshold concepts, researchers need to ensure that content alone does not prescribe identification of threshold concepts but also that abstract notions and capabilities are considered in this process. Thinking on threshold concepts has broadened to include capability theory which focuses not only on what students learn but also how students learn and hence not focus predominately on content (Baillie et al 2013; Akerlind et al 2014). Capability theory and the linkage of these ideas will be explained further in Section 2.3.

Finally, a threshold concept is seen by Meyer and Land (2003) as potentially troublesome. The source of this troublesomeness may emanate from language used in a discipline thereby creating ‘particular understandings and ways of seeing and thinking’ (Meyer & Land 2003, p. 420). Prior concepts that were once familiar may provide conceptual difficulty when addressed in a different discipline (Meyer & Land 2003). An example of this in the accounting discipline centres around the use of the word “cash” as including notes, coins and cheques while literally a student may see cash as purely being notes and coins. Perkins (1999) in Coughlan and Graham (2009) adds that the troublesomeness is not only due to the integrative nature of a threshold concept but also because ‘it is taken for granted by practitioners and therefore rarely made explicit. Knowledge is troublesome when it is alien or counter-intuitive’ (p. 191).

Different kinds of knowledge, according to Perkins (1999), may be troublesome for some learners. The kinds of knowledge referred to are inert, ritual, conceptually difficult and foreign knowledge. Inert knowledge is seen as knowledge that a learner has but it has not been used to actively associate this knowledge with their world, their life or society. Baillie and Johnson (2008) add further to this by explaining that

inert knowledge is seen by the learner as unconnected or irrelevant...and troublesome because students need to learn the isolated 'bits' of knowledge before they can be integrated, but it is then difficult to persuade students to see the whole in a new integrated way' (pp. 135-136).
Ritual knowledge is of a routine nature and hence needs to be more meaningful for a student to engage with it while conceptually difficult knowledge is a mixture of ritual knowledge and misunderstanding where a student knows ritual responses but intuitively their beliefs and interpretations are rediscovered when confronting qualitative problems. Ritual knowledge according to Baillie and Johnson (2008) is knowledge that students 'accept that they need to know it but do not appreciate the complexity of the knowledge or the reasons why they need to know it' (p. 134). It is acknowledged by Perkins (1999) that a combination of these kinds of knowledge may also prove troublesome. Finally, foreign knowledge is described by Perkins as being in conflict with our own knowledge such as, for example, knowledge of differing value systems that exist for different nationalities may provide confusion for a person trying to come to terms with the value system of a different nationality compared to their own. While knowledge can be troublesome for learners, ultimately a transformation in learning takes place that enables learners to extend their understanding and open the way for further learning.

Male and Baillie (2011a) identify that Meyer and Land (2005) refer to two further kinds of knowledge that may be troublesome – tacit knowledge and troublesome language. Tacit knowledge is knowledge that ‘is not explicitly identified, taught or learnt’ (Male & Baillie 2011a, p. 251). Baillie and Johnson (2008) elaborate further by describing tacit knowledge as understandings that are often shared within a community of practice but not often explained or exposed to novice and newcomers e.g. a person coming to a new community or country may not pick up on the nuances of different practices that are ‘common sense’ to old-timers’ (pp. 134–135).

Troublesome language may impact on learning where ‘specific discourses have developed within disciplines to represent (and simultaneously privilege) particular understandings and ways of seeing and thinking’ (Meyer & Land 2005, p. 8).

Baillie and Johnson (2008) undertook a study that investigated how students' experienced professional skills and identified a further category of troublesome knowledge, being the fear of uncertainty where knowledge can differ in different contexts. Fear of uncertainty as a source of troublesomeness may emanate from students who are used to there being a right or a wrong answer and who may be very results oriented. The focus in this instance related to students who came from a maths and science background in high school. Such a fear can act as a barrier for student engagement where they explain that the unknown or uncertain aspect
relates to knowledge 'that must be formed and applied judiciously in particular contexts' (Baillie & Johnson 2008, p. 138).

Davies and Mangan (2007) describe the link between these characteristics. They state that the bounded and troublesome nature of threshold concepts result from a threshold concept being transformative, irreversible and integrative. That is, the boundaries of a threshold concept become delimited once integration of concepts, beliefs and theories takes place. Reimann (2004) in Davies and Mangan (2007) asserts that the boundaries will be more definite or clearer where strong integration has occurred. Also, a threshold concept is likely to be more troublesome when a threshold concept is transformative as the learner needs to use previous understanding to try and make sense of the new knowledge presented to them.

Likewise, Davies and Mangan (2007) state there is a link between the transformative, irreversible and integrative aspects of a threshold concept:

- a concept that integrates prior understanding is necessarily transformative, because it changes a learner’s perception of their existing understanding. If a concept integrates a spectrum of prior understanding, it is more likely to be irreversible, because it holds together a learner’s thinking about many different phenomena. To abandon such a threshold concept would be massively disruptive to an individual’s whole way of thinking (p. 712).

The transformative nature of a threshold concept can mean that while a student is in the process of understanding a threshold concept, they may find it troublesome. Entwistle (2008) identified three types of transformative thresholds that take place in student learning based on the work of Davies and Mangan (2007) in Section 2.3.2.1. Firstly, students develop an understanding of basic concepts in the early part of their degree and extend/illuminate their understanding of the terminology used in everyday thinking of the discipline. Secondly, there is an integrative transformation that occurs where students integrate concepts and understand linkages between different concepts. The third transformation occurs when students develop the ability to academically reason and present this reasoning to others. Entwistle (2008) asserts that knowledge of the transformative thresholds can help to understand ways of thinking and threshold concepts. However, during this transformation, a student may be in a state, referred to by Cousin (2007), as liminality.

Liminality is described by Cousin (2007) as a point in which the student has not quite grasped the threshold concept but is in a transition period where they move to and from their initial
thinking and emergent ideas. Prior to this stage, Meyer and Land (2006b) and Cousin (2007) refer to the student being in a state of pre-liminality where a student has a lack of or minimal understanding of the threshold concept. This can be linked to the approach taken by students in their learning where students with a lack of or minimal understanding are more likely to take a surface approach to learning than those in a state of liminality who are likely to take a deep approach to learning (Marton & Säljö 1976; Cousin 2007).

Land et al (2010) in Meyer et al (2010) provide a relational representation of the characteristics of a threshold concept with the different liminal states a student can go through when encountering and breaching such a threshold. This representation is replicated in Figure 1. A pre-liminal state according to Land et al (2010) in Meyer et al (2010) finds a student encountering troublesome knowledge; the student then moves to a liminal stage where they are grappling with the integrative aspects of new knowledge as well as reconsidering their initial way of thinking and moving towards a new way of thinking resulting in an epistemic and ontological shift and occasioning a change in understanding; as a consequence of this the student finds themself in a post-liminal state where the transformation in learning has taken place, it is irreversible and results in a crossing into a new conceptual area. They also stress that a student may oscillate while acquiring the threshold concept and that there is an underlying game or sub-liminal mode underpinning the process where a student comes to understand the way of thinking and practising in the discipline.

*Figure 1: A Relational View of the Features of Threshold Concepts*

<table>
<thead>
<tr>
<th>Mode</th>
<th>Pre-liminal</th>
<th>Liminal</th>
<th>Post-Liminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instigative</td>
<td>- Encounter with troublesome knowledge</td>
<td>- Integration - Discarding - Ontological and epistemic shift</td>
<td>- Transformation - Irreversibility - Crossing conceptual boundaries - Changed discourse</td>
</tr>
<tr>
<td>Reconstitutive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consequential</td>
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</tbody>
</table>

Land et al, in Meyer et al, Threshold Concepts and Transformational Learning, 2010, page xii
Hence threshold concepts are seen as ‘concepts that bind a subject together, being fundamental to ways of thinking and practising in that discipline’ (Land et al 2005, in Rust 2005 p. 54). The notion of threshold concepts involves learners undergoing a transformation in their learning and in their identity. That is, their perspective shifts and they have a new way of seeing or understanding something and can integrate the ideas of a subject into their thinking but in the process they may have to lose some of their initial beliefs and understanding in order to fulfil their transformation. Hence a complete understanding requires students to internalise a threshold concept to enhance their ability to integrate different aspects of a subject in their analysis of problems [while] students who have not yet internalised a threshold concept have little option but to attempt to learn new ideas in a more fragmented fashion (Land et al 2005, in Rust 2005, p. 54).

This process may cause discomfort when the learner finds that part of their identity and initial thoughts need to be discarded for a different way of thinking (Meyer & Land 2005).

The notion of threshold concepts has been criticised, however, in terms of how threshold concepts are defined which may lead to potential validity and reliability problems when undertaking empirical research on threshold concepts. Such criticisms include the vague wording of the attributes of a threshold concept (Rowbottom 2007; O'Donnell 2010), the description of the transformative aspect of a threshold concept referring to a significant change in a way of thinking and implying that there are degrees of transformation (Rowbottom, 2007); the number of characteristics required of the definition for a concept to be regarded as a threshold concept; whether all of the characteristics are present at the same time or at different stages of learning; whether all, some or few learners are affected by a threshold concept; and whether there are a specific number of threshold concepts (O'Donnell 2010). Sorva (2010) criticises Meyer and Land (2003) for not clearly defining what is meant by the term ‘concept’ when they are describing a threshold concept. Particularly, Sorva (2010) points out that the use of the word concept (in terms of a threshold ‘concept’) has encountered different interpretations where it has been labelled a threshold conception or a threshold philosophy. More recent research in accounting has resulted in the use of the term perceptual threshold. Secondly, Sorva (2010) also believes there is a lack of clarity as to ‘how well a concept has to fulfil each of Meyer and Land’s five main criteria’ as some of the criteria allows for some degree of variation (p. 2). For example, a threshold concept is
described by Meyer and Land (2003) as being integrative but to what extent does this integration have to be for a threshold concept to exist.

While acknowledging the importance of identifying threshold concepts in aiding teaching and learning, Barradell (2013) supports the criticisms by Rowbottom, Sorva and O’Donnell. Included in her criticism is the lack of rigour in discussions when accepting a theory or framework that is still developing and still has unanswered questions. Such unanswered questions surround the characteristics of a threshold concept in terms of whether all characteristics of the definition need to be met for a threshold concept to exist and the relative importance of one characteristic compared to the other characteristics.

Quinlan et al (2013) consider that there is an over reliance on qualitative research methods and a lack of debate on the characteristics of threshold concepts that need to be present for a threshold concept to exist, and that there is a lack of clarity by writers as to how they have chosen the characteristics they have used in identifying threshold concepts.

While some of the criticisms may be valid, it is important to note that continued research in this area is providing evidence that threshold concepts may be a plausible avenue for educators to investigate. Importantly, Säljö (1997) suggests that such criticism and discussion indicates ‘that a theory or research approach is gaining recognition ….and becomes a productive tool to think with’ (p. 173). Of interest is how accounting academics perceive threshold concepts considering these wide-ranging views. In light of the criticism by these writers, the next section presents the results of a comprehensive review of the literature on threshold concepts.

2.3 Research into Threshold Concepts

This section draws upon a wide-ranging, multi-disciplinary literature review of research undertaken into threshold concepts, details of which have been tabularised in Appendix 1. It includes a review of thirty-eight papers in various disciplines including science, business, healthcare and engineering that provides a foundation for subsequent sections in this chapter.

2.3.1 Methodological Positions in Studying Threshold Concepts

As part of the multi-disciplinary review, the research approach adopted in each study of threshold concepts is identified (where possible) with a view to developing an understanding of the philosophical position of the various researchers. In so doing, it was contemplated that
a more complete understanding of the way in which threshold concepts are conceptualised and the findings in the studies are interpreted by the researchers could be ascertained.

Collis and Hussey’s (2014) distinction of the two main paradigms are positivism and interpretivism where a quantitative research approach is aligned with the positivism paradigm and a qualitative research approach is aligned with the interpretivism paradigm. In the review of the literature, studies were distinguished according to whether the researchers took a quantitative, qualitative or mixed method approach to the research. As a result, it is evident that 58% of the studies into the identification of threshold concepts used a qualitative approach (for example – but not limited to - Wilson et al 2010; Scott & Harlow 2012a; Clouder 2005; Kinchin et al 2011; Kobus 2011, 2012; Macdonald & Black 2010 Zander et al 2008;) while approximately 26% of these studies adopted a combined qualitative/quantitative approach (for example - but not limited to - McCune 2003; Park & Light 2010; Scott et al 2010; Scott et al 2012b; Knight et al 2013). The remaining 16% (approximately) of studies reflected on secondary sources of data and/or provided thoughts on the notion of threshold concepts and their identification but did not collect empirical evidence of such. The adoption of more qualitative, as opposed to quantitative, approaches may be the result of threshold concepts being a relatively new phenomenon where the research has tended to describe and explore the notion of threshold concepts. The absence of any well-developed theory on which to develop more formal and testable hypotheses may also explain the predominant use of the qualitative approach and will be addressed shortly in Section 2.3.2.

The literature also reveals a range of methodological approaches aligned with these predominantly qualitative ways of studying threshold concepts. According to Patton (2002) such perspectives can range from ethnography, autoethnography, constructivism, phenomenology, heuristic inquiry, ethnomethodology, symbolic interaction, semiotics, hermeneutics, narratology, ecological psychology, systems theory, chaos theory, grounded theory and orientational perspectives (feminist inquiry, critical theory, queer theory) to inform qualitative inquiry. While according to Collis and Hussey (2014), within the interpretivism paradigm, qualitative, subjective, humanist and/or phenomenological approaches are used while within positivism, quantitative, objective, scientific and/or traditionalist approaches are used. Patton (2002) acknowledges that ‘no consensus exists about how to classify the varieties of qualitative research’ and that different authors have differing opinions as to which perspectives they believe to be the major theoretical perspectives (pp. 132-133).
Clearly explicated methodology in approximately 32% of the studies into threshold concepts was evident and includes constructive alignment (McCune 2003; McCune & Hounsell 2005), constructivism (Eckerdal et al 2006; Yorke-Barber et al 2008; Fouberg 2013) and constructivist/behaviourist (Vagianou 2006) with constructivism dominating explicit identification of the theoretical approach. It should be noted that it is not uncommon for the constructivist approach to be adopted in educational settings (Driver & Oldham 1986).

Approximately 68% of the studies make no explicit mention of the methodological approach although it could be inferred from the method adopted (for example – but not limited to - Moström et al 2008; Clouder 2005; Kobus 2011, 2012; Macdonald & Black 2010; Park & Light 2010) making interpretations and conclusion of the overall research of threshold concepts somewhat confounded. In limited cases, the approach to identifying threshold concepts has been underpinned by a number of learning theories. These are explored in Section 2.3.5.

### 2.3.2 Frameworks Guiding Identification of Threshold Concepts

In order to facilitate student understanding an important role for academics is to be aware of threshold concepts and develop ways to assist students through the liminal stage and help students develop a way of thinking and practising in their chosen discipline. This necessitates first of all identifying what the threshold concepts in a discipline actually are. Use of a single theoretical framework to guide the identification of threshold concepts is not clearly evident within the literature, there are several frameworks that have been used to explore how threshold concepts could be identified. These include the Davies and Mangan (2007) Framework linking conceptual change theory and threshold concepts; mediated learning experience and threshold concepts and use of the attributes of threshold concepts espoused by Meyer and Land (2003).

#### 2.3.2.1 Davies and Mangan (2007) Framework

Davies and Mangan (2007) identified links between conceptual change theory and threshold concepts and suggested a framework to identify threshold concepts. They propose that threshold concepts could be 'seen as a web of concepts which link thinking and practice in a discipline' (p. 711). Different types of conceptual change – basic, discipline and procedural - were linked to the attributes of threshold concepts espoused by Meyer and Land (2003). Such
an analysis, they assert, provides an insight into how threshold concepts can be used to understand conceptual change by focusing on the relationships between changes in thinking rather than seeing concepts as building blocks. This requires learners to rework their understanding with prior knowledge rather than work out how new ideas and new learning are connected. For example, basic conceptual change is exhibited when learners can distinguish between price and cost. The transformation and integration of students’ learning results from an ‘understanding of everyday experience transformed through integration of personal experience with ideas from [the] discipline’ (p. 715). However, being able to understand how the model of elasticity is constructed and evaluated requires a higher level of understanding and therefore procedural conceptual change as the learner has the ‘ability to construct discipline-specific narratives and arguments [that are] transformed through acquisition of ways of practising’ (p. 715).

The Davies and Mangan (2007) framework has been used sparingly to identify threshold concepts. Shanahan et al (2008) undertook a study to ‘explore whether the web of threshold concepts proposed by Davies and Mangan (2007) can be ‘made visible’ by quantitative analytical means’ (p. 157). This was done through a comparison of answers to multiple choice questions in the third week of the course (testing ‘knowledge of economic principles’) with their final exam marks; and comparison of responses to an online Reflections of Learning Inventory completed by students in week three, with final exam marks (p. 156). Shanahan et al (2008) assert that ‘multiple choice questions have considerable appeal in detecting variation in students’ prior acquisition of conceptual elements, and by inference, threshold concepts' (p. 156). However, they explain that the course that is the subject of the study ‘introduces a number of core concepts and, with these, threshold concepts within the web of concepts proposed by Davies and Mangan (2007) – for example, ‘economic modelling’, ‘incentives’, 'opportunity cost', 'the margin', 'interaction between markets', and 'welfare and efficiency' (p. 156) - inferring that identification of threshold concepts was not the guiding intention of this study.

Taylor et al (2011) used the Davies and Mangan (2007) framework to review ‘definitions of threshold concepts in biology around these abstract concepts’ (p. 6). Hence an initial review of literature and discussions of teaching in the three universities from the earlier Taylor studies was used as well as survey data from academics and individual interviews with students and academics resulting in the development of a matrix. They found that survey results and interview data revealed some commonality but also differences between expert
(teacher) and novice (student) thinking in biology where ‘students had more specific conceptual difficulties with biology, while academics identified several concepts’ (pp. 21-22). They assert that ‘this indicates that the latter perceive a web of conceptual difficulty in biology, while students have a narrower view. When academics and students were asked why the concepts were difficult, once again academics had a web of reasons for the difficulties and students tended to indicate a narrower range of reasons’ (p. 22). Students had a wider range of strategies for clarifying conceptually difficult areas than academics and students used more technical approaches (tools to improve motivation, assist visualisation and memorisation) while academics used pedagogical approaches.

2.3.2.2 Mediated Learning Experience

Another framework used in the literature to identify threshold concepts is mediated learning experience (MLE). Weil and McGuigan (2010) reviewed the findings of an earlier study that used MLE with a threshold concept lens on the basis of the Meyer and Land (2006a) criteria. Gonzáles et al (2008) describe MLE as ‘a special quality of interaction between a learner and a teacher, in this case, called a “mediator”’ (p. 313) where the mediator’s role differs to that of the teacher. Rather

the mediator causes the learner to reflect not just on the solution to the problems but also on how the solution was obtained and the generalisations that flow from it [and] helping the learner to understand how he or she is using his or her brain (p. 313).

The aim of MLE is to develop greater mental functioning and competence in learners (Lidz 2002). The earlier study by Weil (1989) in Weil and McGuigan (2010) investigated 'requisite thinking skills for success in the study of accounting' and revealed a broad range of difficulties that students encounter 'but do not indicate either the extent or the severity of each difficulty, or its likely impact on learning' (pp. 334-35).

Hence the attributes of threshold concepts were used to analyse the student data to elicit what the barriers to topic mastery might be. They found that 'problems with definitions and concepts are not likely to be considered threshold concepts' because they could not be certain of the integrative and transformative impact of the potential threshold concept on student learning. However, three other threshold concepts were identified as 'lack of inferential-hypothetical reasoning (on the basis of it being transformative and irreversible), narrowness of the mental field and visualisation of relationships' where examples from interviews were
provided to substantiate their identification (Weil & McGuigan 2010, p. 339). This framework has not been used for further studies to identify threshold concepts. On the other hand, many studies have used the Meyer and Land (2003) attributes of a threshold concept as a framework for identifying threshold concepts.

2.3.2.3 Attributes of Threshold Concepts

A number of studies have explicitly used the attributes of threshold concepts as per the Meyer and Land (2003) definition as a form of framework to identify threshold concepts in a discipline (see Section 2.2) and hereinafter will be referred to as the Meyer and Land Framework (2003). In physics, an Australian study by Wilson et al (2010) identified measurement certainty as a threshold concept using the Meyer and Land Framework (2003). Likewise, the Meyer and Land Framework (2003) has been used to identify threshold concepts in introductory programming (Vagianou 2006); computing (Shinners-Kennedy 2008); geography (Fouberg 2013); introductory electronics (Scott et al 2010); electrical engineering (Scott & Harlow 2012a); and the management discipline (Coughlan & Graham 2009; Coghlan & Graham Cagney 2013). There are many examples where these attributes have formed the basis of the research however there appears to be a trend where not all attributes are considered with a tendency to focus on the troublesome attribute (Baillie & Johnson 2008; Kobus 2012; Macdonald & Black 2010). Davies and Mangan (2007) believe that troublesomeness infers that the threshold concept will as a matter of fact be transformative and integrative as well. In contrast, Holloway et al (2010) and Wilson et al (2010) focused instead on the troublesome nature, irreversibility, integration and transformation of understanding while Knight et al (2013) focused on all of the attributes apart from the irreversibility attribute. Hence, the boundedness of a threshold concept is not always considered (Male & Baillie 2008) and the study of the irreversibility attribute also varies across studies.

After a critical review of the literature, it revealed that while the Davies and Mangan (2007) framework and MLE have been suggested and/or used to identify threshold concepts, there is a lack of a consistent framework to this identification and considerable variability in the focus taken in studies. The Meyer and Land Framework (2003) with a focus on the attributes of a threshold concept appears to have been more extensively justified and adopted in the literature making this a suitable framework to adopt in the current study. Methods of data collection used in studies into threshold concepts will be considered in the following section.
2.3.3 Data Collection Methods

This section will delve further into the range of data collection methods used to facilitate the identification of threshold concepts. These methods will be discussed and highlighted based upon the multi-disciplinary literature review noted in the previous section (see Appendix 1). These methods include comparative studies; reflective diaries or biographical interviews that describe critical incidents; as well as other data collection methods such as face to face interviews and focus groups. Examples are provided to provide a practical insight into the threshold concepts identified in different disciplines.

2.3.3.1 Comparative Approaches

Davies (2006) provides two comparative approaches that could be used to identify threshold concepts. He suggests that threshold concepts can be identified by using 'a mode of enquiry that is distinctive and necessary given the characteristics of threshold concepts' (p. 79). Such modes of enquiry might include 'comparing ways in which different groups of scholars [from different disciplines] analyse the same set of phenomena'. The adoption of this approach, however, has not been reported within the existing literature.

Another mode of enquiry suggested by Davies (2006) is a comparison of how novices (students) and experts (academics) analyse a disciplinary problem to provide insights into any commonality in problem solving and ways in which the problems are seen. Research has been undertaken using adaptations of this approach where comparisons are made between experts and novices but with the data collected by other means and not solely reliant on how each person analyses and solves a disciplinary problem (Wilson et al 2010; Park & Light 2010; Kobus 2012; Yorke-Barber et al 2008; Gray & Blake 2013). For example, Kobus (2012) undertook a pilot study in the UK in relation to dental education. Student and teacher perceptions of the dental curriculum, perceived conceptual difficulties and identification of potential threshold concepts were sought through semi-structured individual interviews undertaken with four students and four clinical teachers.

Comparisons have also been made between academics (experts) and graduating students rather than novice students. Eckerdal et al (2006) justify their choice of interviewing graduating as opposed to novice students as they believe that graduating students ‘were more
likely than novices to have mastered the relevant concepts and to have done so long enough ago to have some perspective’ (p. 109).

2.3.3.2 Reflective Diaries or Biographical Interviews Describing Critical Incidents

Use of reflective diaries or biographical interviews 'that encourage the description of critical incidents might reveal threshold concepts through moments of realisation of how a subject community thinks and practises' (pp. 79-80) is another data collection method suggested by Davies (2006). There has been only limited use of this approach. Clouder (2005) reported on two studies where the project was ongoing that explored the transformation physiotherapy students undertake in practical placement when having to care for patients and, as such, caring was suggested as a threshold concept. Students reflected on critical incidents using discussion forums and the posts were used to gather data as well as data from group feedback sessions. Clouder (2005) found that threshold concepts helped to explore the nature of caring in terms of it being troublesome but also an implicit aspect of student learning in terms of being a health care professional. Reflective papers and essays were used by McGuigan and Kern (2010) to determine student preconceptions of accounting as a threshold concept however the description of critical incidents was not the focus in this study.

Moström et al (2008) used transformation biographies to investigate student experiences when considering their understanding of abstraction in computer science. In completing the biographies students were asked to 'identify and describe a computing concept that transformed the way they see and experience computing' (p. 127). It was found that abstraction was not a threshold concept, a view contrary to that in the literature. However, they do acknowledge that students may have been writing up their biographies in mind with what they thought the instructor wanted them to write. Considering many of the biographies formed part of the assessment they have indicated that this may not provide a reliable indication of the student experiences researched.

2.3.3.3 Other Data Collection Methods

A range of other methods of data collection, often in combination, have been used in studies that have attempted to identify threshold concepts. These include focus groups, surveys and interviews all with students as well as observation of students (Scott et al 2010); observation of students and discussions with lecturers (Scott & Harlow 2012a); concept maps by staff, written reflections by students, a focus group with students involving discussion and a
concept mapping activity and observations of a lecture activity (Knight et al. 2013); reflective essays by students (Fouberg 2013); interviews with students and academics, literature reviews, discussions with academics and completion of surveys by academics (Taylor 2006, 2008; Taylor et al. 2011); focus groups with academics and an online student survey (Gray & Blake, 2013); discussion forums and group feedback sessions with students (Clouder 2005); transformation biographies by students (Moström et al. 2008); focus groups with students, semi-structured interviews with academics and tutors and workshops with students, academics and tutors (Male and Baillie 2011a); concept maps with staff and students (Park and Light 2010); surveys and questionnaires with students (Holloway et al. 2010); observations and semi-structured interviews with students and staff (Kobus 2012); surveys/questionnaires and interviews with students and staff (Eckerdal et al. 2006; Zander et al. 2008; Boustedt et al. 2007); brainstorming with academics and semi-structured interviews with students (Wilson et al. 2010) and surveys with students and staff (Yorke-Barber et al. 2008).

While the majority of studies have used primary sources to collect their data, these primary sources are not always the same. They range from academics, teachers, graduating students, novice students and tutors. A number of studies have selected students as the starting point for collecting data on the identification of threshold concepts (Scott et al. 2010; Weil & McGuigan 2010; Holloway et al. 2010; Fouberg 2013; Moström et al. 2008; Clouder 2005). Others have investigated academics (Eckerdal et al. 2006; Zander et al. 2008; Boustedt et al. 2007; Park & Light 2010; Gray & Blake 2013; Knight et al. 2013; Kinchin et al. 2011, Wilson et al. 2010) although this has not always been successful. Collecting data from students in the first instance to identify threshold concepts may be problematic as it is difficult for students to know what they do not know. Additionally, a student may believe they have a full understanding of a threshold concept but in fact it may be a misunderstanding of such. This may distort the identification of threshold concepts. There is also the potential problem of “recall” by students. Shinners-Kennedy and Fincher (2013), for example, in researching how difficult and important concepts in computer were experienced by students (rather than academics) found that

students were (largely) unable to recall a "critical" moment in their learning ... even when students were aware of the general case, that they had learned something they previously did not understand, they were frequently unable to recall details of the situation – the time or place – that it happened ... there were some students that recalled revelatory moments, but
They were rarely unique, in the way that we were expecting. Rather they reported them as an ongoing experience (p. 12).

They admit that the findings did not support the learning picture they anticipated or the acquisition of threshold concepts espoused by researchers including themselves. They explain their disappointment as hindsight bias where asking learners to recollect conceptual difficulty can be unreliable. They cite Hawkins and Hastie (1990) to support this view as 'projection of acquired knowledge into the past can affect the selection of evidence, the evaluation of that evidence and the way in which the evidence is integrated into decisions about the knowledge' (p. 13). Further explanation is provided by Henriksen and Kaplan (2003), in Shinners-Kennedy and Fincher (2013), as they argue that 'possession of outcome knowledge changes the way we consider "a bewildering array of non-convergent events" because they have now become "a coherent causal framework for making sense out of what happened"' (p. 13).

Notwithstanding that data collection from students has continued, Shinners-Kennedy and Fincher (2013) suggest that evidence from teachers as discipline experts should be the starting point. Lucas and Mladenovic (2007b) also maintain that it is the lecturers’ views of a subject that should form the starting point in identifying threshold concepts where dialogue among lecturers creates discussion of the curriculum, educational practice and the nature of key concepts in a subject or discipline. Cousin (2009) also asserts that academics (subject specialists) are well placed to deconstruct their discipline and are the first place to start when trying to identify threshold concepts. Park and Light (2010) cite the need to draw on the instructor's expertise in undertaking their study. Particularly they identify the instructor using their expertise as not only a scientist but also a student who initially undertook learning of the discipline. Additionally, as a teacher, the instructor could reflect on difficulties encountered by students when learning the discipline as well as constructing curriculum, teaching concepts and developing learning outcomes.

Lucas and Mladenovic (2007b) also suggest that both the views of the student and the lecturer are needed to identify a threshold concept in order to harness expectations of the lecturer in terms of student learning and the experience of the students in this process. Use of a class room exercise can facilitate this as shown in Lucas and Mladenovic (2007a). Hence, testing threshold concepts identified by academics on students may be worthwhile in gaining further insight from the student perspective and may assist in the development of resources and strategies. While not the focus of this study, this raises the question in the writer’s mind.
as to whether people working in the accounting profession might also provide useful insights into threshold concepts. Potentially, research to investigate threshold concepts undertaken with academics and students could be also undertaken with members of the profession. It is timely to consider in greater detail the research undertaken in different disciplines when endeavouring to identify threshold concepts.

2.3.4 Findings and Outcomes across Disciplines

Research in the engineering, science and computing disciplines appears to have exhibited significant interest in threshold concepts followed by a wide range of other disciplines including (but not limited to) dentistry, geography, management, information systems, economics, health care, property education, law and history. In the engineering discipline, Male and Baillie (2011a; 2011b) have been instrumental in using the notion of threshold concepts (with variation theory and capability theory – see Section 2.3.5.1.6) to renew the engineering curriculum in an Australian university. Earlier work by Baillie and Johnson (2008) identified professionalism as a source of troublesome knowledge for engineers and potentially a threshold concept. Object-orientation and recursion (Holloway et al 2010) and critical flow in civil engineering (Knight et al 2013) have also been identified as threshold concepts in engineering based on the Meyer and Land Framework (2003).

Computer science is a discipline where a major study into threshold concepts across the US, Sweden and the UK has resulted in a number of papers (however a final report on the study is not evident) as well as papers written by other researchers who are not part of the study (Sorva 2010; Vagianou 2006; Shinners-Kennedy 2008; Rountree & Rountree 2009; Park & Light 2010; Rountree et al 2013). The study looked at how threshold concepts might be linked to other ideas in this discipline such as “Fundamental Ideas” that are specific to the computing curriculum; however, the researcher of this thesis found that it seems to overcomplicate the notion of threshold concepts, provides duplication and made it difficult to work through how the different theories are related to threshold concepts.

In science, Taylor et al (2011) undertook an Australian study that investigated threshold concepts in biology as a way of improving the understanding of biology by students that used previously identified threshold concepts (Taylor 2006, 2008). The study resulted in the development of a detailed Biology Threshold Matrix where the authors suggest that 'formative assessment, reflection and feedback are key components of the incorporation of
the ideas in the Biology Threshold Matrix into curriculum design. The Matrix clearly provides a model framework for developing standards in teaching and learning for biology courses at all levels’ (p. 33). Research has also been undertaken in physics (Wilson et al 2010; Akerlind et al 2011) and bioscience (McCune & Hounsell 2005).

A large and significant study (that resulted from an Australian Learning and Teaching Council [ALTC] grant) investigated threshold concepts in law and physics (Akerlind et al 2011) and used a combination of threshold concepts and variation theory (see Section 2.3.5.1.4) to develop and evaluate a model for curriculum design. A feature of the study is the focus on one threshold concept for physics (measurement uncertainty) and one for law (legal reasoning) in contrast to other major projects that have focused on the discipline as a whole.

Research on threshold concepts in the accounting discipline is rather nascent and a review of the extant research reveals a limited number of studies. These studies have been predominantly in the area of accounting known as introductory accounting and exhibit some of the issues raised when reviewing threshold concept research in other disciplines. Such issues include the use of other theories in an endeavour to make the research into threshold concepts more rigorous and the identification of preconceptions of the accounting discipline potentially as a perceptual threshold. Early research by Lucas and Mladenovic (2006) in the form of workshops with academics found that there was confusion from an academic viewpoint in identifying a threshold concept in introductory accounting and how such threshold concepts can be organised into a framework.

Potential threshold concepts in part of an introductory accounting course were investigated by Weil and McGuigan (2010) using the notion of threshold concepts and Mediated Learning Experience (MLE) from the cognitive research domain. MLE asserts that ‘a lack of effective mediation results in deficient cognitive operations, for example, poor visualization of relationships and lack of inferential-hypothetical reasoning’ (p. 334). The earlier Weil study focused on the ‘requisite thinking skills for success in the study of accounting’ by analysing problem solving by novices using MLE theory and provided an insight into the types of difficulties accounting students confronted in their studies (Weil & McGuigan 2010, p. 334). Part of the data (on the bank reconciliation question) from the earlier study by Weil using MLE was re-examined by Weil and McGuigan (2010) to investigate an assertion made by Lucas and Mladenovic (2007b) that threshold concepts would need to draw on other areas of research including cognitive psychology if it was to develop its own theoretical framework.
The results of the study suggest that ‘cognitive psychology and threshold concept theory may well be compatible, in that cognitive operations, although not necessarily concepts in a traditional sense, may well possess most of the attributes of threshold concepts’ (Weil & McGuigan 2010, p. 343). They acknowledge that there are limitations of this study as the students in this study were not reviewed in terms of their study effort and previous success or otherwise in this course to indicate if students were diligent and proactive in their study of this topic in the course. While cognitive psychology may have some compatibility with threshold concepts, further research is required in this area before any conclusions may be formed.

McGuigan and Kern (2010) argue that a major perceptual threshold (note that the authors have used the term perceptual threshold rather than threshold concept) students need to overcome in their learning is their own preconceptions of the accounting discipline. Crossing such a threshold, the authors agree, will extend student learning beyond a superficial stage. While negative preconceptions of accounting are known to inhibit student engagement and learning in accounting, further argument and/or research is required to ascertain how perceptual thresholds specifically relates to, or differs from, the notion of threshold concepts.

Research by McGuigan and Weil (2011) investigated preconceptions of the accounting discipline using the notion of threshold concepts from a student point of view. The findings supported earlier research confirming that students coming into the first accounting course, introductory accounting, generally held negative perceptions of accounting. Using the notion of threshold concepts, the defined preconceptions of accounting discovered in the first part of the study, and the comments acquired in reflective essays and journals, McGuigan and Weil (2011) suggest that student preconceptions of accounting may provide a barrier or ‘preconceptual threshold’ (note the change from perceptual threshold in 2010 paper to preconceptual threshold in 2011 paper). Hence students need to negotiate their way through ‘to ignite a major shift in how students perceive – and ultimately study – the discipline of accounting’ and that educators can assist in this process by acknowledging and addressing the perceptual threshold in the curriculum (p. 18). The authors found that ‘allowing students to engage in reflective practice’ was one way of achieving this (McGuigan & Weil 2011). There also appears to be an inconsistency in terms of whether ‘preconceptions of accounting’ is being identified as a threshold concept or a preconceptual threshold i.e., the terms seem to be used interchangeably. While this study makes a valuable contribution in terms of identifying student preconceptions of accounting as a threshold concept, it is perhaps the design and
implementation of the learning and teaching activities (use of reflective practice with reflective essays and journals) that are driving the change in perception rather than the curriculum.

In summary, a review of the literature across a range of disciplines revealed an abundance of interest (with the most prominent interest exhibited in computing, engineering and science) in the notion of threshold concepts and an array of methods (interviews, surveys, workshops, focus groups, observations, concept mapping activities and written reflections with interviews) used to collect data from students and/or academics to identify threshold concepts. While some of the earlier studies into threshold concepts revealed a lack of information as to how threshold concepts were identified, latter research is becoming more comprehensive and thorough. This is an important issue as the identification of threshold concepts is needed before further investigation into them can take place and potential ways of addressing them with curriculum can be considered. Collection of data from academics in the first instance is advocated by several researchers as the appropriate starting point in identifying threshold concepts with subsequent research involving the collection of data from students to ensure that both points of view are considered.

In the accounting discipline, only limited research has been undertaken, in the area of introductory accounting. This provides an opportunity in the current study to gather the perceptions of accounting academics as to what the threshold concepts might specifically be in financial accounting and the reasoning that supports these thoughts. Initial findings in accounting research suggests that student preconceptions of accounting may potentially be a threshold concept in the context of introductory accounting but further research would be needed to confirm this. More recent studies have begun to integrate and make explicit the role of theory around threshold concepts. A range of theories are accordingly considered in the following section.

2.3.5 The Notion of Threshold Concepts and Learning Theories

A range of learning theories is evident in the research literature in different disciplines including education, sociology, neuroscience and psychology. Some of these learning theories according to Land et al (2008) have a close connection to threshold concepts and include social constructivism, social learning theory, variation theory, social anthropological theory, post-modern cultural theory and capability theory. While the application of these
theories to examining threshold concepts is at an early stage, the following sections examine what and how theories have been adopted in studies on threshold concepts to date.

2.3.5.1 Learning Theories

The existence of several learning theories reflects that there are different ways that learning can be seen. This is explained (using examples) by Brockbank and McGill (2007):

> the landscape of learning can be viewed through a variety of lenses. For instance.... cognitive approaches tend to scrutinise internal cognitive structures and see learning as transforming those structures. Where cognitive processes are altered through social interaction like modelling or imitation the learning is identified through social learning theory...constructivist theories are concerned with how learners build their own mental structures through interaction with their environment... (p. 16).

These learning theories will be explored in the subsequent sections with particular reference as to how they relate to the notion of threshold concepts.

2.3.5.1.1 Cognitive and Social Constructivism

Stewart (2012) explains that cognitive constructivism drew on Piaget’s early work on thinking patterns and how these patterns mature. Piaget (1952) in Stewart (2012) ‘proposed that children developed different ways of perceiving, interpreting and gaining meaning at different stages of growth’ but also that ‘the maturing brain develops concepts: flexible frameworks into which we assimilate knowledge and experience [and] Piaget referred to these conceptual networks as ‘schemas’’ (p. 7). When new information is assimilated, the schemata grow and understanding increases in sophistication. Hence constructivism emanated from this thinking where ‘knowledge can be constructed only in the mind of the learner’ (p. 7).

Eckerdal et al (2006) in exploring the notion of threshold concepts in computer science assert that threshold concepts are part of the framework of knowledge constructed by students under constructivist ideals. Constructivism has also formed the basis of thought in other studies when investigating threshold concepts (Yorke-Barber et al 2008; Vagianou 2006; Fouberg 2013).

Overall, cognitive and constructivist theorists see learners as being actively involved in constructing knowledge in the process of learning where previous learning and understanding
is recognised and assimilated with new knowledge. Cognitive and constructivist theorists according to Stewart (2012) advocate student centred learning where the teacher facilitates learning and the student becomes active in the learning process thereby enabling students to construct their own understanding of knowledge. Hence the teacher guides the student to ensure they have the knowledge and skills to support new learning and providing prompts to actively engage the student in the learning process.

Sociologists and social psychologists are critical of such theories including behaviourist theories as they argue that learning does not usually occur in isolation. Social constructivism grew from the work of Vygotsky with the development of the Zone of Proximal Development (Vygotsky 1978, in Stewart 2012). Such thought recognised that language, culture and the impact of other people can have an effect on individuals when they are constructing understanding. Land et al (2008) assert that the notion of threshold concepts has connections with social learning theory, particularly Vygotsky’s zone of proximal development. In particular, they refer to how social learning theory analyses how learners’ identities are transformed as they are confronted with new knowledge. Vygotsky acknowledged that the Zone of Proximal Development (ZPD) required teachers to use activities and strategies that extend a student’s thought as a student is limited to the extent to which their learning can develop if left solely on their own to construct such meaning. The assumption underlying this concept is ‘that psychological development and instruction are socially embedded; to understand them one must analyse the surrounding society and social relations’ (Ardichvili 2001 in Palmer 2001, p. 35). Ardichvili (2001) in Palmer (2001) identifies that this concept is of use when planning instruction and ‘successful instruction has to create a ZPD that stimulates a series of inner-developmental processes' (p. 36).


suggest that learning is situated in distinct contexts and that success in any one is a function of how well individuals fit in and learn to be competent in that setting…. [and that] rather than acquiring structures or constructing models to understand the world, we participate within and adapt to frameworks that already possess structure (pp. 13-14).

Gray and Blake (2013) assert that the use of a constructivist paradigm in understanding threshold concepts has limitations. They argue that while students construct their own understanding, there is still a need for educators to impart a groundwork of knowledge' to provide a broad understanding to students. They agree with Perkins (2006) that if students are
left on their own to solely construct understanding, it may involve understandings that are ‘naive, disintegrated or even misguided’ (p. 2). They believe that students on their own have difficulty understanding threshold concepts because ‘they are not practising professionals or academics in the field’ (p. 2).

### 2.3.5.1.2 Humanistic Theory

Humanistic theorists acknowledge that self-perception and motivation can impact on learning. Campling et al (2008) described how Abraham Mazlow created a hierarchy of needs requiring fulfilment before a person can realise their potential. Basic human needs form the base of the hierarchy, followed by safety needs (day to day security and stability), social needs (of belongingness with others), esteem needs (for respect, recognition; a sense of competence or being able to master something) leading to the highest level of the hierarchy being self-actualisation needs (for self-fulfilment; use of abilities creatively and to their fullest extent). This indicates that ‘students need a supportive context in which to learn: if students feel that they belong, they will be motivated to fulfil their potential and learn for learning’s sake’ (Mazlow 1970, in Stewart 2012, p. 15). Mezirow (1991) in Stewart (2012) developed a transformative learning theory that

> centres on the thinking processes that occur when a person examines existing understandings and a change in perspective results. Mezirow emphasised the central role of critical reflection in working through existing beliefs, assumptions and attitudes, and stressed the role of the teacher in creating a ‘safe’ learning environment to nurture reflective expression (pp. 15-16).

The notion of threshold concepts, according to Stewart (2012), is part of humanistic theory although it also identifies with some of the other theories mentioned and is useful in understanding learning which can then inform teaching practice and potentially, curriculum development. Stewart (2012) supports this by acknowledging that ‘an understanding of learning theories, their applications, limitations and their continuing refinement provides …. a powerful vocabulary and framework for organising thinking and making sense of the challenging demands of university teaching’ (p. 3).

### 2.3.5.1.3 Conceptual Change Theory

Lucas and Mladenovic (2007a) assert that in the past, research has focussed more broadly on ‘the nature of conceptual understanding and on how to achieve conceptual change’ whilst the identification of these concepts, as threshold concepts, are now a developing focus for
researchers (Lucas & Mladenovic 2007a, p. 3). Entwistle (2008) endeavoured to make a clearer distinction between conceptual change theory and threshold concepts. The conceptual change literature tends to focus on solitary concepts but of interest is how students understand topics or theories when they “bring together groups of concepts” (p. 24). Studies undertaken by Entwistle (1992, 2003) in Lucas and Mladenovic (2007a) found that ‘it is not a specific concept or theory that is responsible for the insight arrived at, but rather the students’ attempts to make sense of topics for themselves’ (p. 25). He reasons that exploring student experiences about how their thinking about a subject transforms, when a student grasps a threshold concept, is likely to be similar to the experiences a student has when attaining a knowledge object but that the notion of threshold concepts may assist in integrating such understanding in the syllabus of a subject.

Entwistle (2008) elaborates on the three types of conceptual change espoused by Davies and Mangan (2007) by stating that discipline conceptual change represents threshold concepts as 'it opens up the subject through the integration of other concepts' while procedural conceptual change is more likely to represent a broader change in disciplinary thinking rather than a concept as such (p. 32). While Entwistle (2008) acknowledges that conceptual change theory focuses on solitary concepts, he also recognises that the benefit of both conceptual change theory and threshold concepts is that they both can be used to understand how a student grasps either a threshold concept or a knowledge object. Additionally, he acknowledges that the benefit of threshold concepts is its capability of integrating this understanding into the syllabus.

2.3.5.1.4 Variation Theory

The literature on threshold concepts reveals the use of phenomenography as a research methodology (Wilson et al 2010; Taylor et al 2011; Cope & Staehr 2008; Male & Baillie 2011a) used explicitly in combination with variation theory (Akerlind et al 2011; Park & Light 2010; Male & Baillie 2011b) while other studies adopt a phenomenographic research approach and implicitly adopt variation theory (Wilson et al 2010; Taylor et al 2011; Cope & Staehr 2008; Male & Baillie 2011a). For example, in Wilson et al (2010) the use of variation theory is implied where phenomenographic analysis was explicitly identified to determine the different ways students understood measurement uncertainty in physics.

Male and Baillie (2011b) explain that variation theory attests that learners need to undertake different experiences and situations in order to learn from such variation to assist them in
dealing with future circumstances that are unforseen or unexpected. Hence, variation theory describes ‘how students learn by experiencing variation’ (Male & Baillie 2011b). Bowden and Marton (1998) in Baillie et al (2013) explain that ‘experiencing the variation [is where the student] experiences at the same time [researcher’s emphasis] the different ‘values’ (i.e. instances) in this aspect or dimension that varies’ (p. 35) and that this is not the same as a student having a variety of experiences. This is achieved by students being able to determine which ‘aspects of their knowledge are relevant to the particular situation…and then they need to work out just what the problem really is and …. try to solve the problem by putting together the things they know that are relevant’ (Bowden & Martin 2008 in Baillie et al 2013, p. 233).

Park and Light (2010) used variation theory in the discipline of science to determine surface-area-to-volume ratio as a threshold concept with the use of concept maps. A compilation of key concepts in the course and then a concept map by the instructor was then followed by an interview with the instructor to categorise the concepts as difficult, important or threshold. Students then prepared their own concept maps at the beginning and at the end of the semester using (or not using) the concepts identified by the instructor. Students completed a survey at the end of the course to classify the concepts as the instructor had done earlier. An analysis of the students’ concept maps for concepts and conceptual links found significant variation in student understanding.

While Marton, in Prosser (1993), describes phenomenography as being fundamentally about the 'idea that people experience and understand various aspects of the world around them in qualitatively different ways, and that "how" we go about experiencing and understanding that world is inseparable from "what we experience and understand' creating a relational link between understanding and experience (Marton 1988a, p. 21); and from a learning perspective, 'learning is conceived of as a relational phenomenon – how we learn is inseparable from what we learn' (p. 21).

According to Land et al (2008) phenomenography has a close connection to threshold concepts. Stewart (2012) suggests that

phenomenographic studies have contributed to our understanding of the ways teachers and students conceptualise learning, or concepts within their discipline; this arms the teacher with a crucial insight of the differing ways that students understand subject concepts which can inform approaches to teaching (p. 18).
The link between variation theory and the phenomenographic research approach is explained by Akerlind et al (2014):

variation theory developed out of phenomenography in the early 2000s, with a shared epistemology but a particular focus on pedagogical implications and applications, shifting from the phenomenographic focus on identifying variation in understanding of concepts, researchers started to investigate variation in the way concepts are presented in the classroom and how this relates to the understandings students develop' (p. 233).

Pang (2003) provides further details on how phenomenographic methodology and variation theory are linked:

phenomenography set out to reveal the different ways in which people experience the same phenomena. This 'first face of variation' refers to the variation in ways of seeing something, as experienced and described by the researchers. New phenomenography shifts the primary focus from methodological to theoretical questions, and characterises a way of experiencing something in terms of the critical aspects of the phenomena as discerned by the learners (p. 145)...i.e. from how to describe to what is described, from the researchers' description of their experience of variation between different ways of experiencing various phenomena to researchers' description of the learners' experience of variation and thus the simultaneous awareness of the critical aspects of the phenomenon which define ways of experiencing a certain phenomenon (p. 154).

It is the critical aspects of the phenomenon that highlight threshold concepts as an important research phenomenon through which variation in student understanding can be examined and ways of enhancing student learning and their ability to deal with unexpected circumstances further explored.

2.3.5.1.5 Capability Theory

Variation theory has often been linked to capability theory in recent studies of threshold concepts. Bowden and Marton (1998) cited the need for development of capability in graduates by universities. Such capability prepares students for engaging effectively in situations they will encounter in the future and results from ways of seeing. That is,

as we always act in relation to situations as we see them, effective actions spring from effective ways of seeing. Preparing students for situations in the future amounts to developing their capabilities for seeing in effective ways and developing the eyes through which these
situations are going to be seen. Seeing a situation in a certain way amounts to discerning certain aspects of the situation and focusing on them simultaneously and identifying critical aspects that result in effective action (p. 278).

Bowden and Marton (1998) acknowledge that to be able to distinguish such aspects of a situation in the future, a person ‘must have experienced variation in those aspects… the only way we can prepare for the undefinable variation in the future is by experiencing variation in the present and by having experienced variation in the past’ (p. 278). They assert that this form of learning is akin to a person acquiring new ways of seeing situations and phenomena and that it is important due to its fundamental nature and the fact that knowledge supports the development of a way of seeing. Importantly, they argue that once a person has developed this new way of seeing, it is taken for granted and the person is often not aware of this. As such, they believe that ‘deeper and more holistic goal statements, in terms of capabilities for seeing certain phenomena and situations in certain ways and, accordingly, capabilities for dealing with these phenomena and situations in certain ways’ are needed (p. 279). Hence to obtain certain ways of seeing, the learner must encounter certain patterns of variation in the learning environment.

Capability theory suggests ‘students should prepare for unknown futures, such that graduates can identify key aspects of a situation, relate these to other knowledge, determine the task or problem, design a process to deal with it, and have ability to complete this (Bowden, 2004, in Male & Baillie 2011b, p. 2). Capability theory focuses the curriculum on capability development while learning content rather than curriculum focussed purely on content. Capability theory focuses on developing technical skills related to how someone knows rather than what they know. This becomes important when graduates leave university to work in their profession and/or expand into other professions such as management or education and they need to deal with situations they are unfamiliar with. For example, in the accounting profession changes are made to accounting standards that students need to be able to read and use once in the profession. The capability lies in the ability of the student to read, understand and interpret an updated or amended accounting standard and the implications it will have on practice. Simply learning the contents of a particular accounting standard at university, while useful in the short term, may not be of use if the accounting standard changes and if the student does not have the capability of adapting to changes in accounting standards. Also, changes in the global environment may also reveal circumstances that were not considered during undergraduate studies. Bowden argues that a students’ ability to deal with such
unknown situations can be enhanced with a curriculum that is predominantly focused on capability rather than content. Such capability has been termed knowledge capability (Bowden 2004 in Baillie et al 2013).

Knowledge capability refers to a process where appropriate decisions are made given the circumstances a person finds themself in. It refers to the ability to determine the key aspects that are relevant in each situation, relating them to knowledge a person has or knows how to acquire, determining what the problem or task might be in this situation, designing a solution to the issue and then being able to follow through with the solution (Bowden 2004 in Baillie et al 2013). Threshold concepts are premised on the basis that they are critical to the transformation in student learning and a way of seeing or understanding something. Hence the development of knowledge capabilities through the use of variation are an integral part of student learning where threshold concepts can guide what should be learned while capability development can guide how threshold concepts are learned (Baillie et al 2013). Studies by Baillie et al (2012a, 2012b, 2013) extended the study of threshold concepts and variation theory by combining them with capability theory.

2.3.5.1.6 Threshold Concepts, Variation Theory and Capability Theory

In the engineering discipline, Male and Baillie (2011a, 2011b) report on a project where they used a theoretical framework based on a combination of the notion of threshold concepts, capability theory and variation theory that allowed both the identification and investigation of threshold concepts to enable educators to facilitate curriculum development. The notion of threshold concepts are combined with capability and variation theory as ‘capability and variation theories provide the ideal mechanism for developing a strong pedagogical approach based on the newly emerging knowledge of the attributes of threshold concepts within different domains’ (Male & Baillie 2011b, p. 2). This approach informed the development of the engineering curriculum at University of Western Australia (UWA) where ‘thirteen engineering programs were replaced with one engineering science major to be taken as part of a three-year bachelor program and six two year masters of professional engineering programs’ (Trevelyan et al 2010, in Baillie et al 2012a, p. 12).

Male and Baillie (2011a) acknowledge that ‘threshold concepts are defined by their features as experienced by students … and therefore have collected data from students but also from academics ‘whose experiences give them awareness of students’ experiences (p. 252). They particularly point out that combining the notion of threshold concepts with capability and
variation theories can have implications for curriculum development but also for pedagogy and assessment and encourage deep approaches to learning rather than surface approaches (Male & Baillie 2011a, 2011b). This is supported by Entwistle's (2008) thoughts of threshold concepts not only being part of a syllabus but requiring integration of lower level concepts and recognition of not only content but also abstract notions and capabilities and how a way of thinking in a discipline needs to build up over time. Such recognition can assist in developing curriculum to meet these needs but also assist in other educational means such as design of assessments and teaching tools to promote deep learning approaches.

Baillie, Bowden and Meyer (2013) have since published a paper formalising and identifying the theoretical framework as the Threshold Capability Integrated Theoretical Framework (TCITF). They assert that the notion of threshold concepts is predicated on their identification however, capability theory is not predominantly based on concepts as such. While capability theory relates to individuals in a profession having the ability to deal with unforseen situations, having the knowledge of particular concepts alone is insufficient in assisting individuals deal with new situations.

The TCITF also makes reference to threshold capabilities. Threshold capabilities are identified by Baillie et al (2013) as

those capabilities that are in fact threshold to professional learning in a defined area of knowledge. In combination the development of a range of threshold capabilities will contribute to the development of overall knowledge capability, the primary goal of the capability theory approach’ (p. 236).

Knowledge capability in terms of a profession refers to the ability of a person to see things through the eyes of a professional. That is, an accounting student being able to view things through the eyes of an accountant which has similarities to the earlier threshold concept work undertaken by Meyer and Land (2003) where students needed to think like an accountant, for example. Hence a student would progress from ‘attaining understanding of threshold concepts to developing threshold capabilities and thence knowledge capability’ (p. 236).

Thus, identification of threshold concepts in the first instance becomes a necessary first step in potentially enabling accounting students to develop a higher level of understanding and capability in order to become a professional accountant. It is important to note that while this appears to be a very useful and considered approach to curriculum development, the results of the redesigned curriculum at UWA are as yet unknown but are awaited with interest.
In terms of capabilities, knowledge and skills of accounting graduates, reference is made to the threshold learning outcomes (TLO’s) developed for the accounting discipline in higher education. They have been developed for a number of disciplines in Australia by the Australian Business Deans Council (ABDC) as part of a new regulatory environment of the Federal government. Threshold concepts are not, however, the same as threshold learning outcomes. In fact, they are ‘defined in terms of minimum discipline knowledge, discipline-specific skills and professional capabilities including attitudes and professional values that are expected of a graduate from a specified level of program in a specified discipline area’ (ALTC, p.3). These TLO’s are centred on judgement, knowledge, application skills, communication and teamwork and finally, self-management and centre on what graduates will be able to do at the end of their degree. On the other hand, threshold concepts provide educators with the ability to determine the critical aspects of a degree that students should learn. While capability theory and variation theory can help determine how students are able to learn these concepts and develop knowledge capabilities of a professional accountant. The implications of TLO’s in the accounting discipline in relation to threshold concepts and associated theories such as capability and variation theory will be considered later in section 5.4.

In summary, there are several learning theories that align with the notion of threshold concepts. While cognitive and social constructivism theories, humanistic theory and conceptual change theory have been cited, it is variation theory and capability theory that is now resonating interest with the notion of threshold concepts. Threshold concepts help determine what students should learn whereas capability theory can guide how students learn such concepts. Together with the use of variation (theory) in the learning process, this may assist students in developing knowledge capability and therefore the ability to deal with unforeseen circumstances and to see things through the eyes of a professional such as an accountant.

2.4 Implications on Pedagogy and Curriculum Design

While there has been some criticism of the notion of threshold concepts, the idea of threshold concepts is considered important for several reasons. Threshold concepts may help explain problems student encounter when learning a subject but also provide linkages between learning outcomes and deep or surface approaches to learning employed by students as well
as the impact on curriculum design and teaching approaches (Davies 2003). Threshold concepts may provide a useful exploratory tool for academics to deconstruct, in this study for instance, the financial accounting discipline. Additionally, identification of threshold concepts in this area may assist in a reconsideration of teaching and assessment approaches.

Knowledge of threshold concepts can assist educators in managing a curriculum by identifying ‘a relatively small number of threshold concepts within the curriculum’ so that effort can concentrate on achievement of these threshold concepts (Boustedt et al 2007, p. 507). Akerlind et al (2014) point out that identification of threshold concepts can ‘justify the focused curriculum design attention involved...to guide the selection of appropriate disciplinary concepts’ as the application of variation theory to every concept in a curriculum would be impractical and too resource intensive (p. 229).

Threshold concepts can also be used to help students see the integrated nature of the discipline that goes beyond a particular subject/course. Boustedt et al (2007) suggest that it is important for instructors to understand the student experience in terms of how students learn a particular threshold concept but also how and why a student does (or does not) get stuck when learning a threshold concept. An understanding of the concepts integrated in a threshold concept can assist educators ‘with a context in which the concept might effectively be taught’ (p. 507).

Davies and Mangan (2008) identify several pedagogical issues that should be considered when trying to support students in grasping threshold concepts in their respective discipline. Firstly, they state the need to provide a student with basic concepts that may be open to variation but that form a foundation that can later be re-worked when further teaching and learning takes place. Secondly, making students aware of how procedures are undertaken by discipline scholars and the variation in the use of these procedures. Thirdly, assist students in integrating their understanding of the use of key procedures with foundational concepts in view of the threshold concept. Finally, to develop students’ awareness that uncertainty is a normal part of their learning.

In terms of curriculum design and learning and teaching, Land et al (2005) in Rust (2005) believe that program design and review should follow some general but also specific considerations. Generally, the sequencing of content needs to be considered followed by a reflection of how learners are ‘made ready for, approach, recognise, and internalise threshold
concepts’ and deeming what assessment is appropriate in assessing whether a learner has internalised the threshold concepts (Land et al 2005, in Rust 2005, p. 57).

More specifically, Land et al (2005) in Rust (2005) provide nine considerations when designing and evaluating higher education curricula. Firstly, the ‘jewels in the curriculum’ need to be identified as these threshold concepts are likely to be troublesome and important for conceptual understanding. Secondly educators need to consider how they can encourage learners to engage with the curriculum to facilitate acquisition of the threshold concepts identified and hence, transform the learner’s understanding. Educators need to actively listen to students to discover where students are having difficulty in transforming their understanding (the third consideration). This difficulty may arise from knowledge that is difficult conceptually; requires learners to be aware of the way of thinking and practising in the discipline and/or involve an extension in their use of language in coming to terms with a threshold concept. This can be uncomfortable for a learner hence an awareness of this by educators (the fourth consideration) is necessary in helping students cope with uncertainty and persist in attaining a transformation in their understanding (Land et al 2005, in Rust 2005).

Tolerating uncertainty is the fifth consideration as the transformation in understanding can often take time and does not happen immediately. Creating awareness for learners of this potential uncertainty and the need for the learner to persist are important considerations for the educator. Pettersson (2012) undertook a longitudinal case study to monitor the development of one person’s understanding of a threshold concept in mathematics known as function. The outcome of the case study found that transformation of understanding of this threshold concept by this person necessitated both time and work and was not immediate. The sixth consideration involves learners taking a recursive but also excursive approach to their learning where engagement with threshold concepts and troublesome knowledge is involved. The recursive nature of learning involves the learner looking at conceptual material in different ways and requiring integration of knowledge and oscillating from understanding to confusion to a renewed understanding. A simple model of listed learning outcomes in a curriculum may be too simplistic and not recognise the complexity of understanding required by the learner. Learning also has an excursive element where the learner is taken on a journey of discovery with an intended outcome and direction but also recognise that learners may digress and their direction may change on the path to this transformation in their learning (Land et al 2005, in Rust 2005).
The seventh element for consideration is recognition that not all students will find conceptual understanding troublesome hence an understanding of pre-liminal variation is necessary for retention and progression of students, that is, knowledge of the prior learning and experience of the student cohort can inform the design of the curriculum in terms of structure, sequence and forms of engagement in a program. There is also a need to recognise that what has been considered ‘good pedagogy’ in the past may not necessarily assist learners in grasping threshold concepts (the eighth consideration). For example, reducing parts of the curriculum to very simple concepts may not encourage students to engage with the complexity of a threshold concept and being content with retaining just a superficial understanding of it. Such superficial understanding is indicative of mimicry or ritual learning in terms of the student’s approach to learning. Similarly, endeavouring to relate conceptual understanding of a threshold concept to a student’s personal experience may be ineffective if a student has not had such an experience that enables them to engage in such learning. Academically, educators need to be wary of trying to over-simplify or generalise potentially troublesome concepts to avoid students from mimicking their understanding and therefore not fully comprehending a threshold concept. The use of critical thought designed to challenge students but possibly cause discomfort during the learning process, is one way academics can reconfigure how they introduce potentially troublesome concepts to students, in order to maximise the chances of students achieving such a transformation successfully (Land et al 2005, in Rust 2005; Meyer & Land 2005). Ultimately Meyer and Land (2005) believe that ‘threshold concepts lead not only to transformed thought but to a transfiguration of identity and adoption of an extended discourse’ (p. 375). The final consideration is an understanding of the ‘underlying game’ in terms of understanding the disciplinary way of thinking that may not always be obvious to the learner (Land et al 2005, in Rust 2005).

Another view of curriculum design that uses threshold concepts is provided by Akerlind et al (2014). It involves three stages where stage one involves identification of disciplinary threshold concepts (the focus of this thesis). The identification of such provides a focus for the design of the curriculum by identifying the areas that require intensive attention. Stage two involves the use of a phenomenographic research approach to identify 'what it is about these concepts that students find difficult to understand' while stage three utilises variation theory 'to guide the design of teaching and learning activities to address these difficulties' (Akerlind et al 2014, p. 228). Hence stage three involves focusing on 'how teachers can best design learning activities to draw students' attention to those aspects of a disciplinary concept
that they commonly miss noticing, but that need to be noticed in order to achieve a good understanding of the concept' (Marton & Tsui 2004, in Akerlind et al 2014, p. 228). While Akerlind (2014) acknowledges that any concept could be used for stages two and three, this is not likely due to the intensive resources to do so. Hence they have used the notion of threshold concepts in the first stage to determine the disciplinary concepts that require attention.

Kinchin et al (2011) support the benefit of threshold concepts to curriculum and teaching from a dental education perspective. They argue that removal of unnecessary content can result when priority is given to the integration of prior understanding rather than focussing on the acquisition of new knowledge; explicit linkages of conceptual and experiential understanding can be made; and a review of the curriculum to ensure that it allows cumulative but also segmented learning to allow for integration is required. Consideration of threshold concepts, they believe may mean that the curriculum can focus on thresholds to be crossed over rather than coverage of curriculum content. It also encourages discipline specialists to think about the curriculum and the linkages between dentistry and educational research.

The importance of threshold concepts and a considered approach to curriculum development recognises that learning in a discipline may extend beyond the degree and that such learning should be a combined effort over the curriculum rather than isolated parts. Baillie et al (2012b) found that

it can be expected that students will take a long time, possibly years, to develop threshold concepts and capabilities. Therefore, sustained approaches throughout a curriculum and taken by many teachers, rather than isolated teachers over short periods, will be necessary to help students develop systems thinking and some graduate attributes (p. 11).

From a pedagogical perspective, learning a threshold concept should be a gradual process using variation in learning and creating awareness among students that tolerating uncertainty is a common part of the learning process. In terms of curriculum development, knowledge of threshold concepts can guide understanding of how students learn and where the barriers to that learning may be. Identifying what the threshold concepts are in a discipline is an important first step in curriculum design. It is clear that curriculum development based on threshold concepts requires a combined approach where the focus is on limited threshold concepts, the integration of such concepts and an “all staff” approach that recognises that the
curriculum should not be taught in isolated pieces but as an integrated part of a whole learning experience that encourages lifelong learning.

2.5 Conclusion

The relatively embryonic idea of threshold concepts presents as one that holds much promise for improving the quality of teaching and learning in higher education. Within the accounting discipline, however, the research into threshold concepts is scant at best, with only a handful of published studies undertaken. The aim of this chapter therefore, was to move outside the accounting discipline and undertake a multi-disciplinary review of the research into threshold concepts with a view to developing a greater understanding of what constitutes a threshold concept (how might it be defined), the way in which research had been designed and undertaken – methodological positions, underlying theories, methods of data collection – and to obtain some insight into the findings, broader outcomes (successes) and issues when undertaking research on this topic.

The findings of this review reveal an evolving idea of threshold concepts which are perhaps best defined by their often interrelated characteristics identified by Meyer & Land (2003). These characteristics of a threshold concept - transformative, probably irreversible, integrative, often but not always bounded and possibly troublesome – have provided a valuable framework for researchers across a range of disciplines when attempting to identify threshold concepts. Reflective of the exploratory stage of research into threshold concepts, research approaches have tended to be of a qualitative and constructivist nature and aligned to a range of data collection methods – interviews, surveys, workshops, focus groups, observations, concept mapping activities and written reflections. There seems to be a general consensus that the views of academic teaching staff are an important first step in the process of identifying and researching threshold concepts but with student views an equally important next step in the process and a way to validate and reflect on academic views.

The use and integration of theory in studies into threshold concepts is also at a very formative stage. The Threshold Capability Integrated Theoretical Framework (TCITF), an amalgam of a number of theories (capability theory and variation theory) provides a potentially valuable way of explaining how threshold concepts operate in the process of student learning and how related “threshold capabilities” relate to professional learning in a defined area of knowledge (e.g., professional accounting).
The findings and outcomes of research into threshold concepts across a range of disciplines – but in particular engineering, science and computing disciplines – have highlighted the difficulty in clearly defining threshold concepts and the most effective way in which to obtain data. The myriad of approaches to undertaking these studies and the absence of clearly explicated theory (while perhaps reflective of the exploratory stage of research on this topic) makes drawing any initial (albeit tentative) definitions, or conclusions, about threshold concepts and how to ascertain what they might be somewhat difficult, perhaps even “troublesome”!

The studies conducted thus far across the various disciplines reveal a number of implications for the current study in the discipline of accounting. These include that: there is a demonstrated need for exploratory and descriptive research to identify, as a critical and necessary first stage, what the threshold concepts (which do not need to be extensive in number) in the discipline are. A constructivist approach aligned with interviews with academics teaching accounting courses in the first instance is well supported and should be clearly described when reporting the findings of the study; the characteristics of a threshold concept as identified by Meyer & Land (2006b) provide a useful (but not exclusive) way of ascertaining and examining threshold concepts; and that the outcomes of the study may be considered within the light of, and contribute to, the development of the emerging theories linking threshold concepts to student learning and professional practice.

The variation in views about what constitutes a threshold concept and the attributes surrounding them, in addition to the lack of research into the threshold concepts in financial accounting, provide the opportunity to investigate how accounting academics understand and perceive threshold concepts. As such, this study seeks to address the following questions:

1) What do accounting academics perceive threshold concepts to be?
2) Specifically, what are the threshold concepts in the undergraduate Financial Accounting discipline in Australia as understood by accounting academics?
3) How, and why, are these threshold concepts conceived as ‘thresholds’ in the undergraduate Financial Accounting discipline by accounting academics?
Chapter 3 RESEARCH DESIGN

3.1 Introduction

The literature review in the previous chapter and the questions posed in this study have informed the research design discussed in this chapter. The use of exploratory research to garner further understanding of the notion of threshold concepts, and their identification, signal that such research is still at a formative stage. The potential of threshold concepts to improve student learning is evident with the persistence of investigative research into this phenomenon. The aim of this research is described in this chapter in addition to the research approach undertaken. The method used to gather the data forming the basis of this study is also described. As data was collected through semi-structured interviews with academics, details regarding the selection criteria, the preliminary information supplied to the academic as well as the interview location and process are provided. Additionally, the procedure undertaken for transcription of interviews and data analysis, and issues of reliability and validity are discussed.

3.2 Aim of the Study

The aim of this study was to explore, identify and describe potential threshold concepts perceived to be critical to student learning in the financial accounting stream of undergraduate higher education. In considering the potential integration of threshold concepts into the accounting curriculum, an appropriate first step is the identification of threshold concepts and how, if at all, they are presently being integrated into this curriculum. Land et al in Rust (2005) refer to these threshold concepts as the jewels in the curriculum and identify them as being the first consideration when designing and evaluating higher education curricula. Likewise, Akerlind et al (2014) asserts that stage one of curriculum design involves the identification of disciplinary threshold concepts. An outcome of the identification and understanding of the threshold concepts in financial accounting from this study is the potential to inform teaching and learning practices and approaches’.

3.3 Research Approach

Collis and Hussey (2014) describe a research paradigm as a framework that helps guide how research in a study will be carried out. Such a framework is underpinned by an individual’s philosophy and ‘their assumptions about the world and the nature of knowledge’ (p.43). The
2 main paradigms according to Collis and Hussey (2014) are interpretivism and positivism. Philosophically, interpretivism assumes that social reality is constructed in the mind and 'knowledge comes from subjective evidence from participants' unlike positivism where the assumption is that there is one reality and 'knowledge comes from objective evidence about observable and measurable phenomena' (p. 46). While 2 main paradigms have developed historically – positivism and interpretivism – in reality, Collis and Hussey (2014) clearly enunciate that ‘few researchers now adopt the pure forms of the main paradigms [and that] new paradigms are distinguished by differences in the philosophical assumptions in which they rest’ (p. 45).

Apart from the philosophical underpinnings of each paradigm, different approaches are aligned with each paradigm. Interpretivism generates findings from ‘qualitative methods of analysis, which are based on qualitative research data’ whereas a quantitative approach is aligned with positivism (Collis & Hussey 2014, p. 45). A range of terms are employed to describe the approaches used under these main paradigms. For example, within interpretivism qualitative, subjective, humanist and/or phenomenological approaches are used while within positivism, quantitative, objective, scientific and/or traditionalist approaches are used. Silverman (2000) acknowledges that 'there is no agreed doctrine underlying all qualitative social research' (p. 9). However, he states there is a common belief by qualitative researchers that the methods they use enable them to gain understanding of social phenomena more deeply than pure quantitative data could.

In the review of the literature, studies were distinguished according to whether the researchers took a quantitative, qualitative or mixed method approach to the research. Prior studies in the identification of threshold concepts make the use of a qualitative research approach evident but what is less apparent in these studies is the theoretical perspective of the researcher/s. Some studies explicitly articulate the theoretical perspective while many others make no mention of it (see Section 2.3). As this research area is still in its infancy and due to the exploratory nature of the research questions posed, a qualitative approach has been undertaken for this study with the philosophical underpinning of the interpretivist paradigm. This is similar to the approach used by Kobus (2012) when identifying threshold concepts in dentistry. An interpretivist paradigm essentially 'suggests a broader philosophical perspective' (Collis & Hussey 2003, p. 47) where the focus is on ‘exploring the complexity of social phenomena with a view to gaining interpretive understanding’ (Collis & Hussey 2014, p. 45).}

Denzin and Lincoln (2000) assert that interpretivist philosophies find human (social) action
as being inherently meaningful as opposed to physical objects and that it involves the researcher understanding the meaning of these actions through a process of interpretation.

The characteristics of threshold concepts as espoused by the Meyer and Land Framework (2003) (see Section 2.3.2) form the basis of the approach used to elicit potential threshold concepts in the financial accounting discipline. The focus was on gathering rich data through semi-structured interviews with accounting academics regarding financial accounting as the discipline stream being the basis of this study into threshold concepts. The term financial accounting requires clarification as the term is sometimes used to include a variety of financial accounting topics in different Australian universities. In this study, financial accounting incorporates the introductory financial accounting areas such as regulation of general purpose financial reporting, double-entry accounting, journals, ledgers, balance day adjustments, closing entries, regulation of general purpose financial reports, bank reconciliations, internal control, subsidiary ledgers and statements of cash flow. The financial accounting stream also extends to corporate accounting and taxation areas such as consolidated accounts, tax-effect accounting, accounting for leases, accounting for intangible assets and accounting for property, plant and equipment.

3.4 Method

3.4.1 Data Collection

Data was collected through semi-structured interviews with accounting academics. While some studies identifying threshold concepts have used students as the starting point to collect data, academic views appear to be the appropriate starting point based on academics’ discipline knowledge and their experience in learning and teaching of the discipline. Collecting data from students is a plausible next step in verifying threshold concepts identified (see Section 2.3). Sixteen participants were interviewed for this study (including those in the pilot study). Data from only fifteen interviews were used as one interview respondent was unable to recall any incidences in which students had conceptual difficulties in the financial accounting stream of the discipline. The participants in the study voluntarily provided demographic information at the interview, details of which are summarised in Figure 2.
Figure 2: Demographics of participants in study

<table>
<thead>
<tr>
<th>Participant</th>
<th>Male/ Female</th>
<th>Age Range</th>
<th>Teaching Qualifications</th>
<th>Academic Qualifications</th>
<th>Years Teaching Experience</th>
<th>Years Teaching Experience *</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Female</td>
<td>56-60</td>
<td>Dip Ed</td>
<td>DipBusAcc, MBAcc</td>
<td>31-35</td>
<td>31-35</td>
</tr>
<tr>
<td>2</td>
<td>Female</td>
<td>36-40</td>
<td>BEd–Bus</td>
<td>BEd, BBus (Acc), MBAcc, PhD</td>
<td>16-20</td>
<td>16-20</td>
</tr>
<tr>
<td>3</td>
<td>Female</td>
<td>26-30</td>
<td>Nil</td>
<td>BComp, Grad Dip Sport Mgt, M (Sports Mgt), PhD (completing)</td>
<td>6-10</td>
<td>6-10</td>
</tr>
<tr>
<td>4</td>
<td>Male</td>
<td>56-60</td>
<td>Dip Ed</td>
<td>BBus, GD Computing</td>
<td>31-35</td>
<td>31-35</td>
</tr>
<tr>
<td>5</td>
<td>Male</td>
<td>31-35</td>
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<td>PhD, BBus (Hnrs), GCertResearch Mgt</td>
<td>6-10</td>
<td>6-10</td>
</tr>
<tr>
<td>6</td>
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<td>46-50</td>
<td>Nil</td>
<td>PhD, BCom (Hons)</td>
<td>6-10</td>
<td>6-10</td>
</tr>
<tr>
<td>7</td>
<td>Male</td>
<td>31-35</td>
<td>Grad Cert T&amp;L</td>
<td>PhD, MBA, BSc</td>
<td>6-10</td>
<td>6-10</td>
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<tr>
<td>8</td>
<td>Female</td>
<td>46-50</td>
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<td>PhD, BBus (Hons)</td>
<td>11-15</td>
<td>11-15</td>
</tr>
<tr>
<td>9</td>
<td>Male</td>
<td>46-50</td>
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<td>PhD, MEc, CA, BEc</td>
<td>26-30</td>
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<tr>
<td>10</td>
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<td>36-40</td>
<td>BEd (Sec) Bus</td>
<td>MBAcc</td>
<td>11-15</td>
<td>11-15</td>
</tr>
<tr>
<td>11</td>
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<td>60+</td>
<td>Cert IV Training &amp; Ass't</td>
<td>MBA, DBA (completing)</td>
<td>36-40</td>
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<tr>
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<td>36-40</td>
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<td>16-20</td>
<td>11-15</td>
</tr>
<tr>
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<td>BCom, GD (Bus-Acc)</td>
<td>40+</td>
<td>0-5</td>
</tr>
</tbody>
</table>

* Financial accounting stream
Of the fifteen participants, the majority were male but this was not a deliberate choice as participants were chosen for their knowledge and experience in teaching financial accounting as well as their employment status. Their employment status was of importance as it was considered that full time staff would have a greater understanding of the financial accounting curriculum at their respective university than most casual or sessional staff as full time staff are often involved in course coordination and program development and are aware of curriculum/course developments i.e. not only involved in course delivery and marking of assessments. The age of participants varied, with the majority aged from 36 – 60 years plus with the majority of male participants aged between 46 - 60 years plus and the female participants were generally between 36 - 60 years old. All participants were full time academics at different Australian universities teaching in the higher education sector with nine of the fifteen participants having a teaching qualification - five being male. Of the six participants who did not have a formal teaching qualification, four of these were male. Ten of the participants had between 6 - 20 years teaching experience with 50% being women. The five remaining participants had between 26 – 40 plus years’ experience with four of these being male.

All participants have considerable teaching experience. In terms of the number of years’ experience in teaching in the financial accounting stream, nine participants had between 6 – 15 years’ experience (four being female). Also one participant who had 40 plus years of teaching experience revealed that between 0 - 5 years were spent teaching in financial accounting which still met the criteria outlined earlier for participation in this study as the participant indicated that s/he had five years teaching experience. Ethics approval was obtained from the RMIT Business Ethics Sub-Committee to conduct the interviews with academic staff and the approval document is shown in Appendix 2. A pilot study was undertaken first and consisted of individual interviews with three academics from different Victorian universities. The pilot study helped re-shape the interview questions and also gave the researcher experience and confidence in undertaking the interview (Merriam 2009). The interview questions for both the pilot and main study were very similar as they were informed by the literature particularly the Meyer and Land Framework (2003). They were refined for the main study to include an assumption that participants reflected on students who were doing the work asked of them and the students did not have any major learning difficulties that the academic was aware of. They were also broadened to focus on areas of student difficulty but also areas that academics’ found difficult to convey to students. The pilot study
was followed by the main study. Interviews from the pilot study and the main study are analysed for this research.

3.4.2 The Interview

Use of semi-structured interviews to collect data from academics and/or students was a common theme in the studies identified in the multi-disciplinary literature review (for example, Kobus 2012; Male & Baillie 2011a; Wilson et al 2010) (see Section 2.3 and Appendix 1). Semi-structured interviews with academics based on the notion of threshold concepts and the Meyer and Land Framework (2003) have been used in past research when identifying threshold concepts. Male and Baillie (2011b), for example, reported on a large scale project that used interviews (as well as focus groups) where the earlier identification of threshold concepts predominantly focused on academic views to identify threshold concepts in engineering but also incorporated the perceptions of students during this project. It also incorporated the use of a two-page summary document (Appendix 3) on an introduction to threshold concepts (Cousin 2006) which was given to academics prior to collection of data to provide awareness to participants about threshold concepts. A similar approach was also adopted by Taylor (2006).

3.4.2.1 Pilot Study

The pilot study was undertaken with three accounting academics from three different Victorian universities. The participants were full time accounting academic staff at three Melbourne universities. The sample was predominantly selected on the basis of their involvement in the teaching of the financial accounting stream by the researcher based on personal knowledge of the academics’ involvement in financial accounting and suggestions by supervisors. Full time accounting academics that currently teach in the financial accounting stream or have taught in the financial accounting stream in the past five years were included for the pilot study to attain the views of academics that were reasonably familiar with the subject area. The length of teaching experience was sought in the demographic information from participants but did not determine the selection or otherwise of the participants. Participants were not provided with the interview questions prior to the interview but were provided with the Cousin (2006) document and the plain language statement that was required as part of the Ethics Approval from the researcher’s university. The plain language statement was a document that provides interviewees with details about the study, how data will be kept secure and points of contact if the interviewee has any
questions including the researcher and supervisory teams’ contact details. This was a standard requirement associated with ethics permission at the researcher’s university. Each of the participants had a basic knowledge of the notion of threshold concepts and did not appear uncomfortable in responding to interview questions of which they were unaware before the interview. On reflection this sense of the interviewee being comfortable may be due to the participants having some knowledge of the notion of threshold concepts. The researcher interviewed all of the participants and the interviews were recorded with the permission of the interviewee. An important part of the interviews in the pilot (and the main) study involve the researcher setting the context for the interview by asking participants to focus on students who were doing the work asked of them and who had no obvious or known learning difficulties. This enabled the participants to reflect on the nature of a threshold concept without being influenced by student work ethic.

3.4.2.2 Main Study

For the main study, thirteen interviews were undertaken with academics across Australia with the exception of Western Australia where this did not prove possible for reasons of access and funding. One academic in the ACT was the subject of a telephone interview. The remaining twelve interviews were undertaken with academics representing universities in Melbourne, Sydney, Adelaide, Queensland, the Northern Territory and Tasmania. A Skype interview was undertaken with the participant in the Northern Territory and was recorded with the permission of the participant. All other interviews were undertaken in person with the researcher travelling to the participant's university. Interviews were undertaken in the participant’s office and all were recorded with the permission of the interviewee. Where more than one interview was undertaken in a state, the interviews were arranged to occur on the same day. A spread-sheet was devised that acted as a contact log to identify potential contacts according to state/territory and then by name, phone, email address, relevant financial accounting course code and name, and details of emails sent, phone calls made, and interviews arranged (See Appendix 4). Once interviews were organised for a state/territory, the details of each participant and their location and contact details were recorded in a separate table and printed out and used on the day of the interview/s (see Appendix 5).

Participants in the main study were provided with the Cousin (2006) document and the plain language statement prior to the interview. Initially the interview questions were not provided prior to the interview for the main study for fear of the interview becoming too structured.
However, the lack of knowledge of the notion of threshold concepts exhibited through email conversations with participants, even with the Cousin (2006) summary, and lack of interview questions, seemed to create undue concern to the first participant. As such, the interview questions were provided to the remaining twelve participants prior to the interview. As a result, the subsequent interviews still allowed for exploration by the interviewer of themes and issues that arose during the interview and fear of the interview becoming too structured did not materialise. Overall, participants appeared more at ease during the interview than the first participant.

At the start of the interview, each participant was asked, and agreed, to complete a short document recording their demographic details. The participants were then asked to relate their experience in financial accounting with questions designed to elicit potential threshold concepts in this stream. The interviews averaged around 60 minutes. A listing of the questions that formed the basis of the interview can be found in Appendix 6.

Field notes were completed during and after each interview to record any reflections by the interviewer on aspects of the interview such as the ease with which questions were answered and the tone or feel of the interview. Any analytic reflections by the researcher were also noted in the field notes. Tracy (2012) suggests that analytic reflections can be recorded in field notes and do not have to be recorded in separate journals or diaries. She asserts that 'qualitative researchers go beyond recording "who, what, where, when, and how" to explaining notions of "why", "how does this make me feel", "how does this relate to my research questions", and "what's next"'(p. 121). This is supported by Richards and Morse (2007) when describing the use of memos to record 'memories of the mood or context of the meeting...ideas or impressions about portions of an interview, and to link the text to the literature with other data, or with very raw ideas that you do not want to forget; to record your ideas about an idea, a category, or a theme at which you are coding data, or a concept you wish to develop' (pp. 136-7). Hence the writing of field notes or memos as well as analytic reflection in qualitative research provided a source of data for more formal analysis.

The semi-structured nature of the interview often meant that some of the questions were re-visited when more than one potential threshold concept was identified and other probing questions were asked that were not initially on the list when required. For example, the question “Why do you think this concept is difficult to teach and/or students find difficult to understand?” was re-visited for each threshold concept suggested by the participant. The
nature of an interview is made clear by Kvale (2007) – ‘an interview is literally an inter-view, an interchange of views between two persons conversing about a theme of common interest’ (p. 5). Apart from the ability to ask probing questions, Tracy (2012) explains that interviews are also valuable as

participants can provide accounts – or rationales, explanations and justifications for their actions and opinions. Interviewees can reveal their specific vocabulary and language ... [and] interviews are especially valuable for providing information and background on issues that cannot be observed or efficiently accessed (pp. 132-33).

3.5 Data Analysis

Data analysis involves an iterative approach in which the researcher reflects on and alternates between the existing literature and emerging theories on threshold concepts (Chapter 2) and the themes developing from the data (Tracy 2012). Srivistava and Hopwood (2009) describe this approach as being a deeply reflexive process to obtain meaning and insights where data is visited and revisited to provide focus and understanding. Iterative analysis is distinguished from grounded analysis as ‘in grounded analysis, the study's emphases develop from the data rather than from research questions or existing literature where an iterative approach also encourages reflection upon the active interests, current literature, granted priorities and various theories the researcher brings to the data' (Tracy 2012, pp. 183-4). This is done in an iterative way with the researcher undertaking a reflexive process to understand the data while acknowledging that prior literature and experiences can inform such insights. Tracy (2012) describes sensitizing concepts as one of the key characteristics of qualitative research. Sensitizing concepts recognises that qualitative research may be informed by theories/concepts/experiences already in the researchers' mind forming a background of ideas that help the researcher 'see, organise and experience the research problem' (p. 28). Patton (2002) points out that the notion of sensitizing concepts

reminds us that observers do not enter the field with a completely blank slate. While the inductive nature of qualitative inquiry emphasizes the importance of being open to whatever one can learn, some way of organizing the complexity of experience is virtually a prerequisite for perception itself (p. 279).

Hence, such an approach recognises that there is existing literature and/or models that the researcher is aware of and that the researcher will have their own experiences that they bring
to the analysis as well. When combined with the data collected this provides emergent insights that help the researcher obtain a better understanding of the data.

The procedure for data analysis in this study was informed by Miles and Huberman (1994) and Tracy (2012). It consisted of a number of phases where the review of field notes and correcting interview transcriptions and re-reading interview transcriptions marked the start of the analysis process in a more informal way (Tracy, 2012). Saldana (2011) explains that ‘since qualitative research design, fieldwork, and data collection are most often provisional, emergent and evolutionary processes, you reflect on and analyse the data as you gather them and proceed through the project’ while the ‘continued reflection and more systematic data analysis’ takes place in the post fieldwork period (p. 90).

Organising the data was an important early phase that required the researcher to contemplate the method that best suited them to process such data such as use of computer files, use of a portable hard drive if using more than one computer, use of hard copies stored in labelled folders, etcetera. The importance of organising the data at the beginning of the analytical process cannot be understated (Marshall & Rossman 2006) and such organisation is seen as a critical aspect of qualitative research due to the volume of information gathered (Creswell 2012). The organising of such data is seen as an interpretive activity as 'when the data are organised in a certain way, they implicitly encourage the researcher to notice some comparisons and overlook others' (Tracy 2012, p. 185). The data in this study was organised in a number of ways. The field notes were handwritten and then stored and filed in a binder in chronological order. The interviews were recorded and labelled in the order the interviews were undertaken.

Pilot interviews were transcribed by the interviewer to provide experience in transcription and also to provide the interviewer with a feeling for how transcription and undertaking the interview can help the interviewer understand/“get a feel for” the interview. Interviews in the main study were transcribed by an external third party and checked by the researcher to verify the reliability of the transcription.

Immersion in the data by the researcher was achieved by reading the data over and over again so that the researcher was thoroughly accustomed to the data (Marshall & Rossman 2006). The researcher submerging themselves in the data after around 75% of the data has been collected has been suggested where talking to others about the data and the findings that are emerging is one way of actioning such immersion as it ‘aids in sense making and in
considering a variety of interpretations’ (Tracy 2012, p. 188). This was undertaken by the researcher in this study by talking to supervisors and colleagues as well as reading and re-reading of the data collected.

3.5.1 Coding

As the interview questions are informed by the notions of threshold concepts in the literature and the understanding of threshold concepts by the researcher, it was appropriate to begin with a provisional list of codes as a starting point for data analysis (Saldana 2011). Miles and Huberman (1994) suggest that the codes come from 'the conceptual framework, list of research questions, hypotheses, problem areas and/or key variables that the researcher brings to the study' (p. 58). The iterative nature of the analysis, however, means the codes would be revised, added to and/or removed as the coding progressed. Manual coding was adopted in this study and formal coding was undertaken after data collection took place. A provisional list of codes was prepared based on the Meyer and Land Framework (2003).

Richards and Morse (2007) describe coding as being more than labelling or categorising the data. It should also involve the researcher identifying any themes that emerge from the data and the researcher continually asking "what is this all about". Gibbs (2007) distinguishes coding in quantitative and qualitative analysis by explaining that coding in quantitative analysis seeks to condense the data into ‘a few “types” in order that they can be counted’ while in qualitative analysis coding is designed to help organise and manage the data (p. 4). Tracy (2012) adds that coding 'is the active process of identifying data as belonging to, or representing, some type of phenomenon. This phenomenon may be a concept, belief, action, theme, cultural practice, or relationship (p. 189) while Creswell (2012) describes coding as 'the process of segmenting and labelling text to form descriptions and broad themes in the data' (p. 243).

The first formal stage of coding undertaken is primary-cycle coding. Primary-cycle coding refers to the initial coding activities that occur more than just a single "first" time. The data might be read and coded several times during this primary stage...it begins with an examination of the data and assigning words or phrases that capture their essence...primary-cycle codes are usually, but not always, first-level codes. First-level codes focus on "what" is present in the data. They
are descriptive, showing the basic activities and processes in the data...and require little interpretation (Tracy 2012, p. 189).

The primary-cycle coding undertaken for this study used a preliminary list of codes, as discussed earlier, and in many cases the same data was labelled with several codes and as the coding continued, some of the general codes became more specific. This is not uncommon as according to Tracy (2012) 'you can double-and-triple-code the same datum if several codes relate to it. As you travel through the primary cycles of coding, try to transform general codes into ones that are more specific and active' (p. 189). As coding was undertaken in this study, an iterative process was used whereby re-coding of the data took place to account for any additional codes added and/or any synthesizing of codes that occurred during secondary level coding.

Secondary level coding allows for theorising and synthesis of the data as well as interpretation and identification of patterns and/or cause-effect progressions (Tracy 2012). The analytical process allows the researcher to ‘move from emergent and descriptive coding to more focused and analytic coding and [to] better understand which data [were] most important for the analysis' (p. 195). The listing of codes that emerged from the primary-cycle coding resulted in synthesis of the codes with some of the codes being discarded and some re-grouped as formal analysis was undertaken. A copy of the final List of Codes together with the Definitions of Selected Codes and Other Definitions is provided in Appendix 7. The format of the list was informed by an example provided by Miles and Huberman (1994). The List of Codes in Appendix 7 shows the codes developed and their respective descriptive labels. For example, in this study, NOTC is the code and the short descriptive label for this code is Notion of Threshold Concepts. This code is considered a master code. Underneath this code are two sub-codes – PTC (being Potential Threshold Concept) and ATT (being Attributes). Short codes are used as manual coding is completed in this study as opposed to using a computer program which allows more meaningful phrases to be used as codes (Miles & Huberman 1994).

The final aspect of the analysis is providing focus and making meaning of the data from the codes prepared. One way of doing this is through the creation of analytic memos. Analytic memos can be used to document the researcher’s thoughts as they progress through the analysis such as noting any connections among codes and how they relate to each other. Marshall and Rossman (2006) regard the writing of notes, memos and insights as invaluable.
throughout the analytical process. Tracy (2012) points out that in secondary cycle coding, ‘it is important to go beyond merely comparing and contrasting the data, to also examining it for antecedents and consequences of various codes. Reflecting on, and making hypotheses about, these linkages is crucial for understanding process, action, chronology, explanation, and causation’ (p. 196). Also considered during the analysis are any implications to issues broader than the research topic investigated (Silverman 2000). Such implications will be reported in Section 4.2.4.

Qualitative analysis can be undertaken manually or with the use of computer assisted qualitative data analysis software. Richards and Morse (2007) clearly enunciate that while such programs 'can take much of the clerical burden from each of the modes of coding', the interpretation of the data are done by the researcher, not the computer program (p. 148). In deciding whether to use qualitative software programs or to undertake manual coding, the researcher needed to consider the scale of the project, how adept they are at understanding computer programs quickly and whether qualitative coding is new to the researcher (Saldana 2011, p. 137). Large scale studies may find this more suitable but Saldana (2011) also points out that there can be a steep learning curve that may not be suited to small scale studies. Also where the researcher is a novice and undertaking analysis of qualitative data for the first time, he suggests that it is best to manually code the data so that the focus remains on the data rather than the software.

3.5.2 Organising and Presenting Themes

The use of displays, apart from the use of extended text, is considered a useful way of dealing with data. Saldana (2011) suggests that ‘qualitative researchers use not only language but also illustrations to both analyse and display the phenomena and processes at work in the data. Tables, charts, matrices, flow diagrams, and other models help … cognitively and conceptually grasp the essence and essentials of your findings’ (p. 133). Collis and Hussey (2003) describe detextualising the data as being one of the main challenges to researchers when undertaking qualitative data analysis. Where the data collected is extended text, use of diagrams and illustrations can be used to help analysis and present such data in a more suitable form for the reader. Miles and Huberman (1994) find that 'extended, unreduced text alone is a weak and cumbersome form of display' that creates difficulty for the researcher in seeing the text as a whole particularly when it is spread over many, many pages (p. 91). They argue that 'valid analysis requires, and is driven by, displays that are focused enough to
permit a viewing of a full data set in the same location, and are arranged systematically to answer the research questions at hand and where a coherent display enables the researcher to determine any themes or patterns, observe trends and allow comparisons (Miles & Huberman 1994, p. 92).

Analysis of the data in this study was achieved through a threshold concept matrix, a combination of individual and combined cognitive maps, and analysis breakdowns. Once the themes/threshold concepts were identified, this was followed by a comparison of whether the threshold concepts “fitted” the Meyer and Land Framework (2003). Figure 3 depicts a summary of the data analysis process and the way in which themes were organised and identified.

*Figure 3: Data analysis process and themes*

A *threshold concept matrix* was initially developed. It consists of threshold concepts/themes identified by each participant interviewed. For example, data collected from interviewee 5 resulted in double-entry accounting and cash flow statements being identified as threshold concepts and a theme, way of thinking and practising, also emerged. The threshold concept
matrix was then iteratively developed in parallel with the development of individual cognitive maps, combined cognitive maps, a post-it-note display and analysis breakdowns to provide focus. Each of these tools will be discussed shortly. The threshold concept matrix highlighted 3 themes identified by several of the participants – these being ‘accrual accounting’, ‘double-entry accounting’ and ‘way of thinking and practising’. Such a matrix is appropriate where a 'variable is conceptually important' (Miles & Huberman 1994, p. 105) but it also 'does a good deal to ... enable verification, encourage comparability, and permit simple quantification' (Miles & Huberman 1994, p. 109). The use of this matrix was central to this study to provide identification of potential threshold concepts and themes by participants and allowed for the comparison, and examination, of findings across cases and was beneficial in summarising aspects of the research.

Linking to the conceptual matrix was the preparation of individual cognitive maps (Appendix 8) for each participant that mapped out what each participant described about each threshold concept and/or theme that emerged from the interview. For the threshold concepts that were mentioned by many of the participants, i.e., the main knowledge content concepts (being – accrual accounting and double-entry accounting), (two) overarching or combined cognitive maps were drawn up, one for each threshold concept. Development of a cognitive map for way of thinking and practising in the discipline was also drawn up and will be discussed further in Section 4.2.3. These maps combined what each participant described about that threshold concept. Referred to as combined cognitive maps (Appendix 9), different colours were used to identify different participants and provided a form of “audit” trail of linkages of participant narratives around themes. For the double-entry accounting threshold concept, use was made of post-it-notes placed on a whiteboard to help make further sense of this threshold concept (see Appendix 10). Analysis and determination of the components that constituted double-entry accounting are summarised in Figure 8.

Use of the cognitive maps and post-it-note display helped clarify for the researcher the meaning of the data and provided a conceptual framework to illustrate the thinking of the participants (Miles and Huberman 1994, p. 137). Preparation of the cognitive maps allowed for arrows to be drawn and to link aspects of the interview transcripts to help make more sense of the data. It also provided a more conceptual view of what each participant said. For example, the cognitive maps helped to identify that debits and credits were seen as a sub-set of the threshold concept ‘double-entry accounting’ by many of the participants. The
preparation of the post-it-note display helped the researcher visualise the many interrelationships and links for the double-entry threshold concept.

Also prepared were analysis breakdowns in separate Microsoft word documents for the themes that emerged where relevant data from the interviews were copied and pasted into the analysis breakdown document. This was designed to assist the researcher with organisation of the data and provide focus for the analysis. Participants were differentiated through the use of different coloured fonts. A sample of the analysis breakdown can be found in Appendix 11.

Glaser and Strauss (1967) in Richards and Morse (2007) clarify that 'you know when you have gathered enough data when new pieces add little, if any, new value to the emergent analysis' (p. 195). Tracy (2012) suggests asking the question 'does the emerging analysis attend to my research foci in an interesting and significant way?' and where the answer is no, it may prompt the researcher to gather further data or engage in activities to synthesize the data further. Iterative analysis of the data was undertaken until such time as the researcher attained what was considered a point of saturation.

3.6 Validity and Reliability

An important aspect of any research is ensuring the validity and reliability of the research. Merriam (2009) explains that 'regardless of the type of research, validity and reliability are concerns that can be approached through careful attention to a study's conceptualisation and the way in which the data are collected, analysed, and interpreted, and the way in which the findings are presented' (p. 210).

In terms of reliability this can be problematic for qualitative research. Merriam (2009) explains that the traditional view of reliability is the ability to be able to replicate the research and obtain the same findings. However as qualitative research depends on human interpretations of reality, a replication of the research will not yield the same results [as] what is being studied in the social world is assumed to be in flux, multifaceted, and highly contextual, because information gathered is a function of who gives it and how skilled the researcher is at getting it...so several interpretations of the same data can be made, and all stand until directly contradicted by new evidence (p. 222).

Instead she claims that 'the more important question for qualitative research is whether the results are consistent with the data collected' and that where this is the case, the study can be
regarded as dependable (p. 221). This is supported by Silverman (2000) who explains that 'qualitative research is, by definition, stronger on long descriptive narratives than on statistical tables. The problem of credibility that arises here is how such a researcher goes about categorising the events or activities described’ (pp. 90-91).

Richards and Morse (2007) assert that familiarity with the data when coding helps ensure reliability in that ‘coding for any purpose requires that you are familiar with the data and ensures that you get closer to the data. If the person doing the analysis has not conducted the interviews or the observations, this task is far more difficult and more important’ (p. 135). The researcher in this study undertook each interview personally and was able to recall each of the interviews when reading through the transcripts. Also, the transcripts were read and re-read and checked for accuracy against the electronic recordings of the interviews to ensure reliability.

In terms of validity, resultant explanations that are accurate and encapsulate truly what is happening become valid outcomes in qualitative research (Gibbs 2007). He explains that in terms of validity, qualitative researchers need to be ensure that they have conducted a critical investigation of their data rather than succumb to ‘anecdotalism’ where findings are based on a ‘few well-chosen examples’ (pp. 175-6). Maxwell (1992) maintains that validity is linked to the understanding gained from qualitative research where 'the primary purpose is not to advance the philosophical understanding of qualitative research, but to explicate how qualitative researchers think about validity' (p. 285). For example, primary descriptive validity refers to 'the descriptive validity of what the researcher reports having seen or heard (or touched, smelled, and so on)' and that any disagreement of the account can be easily resolved by referring to the appropriate data (Maxwell 1992, pp. 286-7). In this thesis, detailed quotes from interviewees were included in the analysis to aid descriptive validity, clarify the researchers’ interpretation of interviewees’ descriptions, and allow for consideration of alternative explanations.

Patton (2002) asserts that ‘in qualitative research the researcher is the instrument’ (p. 14) shifting the focus of validity onto the researcher. A strategy to ensure validity is recognition by the researcher of the 'researcher's position (Lincoln & Guba 2000, p. 183, in Merriam 2009, p. 219). In other words, clearly specifying any bias, assumptions or perspectives that the researcher brings to the study help confirm for the reader how this may influence the study. The researcher in this study has experience in financial accounting and a thorough
knowledge of threshold concepts but to the best of her abilities was careful not to let this influence what she believed the potential threshold concepts in this discipline may be. The researcher believes that not every academic will see the world in exactly the same way and was encouraged to find differing ideas from her own in the data collected but also some similarities. Of importance to the researcher was ensuring immersion in the data and the use of different analytic procedures to help understand the thoughts of the interviewees.

Another aspect of validity relates to how findings can be generalised from a sample to a population. This terminology is often used in the quantitative research domain in a statistical sense however from a qualitative viewpoint, Merriam (2009) reminds us that

a single case or small, non-random, purposeful sample is selected precisely because the researcher wishes to understand the particular in depth, not to find out what is generally true of the many… [and that] we need to think of generalizability in ways appropriate to the philosophical underpinnings of qualitative research (p. 224).

This raises the point of transferability of the research described by Lincoln and Guba (1985) in Merriam (2009) where the researcher provides sufficient in depth information to enable transferability of the research to other settings. Transferability is enhanced with the use of rich, thick description of the setting and evidence based findings of the study. It can also be enhanced with the use of sampling strategies where careful selection of the study sample ‘allows for the possibility of a greater range of application by readers or consumers of the research. Alternatively, selection of a typical sample where ‘one describes how typical the program, event, or individual is compared with others in the same class, so that users can make comparisons with their own situations’ can be used to enhance transferability (p. 228-9). In this thesis, the use of a small sample does not mitigate the transferability of the findings. Rich data was collected and analysed providing in depth findings evidenced by participants’ interview transcriptions. Additionally, the sample in this study was specifically chosen for their knowledge and experience in the financial accounting discipline to enable the researcher to understand the perceptions academics’ in this discipline have about threshold concepts both generally and specifically. This provides the opportunity for transferability of these findings to not only the financial accounting discipline but also to other disciplines.
3.7 Summary

To explore the potential threshold concepts critical to student learning in the financial accounting discipline, this study was undertaken using an interpretivist paradigm to understand and interpret Australian academic perspectives of financial accounting. Data was collected from fifteen academics across Australia via semi-structured interviews and documentation of demographic information where the researcher conducted all the interviews. An iterative process of analysis informed by Miles and Huberman (1994) and Tracy (2012) was used to organise and analyse the data. Manual coding was undertaken and use was made of various documents and displays contributing to data immersion, and as part of primary and/or secondary level coding and analysis. Implications to broader issues were also considered and covered in a later section. In terms of reliability of the study, the researcher was the only person who did the coding and the coding was consistent with all of the transcripts aiding in reliability of categorisation and analysis of the data. Additionally, the researcher has been explicit in identifying any potential researcher bias that result from being a discipline expert in this field and how this was overcome. Descriptive validity was addressed through the use of detailed quotes from participants. In addition, the researcher stated her position and revealed any potential bias', assumptions and perspectives brought to the study.
Chapter 4 ANALYSIS

4.1 Introduction

This chapter describes and discusses the analysis of the data relating to fifteen interviews with academics from universities across Australia that sought to identify threshold concepts in financial accounting and how and why these concepts were conceived as “thresholds” by those teaching in the field of financial accounting. As described in Chapter 3, analysis of the data was achieved through the threshold concept matrix which lists the themes and threshold concepts emanating from the data. It was iteratively developed in conjunction with other elements of the analysis process that includes: the development and refinement of individual and combined cognitive maps which link and then amalgamate descriptions of interviewees around threshold concepts; a post-it-note display that helped visualise and make further sense of the double-entry accounting threshold concept; and analysis breakdowns that helped organise the data and provide focus to aid analysis. This resulted in the emergence of three major themes (see Figure 4). Two themes that relate to financial accounting are identified – accrual accounting and double-entry accounting - and a third theme – way of thinking and practising in the discipline – potentially underpinning the former two. The threshold concepts identified were then compared to the Meyer and Land Framework (2003) to determine if they fit this framework and can be considered threshold concepts.

Figure 4: Data Analysis Process and Themes Identified

Threshold concept matrix

Individual and combined cognitive maps; post-it-note display

Analysis breakdowns

Theme 1: ACCRUAL ACCOUNTING

Theme 2: DOUBLE-ENTRY ACCOUNTING

Theme 3: WAY OF THINKING and PRACTISING
4.2 Emerging Themes

Central to the emergence of these themes was the development of a threshold concept matrix (see Figure 5 below). It was developed on the basis of the threshold concepts identified by participants in the interviews and the individual cognitive maps (see Appendix 8). This enabled the researcher to see where there was commonality in the suggestions made by participants. In a study by Boustedt et al (2007) in computer science, the researchers reduced a list of thirty-three potential threshold concepts to a list of five that were more frequently mentioned. In this study a similar strategy was undertaken to confine the analysis to the threshold concepts and themes that were more prominent. Such prominence was visible for double-entry accounting, accrual accounting and a way of thinking and practising in the accounting discipline. Each major theme was also transposed onto a combined cognitive map (see Figures 6, 7 & 9) in which linkages between related “subsidiary” concepts could be visualised and interrelationships explored (and linked back to each participant in Figures 6 and 7 – enhancing management and reliability of the analysis).

In subsequent sections, each theme will be described and discussed in detail with reference to, and closer examination of, the threshold concepts outlined in the threshold concept matrix and cognitive maps and the related views of the participants from the analysis breakdowns. Detailed quotes of the participants are included to highlight their various conceptions and descriptions of threshold concepts and to make explicit how these conceptions have been interpreted by the researcher.

4.2.1 Threshold Concept: Accrual Accounting

Accrual accounting is one of the themes identified in the data analysis as a threshold concept and will be the subject of discussion in this section. Initially the discussion will centre on the combined cognitive map for accrual accounting, the sub-concepts revealed and the reasons why participants felt accrual accounting is a threshold concept. This will be followed by an analysis of how accrual accounting aligns with the Meyer and Land Framework (2003) to determine if accrual accounting is a threshold concept in its own right. Additionally, when discussing accrual accounting as a threshold concept, double-entry accounting (being the other threshold concept to emerge from the analysis) was sometimes raised, but not always, potentially highlighting the integrated nature of threshold concepts. Attention is given to this aspect in the discussion.
### Figure 5: Threshold Concept Matrix

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<th>Threshold Concept / Theme</th>
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<th>12</th>
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**Key:**

- **Threshold concept / theme**
- **Other** threshold concepts

# Way of thinking and practising has not been explicitly highlighted in the individual and combined cognitive maps but instead appears in a separate cognitive map. Further explanation as to why this was appropriate can be found in Section 4.2.3 where a way of thinking and practising in the accounting discipline is addressed.
The threshold concept matrix identified that participants 4, 6, 8, 9, 14 and 15 suggested accrual accounting as a threshold concept. The combined cognitive map in Figure 6 (below) depicts accrual accounting as a threshold concept which is linked to a number of related concepts that could be seen as core concepts that include, for example, the difference between cash and credit; the need to understand transactions; the need to understand the accounting elements from the framework and the difference between cash accounting and accrual accounting. This supports Eckerdal et al (2006) where core concepts are seen as subsets of a threshold concept and aid in identifying a threshold concept.

Other aspects of the combined cognitive map reveal that accrual accounting as a threshold concept requires a paradigm shift where students need to “accept” ideas associated with accrual accounting such as being able to accept that you are accounting for something that you may not have received, e.g., a bill or invoice, which can be difficult for students to understand and accept. Accrual accounting has also been described as underpinning everything that is done in the accounting degree (participant 14) and that it has links with the balance sheet, income statement, accounting equation (participant 15), accounting elements from the framework (participant 9), transactions (participant 4) and balance day adjustments (participant 14) which adds to the complexity of understanding accrual accounting. Also revealed is the “alien” or foreign nature of the word itself which students find difficult to relate to as it is unlikely they will have heard this term before if they have never studied accounting in the past (participant 14). These aspects will be discussed in more detail shortly. The reasons why participants chose this as a threshold concept included the importance of accrual accounting in bringing together the accounting process, its necessity in understanding revaluations, impairment, tax effect accounting and consolidations studied later in an accounting degree and the need to understand accrual accounting in order to do balance day adjustments. In this we can see that the participants take what could be termed a macro or more holistic view of the importance of this concept and why it may be perceived a threshold concept.
Figure 6: Combined Cognitive Map for Accrual Accounting
It was interesting to note that the demographics of the six participants reveal that they were all in the age range of 46 – 60+ and their level of teaching experience in financial accounting ranged from 5 – 35 years. The seniority of the six participants may be a reflection of the experience they have not only in teaching financial accounting, but also working in industry. Interviews and/or conversations with the participant’s pre and post the interview revealed at least three of the participants are known to have worked in industry as accountants prior to joining academia. Future research might explore the impact of both teaching experience (in length of service) and/or the impact of practical accounting experience on the classification of a concept as a threshold concept.

In order to determine if accrual accounting is a threshold concept in its own right, an analysis of academic perceptions of how accrual accounting aligns with the Meyer and Land Framework (2003) is undertaken in the next section. The attributes relating to how accrual accounting is transformative, why it is troublesome to students and how it is integrative will be analysed followed by an analysis of the bounded (see Section 4.2.1.2) and irreversibility (see Section 4.2.1.3) attributes.

### 4.2.1.1 Why is Accrual Accounting Troublesome? How is it Transformative? How is it Integrative?

Davies and Mangan (2007) deduce that a threshold concept that is troublesome will also by implication be integrative and transformative therefore these three attributes will be considered in this section. The transformative nature of a threshold concept can mean while a student is in the process of understanding a threshold concept, they may find the threshold concept troublesome. Troublesomeness may stem from ritual knowledge, conceptually difficult knowledge and/or discipline language (see Section 2.2.1).

Troublesomeness may arise from the use of ritual knowledge by the student. Ritual knowledge is of a routine nature (Perkins 1999) and is used by students but not really understood. According to Baillie and Johnson (2008) ritual knowledge is knowledge that students 'accept that they need to know it but do not appreciate the complexity of the knowledge or the reasons why they need to know it' (p. 134). The use of ritual knowledge by the student may be the source of the troublesomeness in understanding accrual accounting and prevent a student’s transformation to, and understanding of, related concepts such as revaluations, consolidations and tax effect accounting (participant 14). The following extract relates a conversation participant nine had with a student where the student had failed the
accounting subject on two occasions and had not really understood accrual accounting and instead had memorised a description of it in more of a ritualistic manner:

I said, “Do you understand accrual accounting?” And she goes, “Oh, accrual accounting is, is where you measure income earned and expenses incurred, and cash accounting is where you measure income received and, and expenses paid.” I said, oh, basically right. I said, “Do you actually understand that?” “I’ve got no bloody idea, [participant’s name],” she says, “I just memorised that.” And I said, “I thought you had,” and I said, “Thanks for being honest here,” but I said, “…you couldn’t do those if you didn’t understand that concept. They don’t make sense to you. You’ve just tried to memorise,” and she had.

At the outset, a student may believe that a ritual understanding of accrual accounting is sufficient in learning accounting. However participant six points out, using cash flow as an example, that students need to understand accrual accounting and “why” it is done as ritual understanding will not assist them in understanding cash flow:

I really think that once you accept and understand accrual accounting and I guess in terms of my unit, it takes about three to five weeks …when you go through the process. Once they understand and accept it, then really the rest they can identify that cash flow is a different kind of process, ‘cause cash flow includes this and it doesn’t include that, and they can rationalise it. But if, if they don’t understand that first five weeks, they don’t understand accrual accounting, then really the cash flow just makes no sense … you accept accrual accounting and understand it … and you explain why it’s done, then the students just move on and, you know, move to the next issue. But if they haven’t got that then I think they’re just attending, you know, for the sake of it and trying to make it through.

As discussed in Section 2.2.1 conceptually difficult knowledge may also be a cause of troublesomeness. Conceptually difficult knowledge is where a student knows ritual answers but sub-consciously their thinking and interpretations are rediscovered when confronting qualitative problems (Perkins 1999). Participant five suggested the cash flow statement as a threshold concept and revealed that ritual understanding of accrual accounting can provide difficulty for students when having to reconstruct accounts prepared on an accrual basis to determine the cash inflows and outflows for the cash flow statement. This highlights that the conceptually difficult nature of accrual accounting as ritual understanding may not have the transformative impact on the student:
… throughout the early part, I make the distinction between accrual and cash …and …in reality out there most firms are going to be doing accrual accounting, and so that’s what we’re, we’re learning…then I do explain … there is such a statement called the “cash flow statement… its purpose … and that we’re basically bringing back things to a cash basis…that’s important because you know, because of accrual accounting you can have a profit, you can have a good balance sheet but actually could go bankrupt…with no cash… but it’s not until, you know, week 9 or something like that we, we go to cash flow. Um, so you know, I think yeah, there’s, there’s some linkage in the beginning there with this idea… but it’s not until we really get to that actual week of cash flow where I go… “okay” … then I might go through and explain each part then it becomes clearer, like for example you know, um, accounts receivable; … and how that was played out…on a cash basis versus you know, the accrual thing and undoing it, kind of thing…I think that a lot of students just can’t get that very well…in their heads.

Note that reference to the ‘accrual thing and undoing it’ relates to a process where students become accustomed to thinking from an accrual accounting perspective (often when learning the accounting process and double-entry accounting) however, determining the cash flows for the cash flow statement requires students to reconstruct accrual based information to determine the cash flows for the year. A thorough understanding of how accrual based data is captured during the year can facilitate the determination of these cash flows. Therefore, accrual accounting may be troublesome due to the conceptual difficulty that arises when students need to fully appreciate and understand the difference between cash and accrual accounting as without this, a ritual understanding may not be sufficient in understanding how to prepare a cash flow statement.

Conceptual understanding of the link between cash and accrual accounting is an example of conceptually difficult knowledge as students need to understand and accept that there is more than one way to account for events and transactions. That is, transactions can be recognised on a cash basis or an accrual (credit) basis. Participant ten (in discussing cash flow statements as a threshold concept but not accrual accounting) reflects on how the link between cash and accrual accounting can be difficult for students and requires conceptual links to be made in order to transform student understanding. Also acknowledged is the integrative nature of accounting and recognition that students have prior experiences and knowledge that they bring with them when continuing their learning (which will be discussed shortly):
I think the cash bit they’ve dealt with in their life and so they’re comfortable with sort of cash movements, and then I think what caused them dramas with cash flow is … at university we’re learning about accrual accounting, and they… they accept that … and then we go to cash flows and we say to them…but we’re now going back to what you sort of did before and where we came from originally. So and they often go, well we’ve just learnt how to do this, why am I unlearning it? And I think what it is, is they see them as two different things. They see accrual accounting on one hand and cash accounting on another and they don’t see that they could actually be the same sort of information…. I suppose when you’re talking about the cash and the accrual, I mean the accrual stuff permeates everything. So we spend a reasonable amount of time with them doing sort of balance day … end of period transactions...then we go, all right, we’ve got to the end of their period …… now we’d just like you to fiddle with things a little bit …… and we want you to move some things around, um, and again that’s another one where they go, well we’ve just done that, why are we doing sort of more of it? …. they also like to chunk stuff. They like to put it into little bits, and so they put accrual accounting over here and go, oh, I’ve learnt that now, and now they want to do the cash flow statements and that’s cash, so I want to learn that separately but in accounting you can’t…there are very few, actually I can’t think of any off the top of my head that don’t have some integration across different topics.

The conceptually difficult nature of accrual accounting is also highlighted below where a participant explains that students can have difficulty understanding notions of cash and profit and this links back to an understanding of the accounting equation, transaction analysis and double-entry accounting. The participant then explains that the difficulty may relate to the notions of cash and accrual accounting rather than cash and profit. The explanation by the participant fifteen also reveals the complexity associated with an understanding of accrual accounting but also the web of integration involved when dissecting the accounting discipline:

…the notion of cash and profit is difficult. It’s just intuitively difficult for students to grasp the concept that cash and profit are different things, and they’re different beasts. They find it difficult to grasp the notion that a business can declare a $40 million profit one week and be broke the next and go bankrupt. It is a difficult notion and I don’t know why… it goes back to the bloody accounting equation, doesn’t it? …Because if you can understand, you may have received cash but you haven’t earned it, is a really difficult concept. So what do I do with the cash I’ve got that I haven’t earned? Well, if I understand the accounting equation then I recognise I’ve got the asset, which is bank. So I’ve increased my bank, so if I understand my debits and credits, then I’ll debit the bank…. But what’s the double-entry? …now if I apply
the notion of double-entry, it’s got to be a corresponding effect. Well if I haven’t earned it, then you’d hope they make the step well then I must, it must be a liability. But making that distinction, making that jump, requires an understanding of all of that stuff, doesn’t it? ...so it comes back to the other terminal concept, is accrual. The notion of accrual accounting, accrual and cash, maybe not cash and profit, maybe it’s accrual and the concept of accrual and cash accounting, that sort of differential...because they’re linked of course.

Meyer and Land (2003) identified discipline language as a source of troublesomeness and it is the language of the discipline itself that provides a certain way of thinking and practising in the discipline. Some of the discipline language may be terms students are already aware of in everyday life, such as the word asset, however they take on a different meaning or are seen in a different context in the accounting discipline. Hence, a transformation in thinking is required where students need to update their everyday understanding of the accounting elements to include an understanding from an accounting disciplinary perspective and thereby challenge their existing thinking in trying to grasp how to think in an accounting context, and use and understand discipline based language. On the other hand, there may be disciplinary terms, such as accrual accounting, students do not have prior knowledge of which in turn provides difficulty for the student in trying to relate it to their own understanding of the world. This indicates the potential that prior experience has in making a threshold concept easier to grasp.

Analysis of the interview data provided many examples of where discipline language is a source of troublesomeness for the accrual accounting threshold concept. Participant fourteen reveals that the term 'accrual accounting' is not a term used in everyday language unlike asset and liability. Also revealed by this participant is the need for a shift in thinking by the student such that 'they will 'see' the world differently' resulting in epistemological and ontological transformations in the student as referred to by Quinlan et al (2013, p. 586) and will be discussed further in Section 4.2.3; and recognition that prior experience can bring with it comfort in learning and grasping a threshold concept whereas an unfamiliar term may not:

.... they get very excited when you talk about tax because .... they can understand that. They have experience of it... they have to do their tax return. Even though there’s a whole lot of stuff that they don’t understand about it. But it’s part of life. It’s on the news all the time. They talk about it all the time. But this funny word is never spoken about. Yeah, but even the concept’s not really spoken about. You know, on the news, or when they’re reading stuff, or even when they’re reading through their text book. Or when they have to do
problems… Nobody’s ever saying to them, this is accrual accounting…what you’re doing is that…. so it’s, it’s very much a concept. It’s not… something that you learn even. In terms of doing a problem…. well so what do we start doing and …we get them to do these cash based problems first… you get paid and then you have to pay your bills …and you’ve got a phone bill… you’ve made all these text messages to your girlfriend who’s… somewhere else on the other side of the world and it’s cost you a fortune… so those sorts of things they can handle. And then you start talking about the fact that you didn’t get the phone bill, but you have to account for it, even though you have no idea, you’re just going to make stuff up. So the whole making stuff up really does their head in… it’s a paradigm, paradigm shift for them, for something that … it’s not common usage language. Or even common usage ideas, really.

The term accrual accounting is explained by participant fourteen as causing angst because it is not a term that students can relate to and it is a ‘weird word’ that is confined to the accounting discipline. Another participant (9) highlights the common use of terminology students are familiar with (again, their experience creates some familiarity for them) compared to the disciplinary meaning of such terminology causing difficulty for students. Once again, the need for students to shift their thinking is necessary but the participant points out that some students are not open to such a transformation:

I think because the terms we use in accounting are common, familiar terms in English… so by the time we get them they’ve had 18 years of this is what an asset is or a liability. So an asset to the vast majority is something you own, not something you control. A liability to the vast majority is something you have to pay, so that gets rid of all your prepayments, they suddenly disappear off your balance sheet ‘cause, you know, if someone’s prepaid you, you’ve provided a service, well that’s not a payable it’s a provision of goods or services. Hadn’t thought about that one had they? … income to a lot of them is cash received, so they struggle with the accrual. Expenses are cash paid, so again they struggle with the accrual. And equity, well most of them probably haven’t come across equity other than some will have equity in their house and will have some idea of that… it’s what you own when you take away what the bank owns… most of them probably haven’t come across equity very much. But in terms of your other four elements [assets, liabilities, income and expenses] they all have the common meaning which is not right for us.

So they’re coming in at 18 with this language ….. and then we go… here’s the definition, and I will go through the elements of the definition … So I think a lot of the problem why is it hard to teach, because they come in with, they come in thinking they know what they are and trying to shift their brain from one point to another, and even though you specifically say, this is what I’m trying to do, and you can shift the vast majority I think … but you’re
still going to get that bottom end … who will not shift their thinking. They’re not open
and listening and it’s like I know and therefore you talk asset, well I know what an asset is so
I can switch off or I don’t know, I think that’s what it is.

Hence language specific to the accounting discipline can be troublesome for students for a
number of reasons. It may be troublesome until they realise their current understanding needs
to be broadened or they have experienced the language in another context. There is
terminology they will also be introduced to that may seem strange and they may find it
difficult to relate to. In terms of prior experience that students bring with them to a learning
environment, it is their ability to relate the theoretical ideas to this experience that can play a
part in determining whether a student will take a deep or surface approach to learning
(Ramsden 2003). A deep approach to learning is akin with students being able to make the
theoretical links with their prior understanding but it may also involve having to question
their initial understanding or expand their understanding to recognise the different contexts
that may apply (such as what an asset is in accounting compared to their prior experience in
understanding what an asset is) if a transformation in student learning is to occur and a
threshold concept grasped. Hence by understanding the language that is used in accounting,
how it may differ in other contexts and being able to relate to such language may have a
positive impact on the learning process a student goes through and overcome such
troublesomeness.

The integrative nature of a threshold concept is highlighted by participant fifteen when
explaining the importance of links and relationships to understanding, and the importance of,
accrual accounting and the foundations of accounting (where the accounting equation and the
notion of double-entry form part of the foundations of accounting as will be seen in Section
4.2.2.1 later):

It is interesting, because you realise that, to teach even the most basic concept they’ve got to
have an understanding of really, all the interrelations and all the links. I think with any
teaching of accounting, it has to be the, the relationships. To me, if students can understand
the accounting equation, the notion of double-entry… accrual accounting and the concept of
accrual accounting, recognition of stuff, something that mightn’t even exist … then yep, they
can do financial accounting ‘til the cows come home because everything builds on that.

Knowledge of how the basic accounting elements of asset, liability, equity, income and
expenses are defined and recognised in financial reports is integrated with an understanding
of accrual accounting according to participant nine. An understanding of the basic accounting elements is considered part of the foundations of accounting (see Section 4.2.2.1). Below is a good example of the integrative nature of accrual accounting as described by participant nine:

Well I think elements are definitely integrated into say accrual accounting. You know, whether or not… you pay me cash to do a job, well if by balance date I’ve done part of the job then I can show that as income. The part I haven’t done is a liability, and so I have to understand what an income and liability are, but I also have to understand… the idea of accrual accounting that I can only record the bit that I’ve earned…. even with my second years, they had a question recently in an assignment, ah, where they’re given money for… a service and…. there was all these rules on when you cancel as to how much you’d get back… and the deposit was not refundable if you ever cancelled, and most of them said well as soon as you got a deposit it’s revenue, and I’m going, well, but 95% of people would actually expect you to provide the service so until you provide the service you can’t just call that revenue just ‘cause you’re not going to have to give it back, because actually you still have a liability to provide a service. Until they cancel, once they cancel then you can call it revenue… I would say 80% of the class got that wrong.…

A strong theme emanating from the analysis was the extent of the integration, links and relationships that exist in the accrual accounting threshold concept. For example, an understanding of accrual accounting requires an understanding of the accounting equation, the notion of double-entry and how the accounting elements in the financial statements are defined and recognised. This makes it understandable why students may have difficulty in achieving a threshold concept when an integrated understanding is required.

Analysis of the data reveals the troublesomeness associated with accrual accounting emanates from use of ritual knowledge, the existence of conceptually difficult knowledge and the nature of disciplinary language in accounting. An understanding of accrual accounting results in a transformation where the troublesomeness associated with accrual accounting is no longer present and where the student can see and understand the integration of accrual accounting with other threshold concepts and/or sub concepts. The ability of a student to link their prior experience and knowledge with theoretical constructs may aid in the transformation of student learning. The boundedness attribute will be analysed next to continue the evaluation of accrual accounting as a threshold concept.
4.2.1.2  Does it have Boundaries that Lead into Other Threshold Concepts?

Meyer and Land (2003) state that a threshold concept may potentially be bounded and hence create a border that then leads to new conceptual areas but they do state this may be the case for some, not specifically all, conceptual areas. In terms of accrual accounting, participant six iterated the importance of accrual accounting to understanding cash flows but did not specifically identify cash flows as a threshold concept, treating it more as a sub-concept. Importantly, s/he acknowledged students need to 'accept' accrual accounting first before they can understand cash flows, indicating a transformation in thinking is required. This participant did not, however, see a potential border between accrual accounting and cash flows and did not regard cash flow determination as a separate threshold concept. Rather, participant six sees accrual accounting as underpinning knowledge.

Similarly, participant fourteen did not see accrual accounting as a boundary to a particular threshold concept but more that accrual accounting was a threshold concept which was a crucial foundation for student’s studying later courses such as consolidations, revaluations, impairment and tax effect accounting later in the accounting degree:

… they really struggle with revaluations and impairment and tax effect accounting…what is it that’s underlying all that…I really think that the main one is accrual accounting…. when you think about impairment and revaluation and tax effect accounting, that’s all accrual accounting … I don’t think that there is a boundary on accrual accounting. For me, it’s, it’s all pervasive. It’s fundamental, it’s all encompassing, it’s throughout the entire degree. First year, second year, third year…if they miss it, in first year, they will continue to struggle … I think the barrier is understanding the links and relationships.

Links between other suggested threshold concepts (that may be studied later in an accounting degree) and accrual accounting were explored further to determine if accrual accounting was seen as underpinning knowledge for these threshold concepts by these participants. It was found that three participants (7, 11 & 12) who identified consolidations, revaluations, impairment and/or tax-effect accounting as threshold concepts did not identify accrual accounting as a threshold concept. These three participants may implicitly be regarding accrual accounting as part of the double-entry accounting threshold concept each of them suggested however this was not made explicit. There is also the possibility the academics who mentioned tax-effect accounting and revaluations are teaching these topics in higher-
level courses and not recognising the importance of accrual accounting as it may be part of their own tacit knowledge.

Participant eight elucidated that accrual accounting would follow double-entry accounting yet also considered that both double-entry accounting and accrual accounting make sense when a student can understand that a bank statement is using the same debit and credit rules but from the bank’s perspective providing conflicting explanations as to whether a boundary exists between accrual accounting and double-entry accounting.

Overall while participants did not explicitly regard accrual accounting as having ‘boundaries’ to other conceptual areas, the nature of accrual accounting as underpinning knowledge implies a degree of importance is placed on accrual accounting to the extent that it is part of the groundwork for further study in revaluations, impairment, consolidations, tax effect accounting and determining cash flows. The irreversible nature of accrual accounting will be considered next.

4.2.1.3 Is it Irreversible?

Meyer and Land (2003) describe a threshold concept as probably irreversible, that is, it is not likely to be forgotten once it has been grasped. Davies (2006) in Coughlan and Graham (2009) consider irreversibility means the student would see the world and themselves differently as a result of this transformation. In terms of irreversibility, participants generally found this a difficult question to answer and tended to provide answers that were slightly vague and non-committal. In the interviews, it was explained to participants as the ability to understand the threshold concept and if a student actively tried to undo their understanding they would find it difficult to do so as grasping a threshold concept results in a transformation in thinking that would take extreme effort to undo. A sense of this confusion from participant eight is illustrated below:

How, how, how do you unlearn something? …If you unlearn it, I suppose … you've got to learn another way of doing it so you unlearn the first way of doing it, and now a second way of doing it? Is that what you mean by unlearn? To me they don't unlearn anything, they just forget. For me it's not an unlearning process ...if that's what you mean by unlearning.

Participant eight followed this line of thinking and recognised if the student was not using the knowledge gained from attaining the threshold concept, they might forget it and s/he acknowledges unlearning and forgetting as separate ideas. Overall, research shows that if
learning tasks promote surface approaches to learning (or surface processing of learning) this means knowledge is quickly forgotten once used immediately for the purpose intended and leads to poor quality learning outcomes. While a deep approach results in high quality outcomes and the ability to recall detail in the long term (Marton & Säljö 1976; Biggs 1979, 1987; Trigwell & Prosser 1991; Ramsden 2003) making the grasping of a threshold concept the result of a deep learning process and therefore likely to be irreversible. Hence attainment of threshold concepts may have significant implications for teaching and learning strategies and learning tasks that students engage in. Another participant (9) admits memorisation as opposed to understanding results in a student forgetting the knowledge they have gained and likens understanding to “holding that understanding much longer” and implies a deep learning process:

I think people that memorise them and don’t really understand them, yeah, I think they forget them. ...there’s a difference to being able to parrot, and even apply …if you’re only ever asked to apply in a very similar way all the time… you can even memorise that and get through without truly knowing what the hell’s going on and why this is so……and I think once you’ve understood it, I think it’s, I think you will hold that much longer than anything else.

This participant also acknowledges that some students are not willing to change their thinking which suggests perhaps what the student has learned previously about an asset is in some way irreversible, that is, they cannot unlearn it by explaining ‘they’re not open and listening and it’s like I know and therefore you talk asset, well I know what an asset is so I can switch off or I don’t know, I think that’s what it is’.

In support of irreversibility, participant ten recalls students questioning why they need to unlearn what they have just learned in accrual accounting to do cash flow statements, thereby acknowledging unlearning is quite a deliberate act and perhaps different from forgetting:

… I think the cash bit they’ve dealt with in their life and so they’re comfortable with sort of cash movements, and then I think what caused them dramas with cash flow is …at university we’re learning about accrual accounting, and they… they accept that … and then we go to cash flows and we say to them…but we’re now going to back to what you sort of did before and where we came from originally. So and they often go, well we’ve just learnt how to do this, why am I unlearning it?

On a side note, there may appear to be implications for the sequencing of content when participant ten recalls students questioning the need to “unlearn” accrual accounting. While
this may be a valid point, the integrative nature of accrual accounting and its relationship to
double-entry accounting make the sequencing of content problematic as knowledge of
accrual accounting and double-entry accounting is needed in order to prepare the cash flow
statement from accrual based records.

There seems to be some agreement that forgetting accrual accounting does not necessarily
mean the learning has been reversed. A clear distinction between understanding accrual
accounting, as opposed to rote learning, seemed to imply that the learning would not be
reversible. An unwillingness to change thinking may be more of a reflection on the nature of
the knowledge being conceptually difficult and having no meaning to the student.

It appears from the analysis that accrual accounting is an important concept in the study of
financial accounting and sufficiently significant to be a threshold concept in its own right. In
terms of the Meyer and Land Framework (2003), there is a convincing argument that there
are numerous sources of troublesomeness students may experience when endeavouring to
understand accrual accounting. Being able to overcome any such troublesomeness and
understand the linkages and relationships that exist for this threshold concept has the
potential to transform a student’s understanding of accrual accounting. Once grasped, an
understanding of accrual accounting is unlikely to be reversed and importantly it underpins
learning in the accounting degree. Further discussion on the irreversibility attribute will be
addressed in Section 4.2.4.2 as part of other outcomes of the analysis. The second threshold
concept to emerge from the analysis, double-entry accounting, will now be considered.

4.2.2 Threshold Concept: Double-Entry Accounting

Double-entry accounting is the second of three major themes identified in this study. This
section will begin with a discussion of the reasons why participants believe double-entry
accounting is a threshold concept and will draw on the themes that emerged from the
combined cognitive map (Figure 7). Additionally, an understanding of what constitutes the
term double-entry accounting will be considered, followed by an analysis of how double-
entry accounting aligns to the Meyer and Land Framework (2003), to consider if double-entry
accounting can be classified as a threshold concept.

The threshold concept matrix (see Section 4.2) revealed that participants 2, 3, 5, 7, 8, 10, 11
and 12 identified double-entry accounting as a threshold concept in its own right. Double-
entry accounting is linked to a number of related concepts which have been depicted in the
combined cognitive map in Figure 7. These include, but are not limited to, the accounting equation, the need to understand the whole process, the notion of debits and credits, the balance sheet and income statement, the conceptual framework, ledger accounts and the separate entity concept.

The reasons double-entry accounting was suggested as a threshold concept makes it clear it is considered as a basis for student learning in financial accounting. For example, participant eight referred to it as a foundation and ‘everything flows from there’, participant twelve describes it as an umbrella and participant eleven describes how difficult the other aspects of the accounting program would be without this threshold concept:

…the sort of threshold would be the understanding of double-entry book keeping. … and the concept of separate entity and not having those really tied down actually, seriously hampers their ability to put things in place, later on, when you’re talking about double-entry and the difference between the debits and credits and identifying the different elements to be found in a set of financial statements. And how those debits and credits relate to those different elements… so it’s the liability, it’s the equity, the revenue and the expenses.

To provide clarity, participant eleven was asked if the concept of separate entity was a separate threshold concept or part of understanding double-entry accounting. Participant eleven believed it was part of understanding double-entry accounting and understanding the separate entity concept opened up an appreciation for the relevance of equity.

As the double-entry accounting threshold concept was comprehensive, post-it-notes were displayed on a whiteboard to help make further sense of the analysis (see Appendix 10). One of the insights gained from this display was that there are many links and interrelationships in double-entry accounting and participants were not always looking at them in the same way or not including all the possible links. For example, participant eight regards double-entry accounting as a separate threshold concept that includes many of the conceptual aspects of double-entry accounting such as the accounting equation, accounting elements, duality, accounting jargon, debits and credits, specific accounts - what are they, what is their normal balance (which essentially sums up transaction analysis) and accounting standards. Participant six mentions basic accounting principles and the accounting equation but follows this up with more practical aspects of the recording process such as closing entries, preparation of worksheets, special journals and financial statements making this a more
procedural rather than conceptual process. Such differences were therefore considered in the next section to determine what comprises double-entry accounting.
Figure 7: Combined Cognitive Map for Double-Entry Accounting

DOUBLE ENTRY COMBINED
- Explaining analysis of entry as it is recorded
- From different journals and general ledger
- To subsidiary ledger
- But need to understand where a report comes from
- Manual accounting taught even though students likely to use computerised system in future
- Posting procedures
- Autos with auditing reports
- Need to understand why we do this

DOUBLE ENTRY BOOKKEEPING
- Format of recording transaction
- Steps involved in manual process can be confusing
- Confusion between general journal and special journals
- Use of general and/or computerised system in future

ACCOUNTING PROCESS
- Need to understand how it all fits together
- Need to understand whole process
- Need to break it down
- Accounting equation
- "Basic stuff" is the base/foundation

TRANSACTION ANALYSIS
- Transaction analysis rules
- Source documents
- Record
- Summarise
- Classify
- Trial Balance
- Reports
- Double entry is extension of accounting equation
- Need to understand not to memorise

ACCOUNTING STUFF
- Basic understanding of record keeping
- Accounting standards
- Accounting jargon
- Duality
- Need to understand why it all fits together

ACCRUAL ACCOUNTING
- Accounting rules in Australian context
- Like learning a new language
- It takes time
- Language creates issues
- Then can be applied in any context
- People just get it or don't get it!

PROCESS
- Adjusting entries
- Separate entity concept
- Appreciate relevance of equity
- Adjusting entries
- Need to make students "think"
- Need to understand every concept

FOUNDATION
- People just get it or don't get it!
- "Basic stuff" is the base/foundation
- "Basic stuff" is the base/foundation
- Appreciate relevance of equity
- Then can be applied in any context
- Need to make students "think"
- Need to understand every concept

ACCOUNTING EQUATION
- Effects of transactions on elements
-สาธารณ์ elements from the foundation
- How they work together
- Need to break it down
- Normal balance of accounts
- Double entry is extension of accounting equation
- Need to understand not to memorise

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4.2.2.1 What Constitutes Double-Entry Accounting?

There was a degree of variation as to what comprises double-entry accounting as well as a variety of titles given to this threshold concept. The cognitive map for double-entry accounting shows the label given to the threshold concept by participants tended to vary from being “foundation”, “recording process”, “basic stuff”, “accounting process”, “basic understanding of record keeping”, “double-entry bookkeeping” to “double-entry accounting”. For example, participant five described the threshold concept as ‘...the first one is just the basic stuff: debit/credit, journal entries...’ and then referred to a quiz completed by students which provided further guidance as to what constituted the "basic stuff". This included the accounting equation, adjusting entries, during year entries, identifying what the entries would be as well as the normal balance of an asset.

While the label may have varied, many of the components mentioned by participants were indicative of double-entry accounting. A breakdown of the components of double-entry identified by participants who selected double-entry accounting as a threshold concept is shown below in Figure 8. For example, the accounting equation, the notion of debits and credits and understanding the accounting elements (Asset, Liability, Equity, Income & Expense) and the conceptual framework were four of the more common aspects mentioned by between 3 - 5 of the participants (who identified double-entry accounting as a threshold concept). There were many other components that were cited by between 1 - 2 participants as being part of the double-entry accounting threshold concept such as the balance sheet/income statement, transaction analysis, balance day adjustments, the accounting process, separate entity concept, accounting period concept, the normal balance of accounts, source documents and financial reports.

In reference to the threshold concept matrix (see Section 4.2), apart from double-entry accounting, accrual accounting and a way of thinking and practising in the accounting discipline, there were also other threshold concepts suggested by participants. As fewer participants recalled them as threshold concepts, they have not been analysed in their own right as threshold concepts or themes in this study. However, it was found six of these other threshold concepts were seen as important components of double-entry accounting (by some of the eight participants who suggested double-entry accounting as a threshold concept). They are highlighted in Figure 8 (below) and include the accounting elements; the conceptual framework; duality of transactions; the accounting equation; balance day adjustments and
The components of double-entry accounting will now be considered in more detail. Participant seven explains what the accounting process entails in double-entry accounting starting with source documents and ending with preparation of financial reports:

… the process of accounting right, from the point where you collect your source documents, then you record them, summarise them, classify them, and then you prepare the trial balance, ah, you do the adjustments on the trial balance … then you prepare to the financial statements, right. So if a student can understand this whole process … it makes their life very, very easy going forward.

While participant eight provided additional detail by mentioning the need to identify specific accounts, the normal balance of accounts and the importance and linkages related to equity, participants eight and nine from the outset stress the importance of understanding the definitions of the five accounting elements – asset, liability, equity, income and expense.
Additionally, participant eight (below) highlights the importance of students having a good grounding in financial accounting which may otherwise be construed as an understanding of the double-entry accounting system:

Everything from that point comes back to that, even in second year. I'll go, "well now you remember in first year we learned this...so when we're impairing an asset this is what we're trying to do, or when we revalue an asset ...what we have to do is we have to ...write off the accumulated depreciation to get the asset value, then increase or decrease depending upon, and then we start ...applying the accounting standards and what the rule is" .... But it all comes back to what an asset is. Normal balance... and once they can get that concept and they can grasp the overall, and start fitting those into place ... everything comes a lot easier to them ...When you introduce a new topic, such as leasing, you go, "oh okay, so it's an asset for them, so it must be a liability for them, so we want to increase," so things will start, they'll start thinking through and it'll ...start making sense for them, but it's getting them to get that bottom building block. And then as we go through starting to understand … how it all sort of fits in together…. Okay that to me is the, that is the basis of accounting. If you can get a good grounding in that ...in financial accounting ... everything else starts to make sense.

The accounting equation was identified by participant fifteen as a threshold concept in addition to the notion of debit and credit and the difference between profit and cash, however, the participant comes back to the accounting equation and then links it again to the notion of debit and credit, transaction analysis and overall, double-entry accounting (even though s/he did not identify double-entry accounting as a threshold concept). Participant eight also identified the importance of the accounting equation and the need for an understanding of how it functions. Two of the participants (11 & 12) felt that an understanding of double-entry accounting came down to the five accounting elements as a form of underpinning knowledge. Some of the commonality that participants revealed could be considered conceptual for this potential threshold concept and included an understanding of the accounting equation, an understanding of the five accounting elements and the conceptual framework. Hence the researcher has used the term 'double-entry accounting' as it appears to denote what many of the participants are referring.

It was interesting to note that six out of the eight participants that identified double-entry accounting as a threshold concept were in the younger age range of 26 – 40 years (with teaching experience in financial accounting ranging from 6 – 15 years). This was the opposite to that noted when looking at the demographics of those who identified accrual accounting as
a threshold concept (Section 4.2.1). Only one participant, in the 46 – 50 age range, selected double-entry accounting and accrual accounting as separate threshold concepts. Future research might investigate what it is about the age of those academics teaching accounting that might potentially give rise to this scenario and how, if at all, the age of academics impacts on the identification and teaching around threshold concepts. Industry experience could also be factored in to future research as another variable. Further analysis in the next section will consider the degree to which double-entry accounting meets the Meyer and Land Framework (2003) beginning with the potential sources of troublesomeness for double-entry accounting and how overcoming any such troublesomeness combined with an understanding of how double-entry accounting is integrative can provide a transformation in student learning.

4.2.2.2 Why is Double-Entry Accounting Troublesome? How is it Transformative? How is it Integrative?

According to Davies and Mangan (2007) the integrative and transformative aspects of a threshold concept are implied when a threshold concept is troublesome. Hence, in the transformative process of understanding a threshold concept, a student may experience it as troublesome. This may arise from the use of ritual knowledge, conceptually difficult knowledge, inert knowledge, discipline language and/or foreign knowledge and/or the fear of uncertainty (see Section 2.2.1).

While ritual knowledge may be a source of troublesomeness according to Perkins (1999), it is interesting that participant five encouraged memorisation of the accounting rules. In hindsight this may provide difficulty for a student continually reminded of the need to understand what they are learning and not memorise or rote learn – hence trying to deal with contradictory messages and potentially impacting on the transformative nature of double-entry accounting as a threshold concept:

… one thing that I make pretty clear to people is that the debit and credit rules are just that; they’re just a rule, ah, because sometimes I notice people, they’re sort of trying to understand why it’s a debit or credit or something like that….and I just explain to them, “Look, it’s a system that was developed in the 1400’s and there’s no point.” The one thing I tell people is, “You know, debit and credit rules, I’ll never tell you to memorise something except for that. You do have to memorise it. I’m sorry, but that’s just the rules…”
**Conceptually difficult knowledge** - being a combination of misunderstanding and ritual knowledge - may also be a basis of troublesomeness where a student subconsciously reconsiders their existing thinking and understanding when confronted with qualitative problems (Perkins 1999). Understanding conceptually difficult knowledge can help transform student learning. For example, when asked why the participant believed students' had difficulty understanding the debits and credits, participant nine referred to the confusion confronted by students when thinking of their bank statement.

In describing an “a-ha moment”, participant eight also cited an example that relates to bank statements however it was used to describe how accrual accounting (rather than double-entry accounting or understanding the notions of debit and credit) can be conceptually difficult. S/he asserts that in thinking about a bank statement, a student may find understanding accrual accounting troublesome as they may not realize the same debit and credit rules are being used but from a different perspective. However, it is difficult to justify the source of such troublesomeness as accrual accounting as the confusion seems to stem from the debit and credit rules (as posited by participant 9) and how they are used in an accounting system to record transactions (which is more about the double-entry accounting system) rather than accrual accounting itself. Hence the source of the conceptually difficult knowledge in this case appears to be the double-entry accounting system itself (and not accrual accounting) and more specifically an understanding of the notion of debits and credits and the relationships between assets, debits, credits, liabilities and importantly, transaction analysis.

When asked why double-entry might be difficult for students, participant twelve revealed analysis of a transaction can cause such difficulty as it requires the student to understand the accounting elements and then be able to analyse a transaction to identify which elements are affected and how are they affected. Another participant (15) relays how s/he believes the accounting equation is troublesome for students by explaining the multiple layers of principles that need to be considered when thinking about the accounting equation:

> Well, it’s got three principles in it that they’ve got to understand... what assets are, what liabilities are, what proprietorship is. And that’s difficult. Proprietorship, or owner’s equity, is a particularly difficult concept for them. So the, the elements within it cause some problems...and students have to be able to understand the difference between those three notions...and understand their similarity...and then understand the relationship between them. So it’s a multi-level step of understanding. So I think that’s what makes it difficult for
them to understand... then they’ve got to relate their understanding of that to the accounting process. So it’s another layer of understanding, so it’s a really is a multi-layer level of understanding... and then there’s the notion of that equation, of that equals sign. I always ask my first years to tell me why this equation holds true. I ask them... why do assets always, at any stage, at any minute of a business’s existence, why does that accounting equation hold true? And it’s the rare student that can tackle that. And understand really why that equals sign holds true. But that’s, for me, a key question.

The integrative nature of the accounting equation makes this aspect of the double-entry accounting system conceptually difficult for students as it requires an understanding of what each of the accounting elements mean, how they are similar and dissimilar and the relationships between them but also an understanding of the significance of the “equals” sign as shown above. Reference to proprietorship/owners’ equity as a difficult concept is in the context of it being a sub-concept rather than a threshold concept and an integrative part of understanding the accounting equation. Additionally, being able to relate an understanding of the accounting equation to the accounting process is another layer of complexity students need to deal with in grasping double-entry accounting as a threshold concept (participant 15).

Also seen as conceptually difficult by participant nine, and as part of an understanding of double-entry accounting, is the conceptual framework and principles based approach of accounting. Hence, conceptually difficulty knowledge for double-entry accounting as a threshold concept stems from confusion regarding how the ritual use of debit/credit rules apply in a different context (such as from a bank’s perspective), understanding the accounting elements and subsequently, the analysis of a transaction, the layers of principles surrounding the accounting equation, the conceptual framework and a principles based approach of accounting and the ability to see patterns in numbers.

On the other hand, conceptually difficult knowledge is only one potential source of troublesomeness for a student in understanding double-entry accounting. Another source is inert knowledge which is seen by Perkins (1999) as knowledge held by a learner but it has not been used to actively connect this knowledge with their world, their life or society. It may be abstract knowledge that has no context for the student. It was revealed by participants that students have found it difficult to make conceptual links to assets, liabilities and equity and accept these conceptual links to transform their learning. For example, participant nine explained that:
I think it’s your ability to be able to conceptualise the learning to three simple elements and accept that this is possible...you try and tell most people that and they will go wild at you. They couldn’t cope with that.

The notion of debit and credit was cited as difficult by participant fifteen because the terms have no meaning to students and they cannot relate them to their world. Threshold concepts provide a means of identifying critical aspects of a phenomenon that may have implications for educators in developing curriculum or learning and teaching strategies that focus on these critical aspects to assist students in transforming their understanding and their world view.

Meyer and Land (2003) have identified discipline language as another source of troublesomeness where the language of the discipline itself provides a particular way of thinking and practising in the discipline. This is linked to the idea of “foreign knowledge” advocated by Perkins (1999) where such knowledge causes conflict with the knowledge the student already has and requires students to think in a different way that is unfamiliar to them. Hence, a transformation in thinking is required where students need to abandon their everyday understandings of the accounting elements to an understanding of these terms from an accounting disciplinary context or a need to challenge their existing thinking in trying to grasp how to think in an accounting context.

A number of participants identified the definitions of the accounting elements as troublesome. For example, the terminology in accounting such as an asset and liability have a different meaning than the familiar meaning students may have grown up with, apart from equity, which students may not have had exposure to in the past. Participant eight likened the learning of accounting to learning a new language but also points out more time is needed, than is allowed, to do this:

I think because it's, it's like learning a new language…it's very foreign…so it takes some time ...and because we don't have enough time, we've got to move so quickly. We have 14 weeks. I've got to teach them this. So if we could break things down and have it over longer time periods, I do believe ...students would understand but we don't have that luxury unfortunately.

Baillie and Johnson (2008) have identified fear of uncertainty as another source of troublesomeness however it was not as prevalent as the other forms of troublesomeness identified earlier. In terms of double-entry accounting, participant (4) alluded to the need for students to trust that what the academic is teaching (and not teaching) at the time will all make sense at some point when s/he states ‘sometimes you do have to accept something and
then we’ll come back to it’. This fear of the unknown or doubt as to whether or not this will happen for the student can be a source of difficulty students may encounter making the threshold concept difficult to grasp.

*Tacit knowledge* has also been identified as a source of troublesomeness by Meyer and Land (2003) where an academic may unknowingly not make students aware of an aspect of a threshold concept explicitly. Participant four explained the reliance placed on students to understand the logic of the accounting equation and to realise they should not continue until they determine the two effects of the equation. The participant, however, seemed to exhibit some doubt as to whether or not this is made explicit to students:

... if they haven’t picked up the logic of the equation and then initially the duality… the trouble with threshold concepts is they are just bread and butter to the people who know and a mountain to the ones who haven’t got it, so… that’s the issue. … but, you know, you shouldn’t go on …if you haven’t found, two effects I suppose … that’s another trouble with accounting … it’s not perfect physical science… it’s just some ideas

Similarly, participant ten notes:

… I suppose it’s one of those things that, as lecturers and teachers we forget what it was like when we did it originally … um, and I do try and make that point to students that sometimes I do forget and just remind me ‘cause I’ve been doing this for ten odd years now …

Tacit knowledge may result in the academic not making explicit knowledge or links that are needed to aid student understanding. This can have implications for the teaching approach as noted by Taylor et al (2011) when undertaking research into threshold concepts in biology. They found that teaching approach tends to be ‘tacit’ then ‘explicit’ however a change in approach was suggested ‘so that tacit ways of thinking and knowing within the discipline are ‘explicitly’ defined’ (p. 22). It is also of interest to note that while academics are able to deconstruct financial accounting, there is also the indication that they have grasped the threshold concept and therefore do not view double-entry accounting in the same way as students who have yet to make such a transformation. Kobus (2011) in a theoretical paper in dentistry based on observations and existing literature, comments on a study in Massachusetts (Atherton 2010) where a number of learners could not apply a basic concept in a different context. The teacher was unaware of the student misconceptions as the teacher felt it was easy to understand. Kobus (2011) highlights that ‘students need teachers’ help with adopting
new learning approaches [to] show relationships between concepts which might seem obvious to them, but not to students who are still learning’ (p. 51).

It also indicates the elusive nature of a threshold concept that, once grasped, it is difficult to understand what enabled the transformation and in fact, makes the transformation irreversible. Kobus (2011) highlights that it is ‘important to try to view threshold concepts from the perspective of the novice who has not yet made the transition [and that] experts might have a problem with that due to the irreversible nature of threshold concepts’ (p. 51). Although some of the participants in this study did exhibit some degree of tacit knowledge, they were inevitably able to reflect on their extensive experience of different student cohorts with ease. This also points to the benefit of undertaking further research to determine if students experience double-entry accounting and accrual accounting as threshold concepts.

In terms of the integrative nature of a threshold concept in helping to transform learning, participant twelve explains the linkages in the double-entry system in detail:

> See one thing that is very much related to double-entry is the accounting equation itself... if you go into the specifics of accounting, the first thing we tell the students is A is equal to L plus E... it’s so important for them, for us to teach them why it is A is equal to L plus E. Why is not A plus L is equal to E, you know, why it is that... [that] creates a very big picture in the minds of students. They start to visualise a company, a business where there are those assets, those liabilities, those equity. And then those things, then once we teach them the double-entry then they can relate further. They can start to think that okay, assets, everything that is owned by a business, it is now funded by two sources, either outsiders which are the liabilities or the owners themselves. And the whole thing revolve[s] around that. So it might appear very simple but I’ll say this is the core of accounting. If you are able to really, really make the student understand these things, the business environment, and then trying to develop them, all these accounting technicalities is not going to be difficult.

A range of participants noted the integrated aspects of accounting. This extended to an understanding of business, how businesses work and the accounting process. The integrative aspect of this threshold concept (double-entry accounting) encompasses many links and relationships to be understood between the accounting equation, the business environment, the financial statements and the notions of debit and credit. Analysis of the data reveals there are many sources of troublesomeness for double-entry accounting including conceptually difficult knowledge, ritual knowledge, inert knowledge, discipline language and foreign knowledge, tacit knowledge, and the fear of uncertainty that can be identified. The
boundedness attribute will now be analysed to continue the evaluation of double-entry accounting as a threshold concept.

4.2.2.3 Does it have Boundaries that Lead into Other Threshold Concepts?

A second insight that became clear from the preparation of the cognitive map (see Appendix 9) was a distinct boundary between double-entry accounting and cash flow statements where attainment of double-entry as a threshold concept is necessary if a student is to understand how to prepare a cash flow statement. Double-entry accounting being a boundary to consolidations and tax effect accounting were more obvious considering they are usually taught later in the degree while cash flow statements are often introduced in the same course or year that double-entry accounting is introduced. This can have implications for how an accounting degree is structured in future.

Participant eleven states the need to understand double-entry accounting to then undertake corporate accounting where s/he states:

…they have to be on top of double-entry book keeping from accounting principles stage if they’re going to have any, any chance of coping with corporate accounting.

The same message was iterated by participant nine regarding the conceptual framework definitions of the accounting elements and the fact that in corporate accounting, an understanding of these definitions is required indicating a boundary between the double-entry accounting system and corporate accounting principles.

While accrual accounting is considered a threshold concept as result of the earlier analysis, and at this stage double-entry accounting appears to be meeting the criteria to also be a threshold concept in its own right, this raises the question of how double-entry accounting (as a foundation) and accrual accounting (as underpinning knowledge) are related. As mentioned earlier in regards to accrual accounting (see Section 4.2.1.2), one participant elucidated accrual accounting would follow double-entry accounting, thereby creating a conceptual border. When asked by the researcher if it would be really difficult for a student to understand accrual accounting if a student had not understood the foundation, the participant (8) was adamant the foundation needs to be understood first, making it clear they can be considered separate threshold concepts:
No, they've got no hope. Absolutely no hope but they have to know that [the foundation] first before moving to the second, or I know they've got absolutely no hope of knowing that second building block. And then we start talking about applying that, that knowledge, particular applying different standards and, you know, the way we account for, accounting for assets and all that type of thing. If they don't have those building blocks they can't do that.

Hence boundaries appear to exist between double-entry accounting, cash flow statements, consolidations and corporate accounting, tax-effect accounting and accrual accounting. The potential irreversibility of double-entry accounting will be considered next.

### 4.2.2.4 Is it Irreversible?

A threshold concept is considered irreversible if it is not likely to be forgotten once it has been grasped (Meyer & Land 2003). It can mean the student sees the world and themselves in a different way as part of this transformation (Davies 2006, in Coughlan & Graham 2009). There was some sense of confusion regarding this attribute by participants as was the case with the accrual accounting threshold concept. In terms of irreversibility, it was acknowledged by participant ten that ‘if you don’t use it, you lose it’. This refers to knowledge not being forgotten or “unlearned” but rather being ‘a bit rusty for a bit but it comes back to you after a little bit’:

They forget how to do things, but I’m not sure that …they’ve unlearnt them as such… what I do see them do is compartmentalising stuff ….. um, where you ask them to do something new that relies on a previous concept …… and they can’t make the link between that. But I wouldn’t, from what I’ve seen, I don’t think that means that they don’t know what it was anymore, um, it’s not fresh in their mind …… but if I asked them to go back and do it and refresh a little bit they’d get that again. They’re just unable, unwilling, and trying to make those links, so, um, yeah, I don’t think the unlearning is an issue ….. um, around those particular concepts and it’s that old example of riding the bike, if you get back on it you’re a bit rusty for a bit but it comes back to you after a little bit…I don’t think that they unlearn it. I think they lose it. I don’t even think they forget it. I think they lose it in their long term memory. And they don’t have the strategies to bring it forward …Until they get, you know, they go somewhere else and it’s ah, I remember something about that …But they can’t bring it forward themselves. But I think that that’s part of, I think that that’s part of the whole knowledge transfer thing of being able to apply it and… if you don’t use it, you lose it. And it’s the same with teaching anything. You can’t just pop up and go and do it if you haven’t done it for a couple of years.
Another participant (4) likens irreversibility of debits and credits to the foundations of a house and also cites the need to ‘dust if off a little bit’ recognising that the knowledge is not forgotten as such but rather needs to be refreshed:

They can relearn it, I don’t think they forget it… my analogy it’s like a foundation. You never see your foundations, you know, but if they’re weak…they fall down. So…if it’s a threshold concept and …understood as a tool and that’s what it would be wouldn’t it… it’d be there, you might draw upon it but, ah, you might have to dust it off a little bit but, ah, it shouldn’t take much dusting.

Participants likened irreversibility with the need to refresh knowledge if it has not been used recently but agreed that such knowledge was still in the possession of the student. It should be noted that previous studies into the identification of threshold concepts have not always considered the irreversibility attribute when identifying a threshold concept. This attribute will be discussed further in Section 4.2.4.2.

In conclusion, it strongly appears that double-entry accounting is a threshold concept. In terms of the Meyer and Land Framework (2003), there are a variety of sources of troublesomeness surrounding double-entry accounting that may need to be overcome and integration of sub-concepts understood if a transformation in learning is to occur for this threshold concept. Definite boundaries were identified for double-entry accounting with many of them being conceptual knowledge encountered in later courses in the accounting degree apart from accrual accounting which would often be encountered in the earlier part of a degree. As was the case with the irreversibility attribute for accrual accounting it appears that double-entry accounting is unlikely to be reversible if it is understood (although it may need to be refreshed if not used). The attribute of irreversibility is discussed further in section 4.2.4.2. The third theme to emerge from the analysis is a way of thinking and practising in the accounting discipline that will be addressed in the next section.

4.2.3 Way of Thinking and Practising - in the Accounting Discipline

The way of thinking and practising in accounting is one of the themes identified from the data analysis and will be the subject of discussion in this section. The cognitive maps illustrating the elements that comprise this theme are shown in Figure 9.
Figure 9: Cognitive Map for Way of Thinking and Practising in Accounting

Way of Thinking in Accounting

- Make connections; put in context
- Know when something does not look right
- Open up your mind
- Wanting to know what would happen if...
- Keep open mind about past experiences / past prejudices
- Challenge what you've been told
- Realise that they may get in the way of what is going on here
- Need to solve problems
- Need to think critically
- Need to understand and "unpack" e.g. Accrual Accounting
- Need to interpret professional opinion / judgement
- Accounting is about language, not numbers
- Accounting is dynamic
- Accounting requires interpretation
- Whole world modelled on A, L & Equity (Rev & Exp subsets of Equity)
- Negative preconceptions of e.g. accrual accounting
- Misconceptions of what accruals & what accountants do
- Negative preconceptions of e.g. accrual accounting
- Make connections; put in context
- Different meanings for the same word
- Different meanings for the same word
- Technical terms
- Words not encountered in everyday language
- in different disciplines
- in everyday language
In terms of the literature, Meyer and Land (2003) explain that a threshold concept is akin to a gateway in that it results in 'opening up a new and previously inaccessible way of thinking about something’ (p. 3) that involves a transformation in the way a student understands, sees or interprets something. Land et al 2005, in Rust 2005, relate the importance of a way of thinking in the discipline by confirming that threshold concepts are ‘concepts that bind a subject together, being fundamental to ways of thinking and practising in that discipline’ (p. 54).

As the interview questions were informed by the Meyer and Land Framework (2003), and focused on identifying threshold concepts in the financial accounting discipline, a specific question regarding the way of thinking and practising in accounting was not explicitly included in the list of questions guiding the interview. This theme emanated from the data in this study when participants reflected on the troublesome nature of the threshold concept they had suggested so it was unexpected yet pleasing that an analysis of the data revealed a particular way of thinking and practising in the accounting discipline. Baillie and Johnson (2008) identified professionalism as a threshold concept in engineering but only focused on the troublesomeness attribute where all forms of troublesome knowledge were evident. They suggested that the threshold concept in this study ‘appears to be related to ways of thinking and practising (Wenger 1998)’ (p. 137). Hence it appears that a way of thinking and practising is linked to the troublesome nature of a threshold concept.

When preparing the individual and combined cognitive maps, it often became unclear where some of the abstract notions raised by participants should be placed in the map as they often related to all the content and not just an aspect of it or to the discipline as a whole. As threshold concepts are predominantly content based, more abstract notions in relation to the way of thinking and practising were placed into a separate cognitive map displaying the way of thinking and practising in the accounting discipline and incorporated issues of language tending to go beyond the content. This made it clearer to determine where the way of thinking and practising and language issues sat in the “big picture” of the financial accounting stream and potentially the accounting degree. For example, having an attention to detail is a capability mentioned by participants and is foreseeably developed throughout and permeates the whole degree and not just one part of the degree. Participant eight describes this capability below as an important trait for an accountant:
So they've got that whole attention to detail, anally retentive type thing, that I think that makes a good accountant..... and once they've got that knowledge, and sometimes they'll actually come out with more knowledge than what an average student will. Because they've actually explored more areas through their attention to detail...they'll learn how to, they'll know more and be able to apply more ...when they become an accountant in the real world, and I think that will make them a better accountant.... that’s only just talking about .... the application stuff. I mean we haven't talked about ethics or …

Likewise, participant thirteen revealed the need for students to have attention to detail which involves a range of capabilities for an accountant such as being comprehensive, keeping an open mind and able to think critically and solve problems:

...what it is to be a professional.... problem solving, critical thinking ... they’re just woeful at... and to open up their minds. Recognition that being a professional is a matter of detail... thinking like a professional ...... it doesn’t have to be an accountant but thinking like a professional. And I also tell them that detail is really important, and being accurate is wrong ‘cause you never really want to talk about accounting and accuracy but, but being comprehensive ...... and being accurate with what you’re working with is really important ...... ‘cause I say to them well you go into hospital and you have an operation, do you want the surgeon to say, oh, I had a look around here, that’s okay, and walk out, or do you want them to be a hundred per cent certain that’s everything done? Or when you get on your next A380 and looking at the wing do you want the aerospace engineer to be 90% okay, happy with it, or you want them to be 100%? …and they think, well come on [participant's name removed], you’re talking about different things…I said well, so here’s, here’s a real life situation that you could be faced with as an accountant. Someone comes to you and you set up a self-managed superannuation fund and they want $5 million to be in there in 20 years’ time, and you set out all the calculations, all these sums and da, da, da, set it all up, and 20 years’ time, oh, there’s only three million, oh, ‘cause you made a mistake back then. Ah, well then what’s going to happen? I said you’re going to get your arse sued off, so, you know, it does matter. It does matter…and getting them to start to think about it being a professional, and you can see those that get it …

In terms of being a professional, participant thirteen took an even broader view believing an eye for detail extended to being not only an accountant but a professional by explaining ‘being a professional is a matter of detail, and if you don’t have that eye for detail ...then you’ve got to build up, ah, a mechanism in which that can be overcome’ and provided a clear description of the expectations of such above.
Participant seven explained that their (students’) brains just don’t work in a way that is conducive to studying the accounting discipline. This participant identified having an attention to detail is a crucial part of being an accountant that not everyone is capable of:

… when we were teaching the non-accounting students, we struggled with that 'cause some students just shouldn't be doing it, just don't have that ...they're brain just doesn't work that way… to be good at accounting you have to be anally retentive to a certain degree, you have no choice, you have to be, and attention to detail is very, very important and …those that are very anally retentive and have got very good attention to detail, you're going to make a great accounting student. And they always perform well. I haven't yet been proven wrong in 12 years.

The use of judgement and there being choice and alternatives in accounting can be troublesome for students but they are also capabilities that form a way of thinking and practising students need to accept in becoming an accountant according to participant ten:

And I think, one of the things with accounting that does cause them some difficulties … we keep saying to them or you could do it this way, or you could do it this way and they’re both right…. I remember having one student come to me at one stage …an ex-science student, and they came in and they were …sort of I don’t know if distressed is the right word, but they came to me… well what’s the right way of doing this? What’s the true way of doing this in accounting? .... well there isn’t a true way. They go but one of my other lecturers said there’s truth in accounting, and I said, well no, there is truth in accounting but there’s not one absolute way to do it… I think it’s the alternatives...... and where they’ve got alternative ways of doing things that is a harder thing to get across...

Participant nine relayed an interesting story of how the way of thinking in the accounting discipline differs to the medical discipline and acknowledging that in fact accounting may not be that easy to grasp in hindsight:

So I think it, it’s pretty integrated. I don’t think accounting’s that easy actually. When you start to think of it at those levels you can see why it’s hard for people to do... I was at this thing the other week, this guy’s brother-in-law he was, he was a medical person running his own business so he thought he’d go and do some accounting ….. and he’d done brilliantly at medicine throughout uni so he thought accounting would be easy, and he scraped through on a pass. It was just a totally different way of thinking and he didn’t get it. You know, his brother-in-law is teaching him accounting and, you know, is forever helping him, and just, he said this guy’s brilliant but he just doesn’t get it. It’s a different way of thinking…they just
don’t get the way why debits and credits do what they do and why the patterns are the way, they just don’t get that. … When you get [it] it’s hard to tell isn’t it, it’s hard to explain? …I think it’s your ability to be able to conceptualise the learning to three simple elements and accept that this is possible. You try and tell most people that and they will go wild at you. But here …you’ve got these very vague concepts about the world and you’re modelling the world, and they’re going this is just a different way of thinking from medicine.

It appears that those who have grasped a threshold concept have experienced a transformation in thinking that makes it difficult for them to recall how difficult it may seem to others who are yet to experience such a transition as the participant above relates to. Hence, conscious thought and attention on the part of academics is needed to understand the notion of threshold concepts to ensure that tacit knowledge is not omitted from the learning environment. The way of thinking and practising in accounting necessitates a range of capabilities that provide the ability to see a “bigger picture”. The need to continually ask questions and not just accept what you are being told as referred to earlier by participant five when s/he explains ‘they need to see a bigger picture I think…you know, outside of just this, they need to understand how, actually it’s going to apply to something in the real world’. Being able to see a “bigger picture” is linked to the integrative nature of the double-entry accounting threshold concept where an understanding of business and business processes is necessary for understanding this threshold concept and was discussed in Section 4.2.2.2.

A way of thinking and practising in the discipline was also linked to how the accounting discipline itself is different to other business disciplines in that financial reporting is based on accounting standards whereas the other business disciplines are not based on standards as such:

What makes it different to other disciplines? …. accounting is very much a practical course… It's not really until third year where you start talking about the theories of accounting....but everything up to then, in financial accounting is very, and the reason why is because if they don't understand the practical, it's pointless talking about the theories, 'cause they've got nothing to apply it to...so to me it makes having theory like a capstone course right at the end....so to me it's, not only is it just a practical, it's also, we are applying a set of standards, accounting standards ...that a lot of other disciplines don't have. Management don't have them. Marketing don't have them. Human resources don't have them. Economics don't have them. Finance don't have them ...and that makes us very, very different to a lot of other disciplines… Even if in the real world they may not be applying debits and credits, but to be
able to take that step up, that higher level they've got to understand that basic ...they've got to understand the basics or they can't do that.

(Participant 8)

Such differences contribute to what makes the accounting discipline distinctive to other disciplines thereby influencing the way of thinking and practising in the discipline.

Issues of language in the accounting discipline were addressed earlier when considering the troublesome nature of accrual accounting and double-entry accounting in terms of discipline language. However, such language is not always specific to a particular threshold concept and can permeate the whole degree and necessarily become a part of the way of thinking and practising in accounting. Participant nine provided an excellent example of how the word ‘capital’ has multiple meanings and can be construed in different contexts and disciplines:

…if I’m talking geography a capital is usually the major city in a certain State. If I’m talking English language, it’s usually an upper case letter at the beginning of a sentence. Ah, if I’m talking finance then I’m probably talking about the shares and etc… there’s lots of different meanings for each word, it depends on context and discipline, so now …we’re going to talk about these elements in the accounting discipline and they are going to be different from what you think they are but there’s that bottom 25, 30% are not going to. So I think that’s why it’s hard, and even for those that get it, it probably is hard because you come in thinking it means one thing and someone says it means something slightly different.

Revealed by several of the participants was the need for accountants to have an attention to detail as accounting is very detail oriented. This involves the ability to think critically, solve problems, keep an open mind, see patterns in numbers, use judgement, continually ask questions, not just accept what you are told, realise that there are choices and alternatives in accounting and understand the language of accounting. This resonates with capability theory (Section 2.3.5.1.5) where the ability to understand the importance of the detail and complexities associated with being an accountant can help students deal with unknown situations or problems effectively when they are encountered in the future. More specifically, it may be a threshold capability described by Baillie et al (2013) (Section 2.3.5.1.6) as a ‘threshold to professional learning in a defined area of knowledge’ (p. 236) that will assist students in developing knowledge capability in the accounting discipline and the ability to see the “big picture” through the eyes of an accountant which is an important aspect of any future curriculum development.
Several participants provided fascinating insights into accounting having two extremes - people either “get it” or “don’t get it” - and there are clearly people that cannot do accounting. The reasons for this range from it is the way the brain is oriented, student perceptions leading them to believe they are suited to accounting where they may not be, the need to naturally like accounting in order to get it and students who are successful in other disciplines such as science and engineering but not accounting as it has a different way of thinking and practising. Participant thirteen articulated these two extremes using a mushroom analogy:

I always say, I know it sounds a bit silly, accounting’s a bit like eating mushrooms, you either naturally like it or you don’t, and if you don’t you’ve got to really work hard at it. And accounting is very much like that, you either get it or you don’t.

Participant two believed the way the brain operates impacts on the ability of a person to “get” accounting and added that generally “numbers” people are more likely to understand accounting:

…because from my knowledge of teaching accounting for a long, long time now, it’s always been something that people either get or they don’t get and obviously the same people probably having trouble with initial double-entry would have problems with consolidations down the track. So I think the issue there I think it’s just the way the brain operates and its, to me, the same sort of people who are often numbers people and love the mental arithmetic and …I think that if you’ve got a passion for that I think that obviously helps you understand things like double-entry and bank reconciliations and consolidations and GST accounts … so I think it comes down to the fact that some people’s brains just aren’t orientated in that way.

An incorrect perception that accounting is all about numbers when it is not may also mean the student does not realise they may not be suited to this discipline. Participant four considers the situation where double degrees result in students studying in more than one discipline and how it is noticeable that students studying in other disciplines may have difficulty studying accounting:

… that’s another trouble with accounting … it’s not a perfect physical science, it’s just some ideas and that’s why I think some of our double degrees, the science students, how could they struggle with the logic of this …but it always amazes me that they struggle with accounting when they’ve got programming, they’ve gone with maths…
This is in contradiction to participant two who believed that “numbers” people are more likely to understand accounting as the quote above reveals a student who has done maths is struggling with accounting, potentially dispelling this myth.

The philosophy of participant seven is not everyone can do everything and it is obvious to him/her which students will be accountants, or not, based on their first exam assessment. Also the motivation for doing accounting is a contributory factor according to this participant where students are unsure what they want to do or are doing accounting because a family member is an accountant or their family wants them to do accounting. Participant thirteen also talks about a student who is not performing well in accounting and questions whether the student should really be doing the accounting degree. While this provided some interesting insights into the accounting discipline, further research could determine if these beliefs have merit.

Overall, the way of thinking and practising in accounting denotes a way of being or acting as an accountant that encompasses several capabilities. Understanding that accounting is dynamic and can change is an important part of this as well as the notion there is not always one right answer in accounting as it involves professional opinion, interpretation and judgement. Being able to see the linkages and interrelationships in accounting is vital but also being able to put a situation and/or information into context and understand who you are preparing information for becomes a crucial capability. Students’ recognising that accounting is predominantly language based is important. In addition, the ability of students to recognise past prejudices and misconceptions and keep an open mind to what they are learning and seeing, being prepared to challenge what they have been told and then fundamentally realising and accepting that in accounting, the whole world is modelled on assets, liabilities and equity, with revenues and expenses being part of equity is an important shift in thinking.

The need for attention to detail appears to be a threshold capability for a professional accountant that resonated with several of the participants, and when combined with threshold concepts, may have important implications for curriculum development in the future and development of knowledge capability in accounting graduates. It is possible that academics in different disciplines would identify a particular way of thinking and practising in their own discipline. For example, a medical doctor or an engineer would require an eye for detail but it may be self-evident and implicit in their discipline, whereas this may need to be made explicit to a student in the accounting discipline. While this is outside the scope of this study, it may be a topic for future cross-disciplinary study. Thoughts on accounting being a
discipline that is suited to some people were also of interest where participants provided interesting insights into accounting being something where people either “get it” or “don’t get it” and that there are clearly people that cannot do accounting. Apart from the three major themes that have been discussed, other outcomes were also evident and will be discussed in the next section.

4.2.4 Other Outcomes

This section reports on the other outcomes revealed from this study. In this section, the analysis confirmed that light bulb moments (also known as the “aha” moment, when the “penny drops”, “I get it” moment) do exist and are akin to grasping a threshold concept but also provided an insight into their elusive nature. Some enabling and inhibiting factors in achieving the light bulb moment arose from the analysis. These include the importance of experience in aiding student understanding and transformation, realising that grasping a threshold concept takes time and the ability to understand the myriad of links and relationships of a threshold concept. Also revealed were the perceptions that many participants had about the irreversibility attribute of a threshold concept (Meyer & Land 2003) and reflections by the researcher on use of the Meyer and Land Framework (2003).

4.2.4.1 The Light Bulb Moment– Enabling and Inhibiting Factors

The light bulb moment is often thought of as the moment when a threshold concept is grasped yet its elusive nature makes it difficult to determine what lead up to the light bulb moment. The analysis in the current study revealed that light bulb moments do occur in the accounting discipline. Many participants reflected on their obscure nature. When talking about the impact of a threshold concept on a student, participant fifteen states it ‘opens up everything…it’s the “aha” moment – oh, I get it. I get it. And I can do anything now…which is quite right’.

Participant ten described “I get it” moments and how s/he also experienced this moment however s/he could not specifically remember it apart from the fact it was achieved highlighting the obscure nature of such a moment. Participant 1 was asked if a thorough understanding of what an asset and a liability is results in a transformation in a students’ learning. This participant likened it to a light bulb moment where student learning is transformed thereby enabling them to continue their learning - ‘once they’ve had the light go
on or hit the nail on the head, it actually frees them to then start actually exploring the world or going on to the next step’.

While participant thirteen likened the light bulb moment to when the “penny drops” being common to the accounting discipline but not exclusive to it:

…well the penny does drop, accounting is one of those where the penny drops… if you like what’s happening around you, it just drops and it just all makes sense. I’m sure that happens to lots of people and lots of students in lots of degrees, not just accounting and/or business.

Participant thirteen acknowledged that light bulb moments do exist and revealed above that you need to “like what’s happening around you”. This implies that the “aha” moment is related to the student gaining satisfaction from, and enjoying, their learning. This can stem from the approach students take to their learning which Ramsden (2003) asserts is ‘intimately connected to students’ perceptions of the context of learning … which are clearly adaptive responses to the educational environments defined by teachers and courses’ (such as assessment requirements, effectiveness of teaching, etcetera) and the students’ previous experiences (p. 81). According to Ramsden (2003), a deep approach to learning is more enjoyable and associated with better academic results and higher-quality outcomes. As educators, creating an educational environment that students enjoy may encourage deeper approaches to learning and have important implications for attainment of the “aha” moment and hence a threshold concept!

While achieving the variously described “light bulb” moments (and when they breach the threshold) helps a student make sense of something, it also seems to open the way for the student to continue their learning. The analysis revealed some enabling and inhibiting factors in achieving a light bulb moment that could be investigated in further research.

Participant fourteen reveals the ability to transfer knowledge to different contexts is an important part in achieving the light bulb moment. This has links to threshold capabilities and the development of knowledge capability where a professional accountant needs to be able to apply knowledge in different contexts and is an enabling factor in achieving the light bulb moment but importantly it needs to be something the student works out for him/herself rather than being told by the academic:
… application and that transfer of knowledge. If they can transfer it to other situations, you
know, a bit like my profit. If they can understand that profit in management accounting, doing
CVP analysis, is exactly the same as what we did in financial accounting when we were doing
an income statement, if they can understand that, if they can see that without me telling them
… the whole, the whole light bulb moment…you can tell in their eyes.

Likewise, when discussing light bulb moments, participant four talks about it in terms of a
switch but also recalls difficulty in ascertaining what led to the light bulb moment and
questions whether students may be looking for complexity in the concept when it may not be
present:

…like a switch …I can’t remember back that far but it’s just, and that’s the trouble, you take
these things for granted and you’re just struggling with why can’t they see it, it’s so, so simple
and perhaps it’s too simple, they’re looking for it to be really complex… but it just seems like
right through my career there’s always been the brick wall of debits and credits, some people
just break through it, and you can actually see it, where the penny drops and it’s always a
little bit harder when you’re a lecturer or a tutor situation than perhaps in the old days when
you were in class. But that concept of…it’s just amazing, falls into place.

In this case, if the students’ perception of ease or difficulty in obtaining the light bulb
moment differs to the reality of achieving it, such a perception may become an inhibiting
factor in achieving a light bulb moment and may be linked to the learning environment
created by the educator. Additionally, the participant above makes reference to “you take
these things for granted” which was raised by several participants and implies that tacit
knowledge of the academic is not always drawn to the attention of students which has
consequences for learning and teaching. A deliberate and conscious effort by academics in
understanding the notion of threshold concepts may be necessary to ensure that tacit
knowledge is recognised and not omitted but also to enable academics to be mindful of
student behaviour in class in recognising when an “aha” moment has been reached (or not!).

An inhibiting aspect is also the way university teaching is often structured in terms of
lectures/tutorials/classes where participant seven recalls the “aha” moment as being
achievable on a one to one basis only rather than in a classroom situation and relays an
example to illustrate this. Potentially this could have implications for teaching and learning as
an enabling factor:
… I generally only know the 'aha' moment is on a one to one basis, when I've had a student who can't, it's hard to get in a room, and get the 'aha' moments in a room. But when I've had students that have had a difficulty with something and they've come to see me during consultation at some stage and I've just been explaining something to them...and they go. "Oh I get it, is that what it is?" And that, that's the 'aha' moment. The best explanation I guess, when they don't get the whole assets, debits, credits, accrual accounting, all that, so they just don't get that, and the reason why, the reason why they don't get it, is because they keep thinking, they've got in their mind, their bank statement. Okay. So they've got everything in reverse 'cause they keep thinking that the bank, and, and it's not until I can actually really get them to understand that the bank statement is prepared from the bank's perspective, rather than from their perspective individually. So they go, "oh well then that makes sense …I've had that 'aha' moment with a number of students. That's just an example of …how do you know, because they've had some concept in their mind, or some idea and it's not until you explain to them, and they, "oh." But that often doesn't come up in a lecture because you don't teach them like that, but ...most students can get that but I've had that individual 'aha' moment a number of times with students who haven't understood it …

Recognition by the above participant that 'they’ve [students] have got in their mind their bank statement' recognises that students’ previous life experiences may impact on the ease with which they are able to grasp a threshold concept.

Other factors mentioned that potentially inhibit students from grasping threshold concepts include overemphasis on a large amount of content which, in turn, impacts on the time students have to reflect on the process and linkages in accounting and the opportunity to consider the “bigger picture”. This is supported by Boustedt et al (2007) as they point out knowledge of threshold concepts can overcome some of these factors as effort can be placed on understanding the relatively few threshold concepts within a curriculum to maximise student understanding. For example, participant seven noted the accounting language as a potential barrier to understanding accounting and the need to provide time within the curriculum to allow for this. Similarly, participant one acknowledged that internalising a threshold concept can often take time to achieve.

The analysis also revealed the importance of experience in a number of contexts including a shift in thinking and achievement of a light bulb moment by ‘seeing’ something in order to understand it. Participant fourteen revealed the need for a shift in thinking by the student such that 'they will 'see' the world differently' resulting in epistemological and ontological
transformations in the student as referred to by Quinlan et al (2013, p. 586). Essentially this can have implications for how academics teach in terms of creating experiences to assist students in managing threshold concepts and/or utilising existing experiences of students to enhance learning:

.... they get very excited when you talk about tax because .... they can understand that. They have experience of it... they have to do their tax return. Even though there’s a whole lot of stuff that they don’t understand about it. But it’s part of life. It's on the news all the time. They talk about it all the time. But this funny word is never spoken about. Yeah, but even the concept’s not really spoken about. You know, on the news, or when they’re reading stuff, or even when they’re reading through their textbook. Or when they have to do problems... Nobody’s ever saying to them, this is accrual accounting... what you’re doing is that...so it’s, it’s very much a concept. It’s not... something that you learn even. In terms of doing a problem.... well so what do we start doing and ...we get them to do these cash based problems first... you get paid and then you have to pay your bills ...and you’ve got a phone bill... you’ve made all these text messages to your girlfriend who’s...somewhere else on the other side of the world and it’s cost you a fortune...so those sorts of things they can handle. And then you start talking about the fact that you didn’t get the phone bill, but you have to account for it, even though you have no idea, you’re just going to make stuff up. So the whole making stuff up really does their head in...it’s a paradigm, paradigm shift for them, for something that ...., it’s not common usage language. Or even common usage ideas, really.

An example of an audit was used by participant thirteen to explain it is only really when students experience undertaking an audit that they really “get it” but also you need to "see it" in order to "get it" implying experience enables a student to “see” therefore making experience an enabling factor for a light bulb moment:

That’s a big shift when you say, yeah, I got it, and I mean that’s going to happen sometime down the track, and it may not happen during your degree, it might happen when you start to work for someone ... which is for audit is when it happens. Out of the audit course we do here, in fact any university ...no one gets it. It’s only when they go out and do it. Very few people get it here... ‘cause it’s a lot of knowledge and a lot of things going on. It’s only when they actually go out in the real world and they’re auditing maybe accounts receivables, and they see how that’s done really well and how ... the sampling comes together and the errors and what errors there are, whether they’re material or not and where the provision account for doubtful debts, how the calculation of that’s done, til they see it all, when they see it happen like that they get it ... and they see that’s just one little piece of the pie. And there are all
these other little pieces of pie going on around the place, they can see how it all comes, they
get it … and you’ll hear that a lot about audit.

The need to “see” has also been used in an abstract way to describe a students’ ability to
“see” and experience the integrative nature of a threshold concept. For example, participant
ten provides this experience to students whereby students complete a set of accounting
records manually and then using a computerised system. Participant thirteen also reflected on
the need to experience doing a set of books in order to fully understand how the financial
statements come together and that in a university setting academics try to incorporate such
experiences to facilitate learning. Participant nine has linked the ability to “see” in a real
world context through experiencing it by explaining ‘rather than asking them to do the
assignment [on consolidations], I want them to go and look at an annual report and see how
this is being done, so I want them to experience that. So I mean the idea is to give the bigger
picture’.

Experience, and in some cases lack of experience, can inhibit the light bulb moment. Participant nine recalls a student doing a test but applying the debit/credit rules from an
incorrect perspective based on her prior understanding and/or experience related to the bank
statement and where the student did not realise the bank applies the same debit/credit rules
but from their own perspective. This illustrates how experience or prior understanding can
sometimes inhibit the light bulb moment as student thinking needs to allow for the integration
of current knowledge with new knowledge so that students can apply such knowledge in
different contexts. When asked why students found accrual accounting difficult, participant
fourteen explained their lack of experience results in students not being able to see why
accrual accounting is used and this makes it harder for students to relate to thereby inhibiting
achievement of a threshold concept. This has implications for teaching and learning in terms
of embedding experiential learning in teaching and learning strategies to create such
experience for students and provide a learning environment that encourages achievement of
the light bulb moment.

Strategies are used by academics to relate the experience a student already has into an
accounting context to help a student understand it from a real world perspective. Participant
four recalls the need for experience in a number of contexts, particularly in terms of students
being able to understand transactions as the key to being able to record transactions but an
understanding of how a business works and operates is also needed to be able to understand transactions:

...I just say you’ve got to understand the transaction... so sometimes they’ve just got to come to grips with that when you talk about, I talk about electricity bills and I ask them, do you pay the electricity bills, and none of them have or they don’t own up. For me, it means that they don’t understand sometimes that the transaction is the issue. So we’re talking about the concept of recording, and how to record it based on the duality of the transaction. So that’s the mechanism ... you should have a really good idea of what we’re trying to record, so it doesn’t help if they don’t have much experience with the transaction. Do the students have an idea of what a business is how it runs and operates ... ‘cause that’s what we’re reporting isn’t it...the operation of a business...? I suppose it comes back to more understanding the transaction, if you don’t understand how a business works and what it’s about...then really how can you relate this information system to it? . it’s a lot easier when...you might be talking about inventory and how many have worked in a supermarket and so, you know, about the barcode and you talk about inventory matters and try and make that the physical connection. So it’s always easier to talk to them if they work versus the ones that haven’t.

Reflections by participants also revealed that the use of real life examples may help students make the connection between their learning to their own experiences and make them meaningful. Participant one finds concepts have no meaning if students cannot relate to them while participant nine also found relating concepts to students personally helps students to grasp a threshold concept:

I can have students sitting where you are and I can see the look in their [eyes], and I can see they’re trying, and you’re just throwing different examples and trying to personalise the examples ...and hopefully with some of them, you see this light go on and you think, oh, they’ve finally got it. And sometimes once the light goes on they go, oh that’s really easy and they wonder why it wasn’t. And what was the block? Often personalising it to things in their life…. making them think about things they haven’t thought...

Identifying factors that enable or inhibit the grasping of threshold concepts can potentially assist academics in curriculum design. However, it is often the description and identification of the threshold concept itself that participants in this study found harder. The elusive nature of a threshold concept is not easily explained as it appears to constitute links and relationships that need to be understood in relation to personal experiences as a starting point and is something that evolves over time and needs to be able to be seen in different (and
appropriate) contexts for it to free the student to undertake further learning. The difficulty in identifying threshold concepts from an academic perspective is reflected in the following comment by participant four:

…it’s just so ingrained in me I can’t break it up into those threshold concepts, you know, that I’ve absorbed and I haven’t unlearnt them and they are perfect examples of threshold concepts ‘cause I can’t actually say them because they’re just there…

Likewise, participant nine revealed difficulty in explaining how a threshold concept is grasped but also recognises that students need to be able to accept something at first they may not necessarily believe but when they do, it can potentially transform the way they see the world.

In summary there are various enabling and inhibiting factors that can impact on the achievement of the ‘light bulb moment’. Enabling factors include the ability to transfer knowledge to different contexts, students enjoying their learning and working with students on a one to one basis. Inhibiting factors were predominated by time constraints in terms of overcrowded curriculum, more time needed to fully explain and explore the links and interrelationships of a threshold concept and the inability to illustrate entire processes to aid understanding. Other inhibiting factors include the perception of something that is to be learned as difficult or easy to learn and the reality of such being different to this perception, the use of lectures/tutorials/classes in the teaching/learning environment and the limited resources available. The use of experience could be seen as an enabling factor but also an inhibiting factor in different contexts. Sometimes prior experience can prevent a student from further learning as they may not realise how their prior experiences can be conceptualised in different contexts. This necessitates a shift in thinking that a student may not be open to. Alternatively, prior experience can assist a student in helping them see how an aspect of their learning can relate to their own real life experience and therefore making it more meaningful for them. The use of capability theory in conjunction with knowledge of threshold concepts in the development of a professional accountant makes this a potential area of further research in accounting. Overall, awareness of the enabling and inhibiting factors of light bulb moments may provide insights into how threshold concepts can be grasped that could inform teaching and learning.

One of the characteristics of a threshold concept is that it is potentially irreversible (Meyer & Land, 2003). The analysis provided some interesting insights as to what this means and
whether knowledge is irreversible or not and as such it warrants further discussion in the next section.

4.2.4.2  The Irreversibility Attribute

Another outcome of the analysis was how academics perceived the ‘irreversibility’ attribute of a threshold concept in the Meyer and Land Framework (2003). Participants tended to think of irreversibility as the ability to refresh knowledge rather than forget it. When participants were asked to reflect on whether or not a threshold concept that they had identified was irreversible or not, it raised interesting insights into what irreversible actually meant and whether knowledge that is irreversible (but not used), can be retrieved once it is refreshed in the mind of the student. This insight implied a student can grasp a threshold concept and it can be seen as irreversible to the extent that it can be retrieved at ease by the student. This confirms the criticism by Rowbottom (2007) and O’Donnell (2010) where the vague wording of attributes was questioned however the analysis revealed this was the only attribute where there was some confusion by academics.

The notion of students not really forgetting a threshold concept but needing to “refresh” such knowledge or skills if they have not been used for a period of time was a common response by many of the participants. Participant four likened a threshold concept as something that is drawn upon when needed but may require some dusting off. While participant seven believed that students forget, rather than unlearn, and likens knowledge (and the brain) to a muscle:

I don't think they unlearn, they forget. I don't think that you can unlearn that. I think the brain and knowledge is very much like a muscle and that if you don't exercise that muscle ...it withers away. And it doesn't mean that you unlearn, it just means that it's not being used and you forget how to use it... so to me the knowledge is very much like a muscle in that way. So for me, no I don't think they unlearn, I think they just forget.

Participant five had an interesting way of also supporting this notion by comparing it to not having ridden a bike for ten years but with a little bit of effort, it would come back to you fairly quickly. When participant twelve was prompted as to whether a threshold concept would be irreversible if a student did not use it, this participant also recognised the need to refresh the mind and describes how this occurs from an academic point of view as well:

…of course they have to refresh their mind. They have to go back and probably, even with myself I have been teaching a lot of management accounting in the past, but I haven’t taught
management accounting for the last five years here…. now if someone asks me suddenly about activity based cost accounting, well I know it but I don’t remember. So I’d have to go back and refresh my mind, I have to go over everything, but then recalling and trying to relate won’t be difficult…because I have understood everything in the past. So then once I sit down for a few hours I know, I understand everything, it’s back in my mind.

Surface learning approaches and memorisation were regarded by several participants (3, 9, 11 & 12) as being linked to reversibility of a threshold concept. When asked if students could forget the threshold concepts once they have grasped and understood them, participant nine also raised other factors such as learning styles and personality and also confirms understanding means there is no need to memorise. Likewise, participant three indicated that surface learning, memorisation and rote learning are reversible whereas teaching methods encouraging a deep approach to learning are more likely to result in a threshold concept being irreversible:

If they understand it in a logical fashion …not a rote learning thing … no I don’t believe anything like that can be undone but if it’s surface learning, if it’s memorisation, it would definitely be undone so it does have to do with the technique and that’s where the teaching comes into it to present it in a way, motivate the students to learn, learn in that deeper approach rather than a surface approach but you know I mean like I hear stories from students now and again … once they do things like double-entry who have learnt it properly they’ll never forget it.

Similarly, participant twelve explained a threshold concept can be relearned if it is not practised but the level of complexity can have implications on the amount of relearning needed. S/he explained this in relation to tax effect accounting as a threshold concept and the relearning required:

Tax effect is more complex than double-entry, definitely. It’s not, it’s not something that you can, but again, if they have just learnt without having a good knowledge they’ll forget, a good understanding … but where they’ve understood well, they will forget if it is not practised … because the complexity level goes up and they might have to spend more time compared to double-entry to understand or learn back what they’ve learned...

Participant eight also likens an understanding of a principles based approach to setting accounting standards to being irreversible or difficult to unlearn - ‘… if they understand this
principles based approach to standards setting... it would be easy for them to learn when things change, the reasons for those changes... it’s very fundamental ...it’s hard to unlearn’. However participant eight distinguishes between technical concepts and broad concepts where technical aspects could be forgotten but not the broad concept by explaining ‘...the technical aspects they may forget, but the broad concepts, I think once you get the concepts you tend to keep them’. Also, the reference by this participant to ‘it would be easy for them to learn when things change’ may be associated with capability theory (Section 2.3.5.1.5) where an understanding of the principles based approach to the setting of accounting standards can help students deal with changes to accounting standards effectively when they are encountered in the future.

Scott and Harlow (2012a) used the Meyer and Land Framework (2003) as the basis for identifying threshold concepts via observation of students and discussions with lecturers. They found ‘no evidence that our threshold concepts are any more irreversible than other concepts’ (p. 3) This supports the need for the irreversibility attribute to be developed further and reconsidered in terms of how it is defined and/or described. Based on this study, such reconsideration would be beneficial in clarifying the meaning of this attribute and further reflections by the researcher on this attribute will be addressed shortly in Section 4.2.4.3.

Overall the analysis provided noteworthy insights into the irreversibility attribute of a threshold concept (Meyer & Land 2003). Further investigation could be undertaken as to whether the irreversibility attribute is appropriately described based on the results of this analysis to avoid potential confusion. However, in the next section, the researcher will reflect on the Meyer and Land Framework (2003) itself and insights into the practical implications of using this framework.

4.2.4.3 Researchers’ Reflections – Using the Meyer and Land Framework (2003)

The Meyer and Land Framework (2003) was used to inform the interview questions for this study as well as to evaluate whether threshold concepts identified by the participants comprised attributes described in the framework. In this section the researcher reflects on the Meyer and Land Framework (2003) as a whole as well as the practical implications of using the framework.

At the back of the researcher’s mind is the knowledge that not all research studies use all of the attributes when undertaking research into identifying threshold concepts. For example,
Taylor (2006) undertook interviews with academics and attempted to identify threshold concepts in biology on the basis of the Meyer and Land Framework (2003) and then analysed students’ written answers to determine student understanding of the potential threshold concept/s. In terms of the attributes, the paper appeared to focus predominantly on the troublesomeness and transformative aspects of the definition. It was acknowledged that the author found it more difficult to establish the integrative, bounded and irreversibility attributes as opposed to the troublesomeness and transformative aspects of the threshold concepts.

While this current study was not extended to testing the threshold concepts on students, the researcher found it was possible to validate the troublesome nature of accrual accounting and double-entry accounting (and by implication their transformative nature) but also the integrative nature of these threshold concepts unlike the Taylor (2006) study. One possible explanation for this could be the nature of the discipline as this study focused on the accounting discipline while the Taylor (2006) study focused on biology. While data was ascertained for the irreversibility and bounded attributes, data relating to the other 3 attributes was significantly abundant. There are several potential explanations for this – there are a variety of reasons that can evoke troublesomeness in learning and understanding a threshold concept that participants seemed to elaborate on at ease but also an array of linkages and relationships in these threshold concepts was evident when undertaking analysis of the data in this study. By implication, the transformative nature of the threshold concept is a result of the student being able to see the integrative nature of a threshold concept but also being able to overcome the troublesome nature of the threshold concept.

Further to this, a study by Zander et al (2008) also revealed that academics placed a greater focus on the troublesomeness attribute of a threshold concept. Park and Light (2010) reveal only some of the attributes of the Meyer and Land Framework (2003) were investigated in their study where an academic identified a threshold concept and it was subsequently tested on students. They identified this as a limitation in that the irreversibility and bounded attributes were not part of the study. Likewise, the bounded attribute has not been addressed in some studies (Holloway et al 2010; Male & Baillie 2011a), McDonald and Black (2010) only focussed on the troublesomeness attribute in their study in history and Knight et al (2013) did not address the irreversibility attribute. However, in this study all of the attributes were analysed to provide a more complete analysis of the data.
In this current study there were some problematic issues in dealing with a framework that “bundled” all the attributes together. It seemed that the attributes related to differing aspects of learning and teaching that combine the context of learning and teaching (troublesome nature of threshold concepts; boundedness) with approaches to learning (deep learning being transformative and irreversible; integrative nature of threshold concept needs to be seen for transformation to occur) and then the outcome of this process (transformative change). Another way the researcher perceived the framework is that it is looking at what students can do (transform learning that is irreversible and recognise the integrative aspects of the threshold concept) but also why students cannot grasp the threshold concept (reasons for troublesome nature of the threshold concept such as learning ritual knowledge, conceptually difficult, etc…) or what academics forget to do (tacit knowledge) – but also potential boundaries for the threshold concept - while underpinning some of these attributes is the notion of deep and surface approaches to learning. Land et al (2008) openly suggest that it provides ‘an analytical framework for trying to understand how students learn, where the barriers to their learning lie ….and what appropriate pedagogical adjustments or modifications might overcome such difficulties’ (p. xi). Upon reflection, it seemed somewhat illogical to the researcher to group these aspects together and label them as attributes and the researcher contemplates whether exposing the attributes in a model that depicts potential links and relationships might be a way of overcoming this.

On the other hand, use of the framework seems to have merit when each of the attributes are analysed apart from how the irreversibility and bounded attributes are described. Additionally, the degree of interest and research in the notion of threshold concepts in so many different disciplines provides the sense that educators see something valuable in this notion although it is the variable use of the attributes in the Meyer and Land Framework (2003) in research that seem to create inconsistent use of the framework. This may be due to researchers focusing on what they believe to be the more important aspects of the model or perhaps they conceive that the irreversibility attribute is inevitably linked to the transformative nature of a threshold concept and therefore does not require specific analysis. Perhaps researchers question the usefulness of identifying boundaries when trying to identify a threshold concept and see this as more of a macro issue when determining curriculum and its sequencing? Building on the framework to clarify each of the attributes or as suggested above, converting the attributes into a model to formalise how the attributes are related (or not) may be a way forward.
Practical issues experienced by the researcher in using the Meyer and Land Framework (2003) include the substantial amount of time required to undertake analysis of the data and draw out the themes.

4.3 Summary

Analysis of the data in this study was of an iterative nature where several display and analysis tools were used to help make sense of the data as well as demographic information. Three main themes emerged from this analysis being the identification of two threshold concepts – accrual accounting and double-entry accounting – while the third theme centred on a way of thinking and practising in the accounting discipline.

In regard to accrual accounting as a threshold concept, it was regarded as important due to the need to differentiate between cash and credit and its links to the accounting process in addition to its usefulness in terms of underpinning knowledge for later higher level courses or permeating later courses instead. Use of the attributes in the Meyer and Land Framework (2003) revealed accrual accounting as a threshold concept can be troublesome for a variety of reasons (ritual knowledge, conceptually difficult knowledge and discipline language), is integrative, transformative, is unlikely to be reversible if the understanding by students is of a deep, as opposed to a surface, nature and explicit boundaries to other conceptual areas were not prevalent however accrual accounting as underpinning knowledge was.

Double-entry accounting was identified as a threshold concept and different schools of thought as to what constitutes double-entry accounting and the many links and interrelationships present in this threshold concept make it easy to understand why participants have different opinions as to the most troublesome and important parts. An analysis of the components revealed some significant sub-concepts such as the accounting elements; the conceptual framework; duality of transactions, the accounting equation, balance day adjustments and notion of debits and credits. Analysis using the Meyer and Land Framework (2003) revealed double-entry accounting was troublesome due to ritual, conceptually difficult, inert and foreign knowledge, discipline language, tacit knowledge and the fear of uncertainty. Boundaries exist between double-entry accounting and cash flow statements, consolidations and corporate accounting, tax-effect accounting and accrual accounting. Double-entry accounting is seen as transformative as there are several sub-concepts that are integrated and need to be understood if students are to grasp double-entry
accounting such as the accounting equation which requires an understanding of the accounting elements. This, in turn, can assist in understanding the notion of debits and credits and duality of transactions. The highly integrative nature of this threshold concept means grasping it provides students with a powerful foundation to continue with higher-level learning in accounting. The irreversibility of this threshold concept was seen by participants as a need to refresh the memory of the threshold concept rather than being irreversible. In contrast to accrual accounting, double-entry accounting was suggested by a majority of participants who were less senior in age. Future research might investigate this scenario and if the age of academics impacts on the identification and teaching around threshold concepts. However, this does not diminish the finding that double-entry accounting can be considered a threshold concept.

Finally, a way of thinking and practising in the accounting discipline was a theme that emerged out of the data. The way of thinking and practising in accounting centres on students having an attention to detail which may be a threshold capability for a professional accountant that can help develop in students a way of thinking and practising in accounting and overall knowledge capability. A paradigm shift is often required for students to recognise any misconceptions they have but also realise the dynamic nature of accounting. The need to use judgement and professional opinion and be aware of the context of a situation is essential as is the realisation accounting is more language based rather than numbers based. Understanding and accepting that accounting is modelled on the accounting elements often requires a fundamental transformation in thinking. Also revealed were the intriguing views of some participants that accounting is something where people either “get it” or “don’t get it”.

Other outcomes revealed from the analysis included a greater insight into the light bulb moment that is akin with a threshold concept, how experience can assist or inhibit grasping of a threshold concept, the perception of participants regarding the irreversibility attribute of a threshold concept (Meyer & Land 2003) and thoughts of how the researcher experienced use of the Meyer and Land Framework (2003) in this study.
Chapter 5 DISCUSSION AND CONCLUSIONS

5.1 Introduction

While significant literature abounds regarding student learning and teaching and learning styles and approaches, there are still some students who ultimately find the study of accounting difficult even though they do not have any apparent or observable learning difficulties and they are doing everything asked of them (e.g. asking for help, doing the required reading and work, attending and participating in classes). The notion of threshold concepts, being a somewhat recent development, provides further insight into student learning in the discipline and areas in accounting that students’ find troublesome. This can have implications for not only how a curriculum is structured but also on teaching and learning strategies designed to assist students in transforming their knowledge and understanding of threshold concepts.

The primary objective of this research was to identify threshold concepts in financial accounting and explore how and why these concepts were conceived as “thresholds” by those teaching in the field of financial accounting at tertiary level in Australia. Threshold concepts are seen as critical in transforming student learning and the way of seeing and understanding something that results in epistemological and ontological transitions for learners. The seminal description by Meyer and Land (2003) of threshold concepts (adopted in this study as the Meyer and Land Framework 2003) comprises particular attributes that are transformative, probably irreversible, integrative, often but not always bounded and are possibly troublesome.

To achieve the primary objective of this research a comprehensive, multi-disciplinary literature review was undertaken in order to ascertain the “state of play” of threshold concepts, given the relatively recent interest of this phenomenon in educational research in general, and the accounting discipline in particular. From the researcher’s perspective, an extensive review of the research into identification of threshold concepts became necessary as the different approaches used in previous studies seemed to hinder moving forward with this research until an appropriate research approach could be determined.

The literature review was followed by interviews with 15 accounting academics from universities across Australia. From this data, a number of threshold concepts were identified and reasons for how and why these concepts were conceived was explored and described. In this final chapter the key findings from the analysis and discussion of the results presented in
Chapter 4 are summarised and the implications for financial accounting education are described. The limitations of this research and implications for future research, in both accounting and other disciplines, are then presented.

5.2 Summary of Key Findings

A significant amount of the extant research into threshold concepts has been undertaken in a wide variety of disciplines revealing considerable interest from many researchers. The majority of this research has been in the computing, science and engineering disciplines while in the accounting discipline such research has been limited to introductory accounting and is at quite an embryonic stage.

Findings from research into threshold concepts across the various disciplines reveal that qualitative approaches are predominant and aligned with a wide range of methodological approaches. While in some studies the research approach is clearly explicated, other research makes no clear mention of the research approach (leaving interpretation of the findings overall less than conclusive). A multiplicity of research methods was also evident and perhaps reflects the infancy of the phenomenon under study, the absence of clear research methodology and the absence of any clear definition of threshold concepts. Use of the Meyer and Land Framework (2003) appears to be the prevailing way of identifying threshold concepts across a range of disciplines. Hence this framework formed the basis of constructing threshold concepts in this study based on a qualitative research approach with the philosophical underpinning of the interpretivist paradigm.

Of particular interest in the literature review was the relatively recent application of two theories – variation theory and capability theory – which had been combined into a theoretical framework (threshold capability integrated theoretical framework) as a way of designing curriculum based on the identification and knowledge of threshold concepts (Baillie et al 2012a, 2012b). This framework resonates with the accounting discipline’s emphasis on the development of critical capabilities in students which allows them to deal with variations (or “new things”) in practising as a professional accountant.

The perceptions accounting academics had regarding what constituted a threshold concept revealed complex descriptions, provided insights into the Meyer and Land (2003) Framework and the significance of grasping a threshold concept, and highlighted the factors that may enable or inhibit this event. While a significant amount of valuable data was obtained in this
study, determining a threshold concept was complex due to the different ways participants described the same threshold concept and the interrelationships between components of a threshold concept. This involved multiple iterations between analysis of the data and the underlying concepts and theory (albeit developing). This involved the emergent and iterative use of a myriad of tools that were crucial in enabling the researcher to understand and analyse the data. The use of the cognitive maps proved to be particularly useful as it provided a visual representation that helped the researcher organise the data and link the intricate web of components that formed a threshold concept.

While studies in the accounting discipline into the notion of threshold concepts are scant, ideas surrounding capabilities of students and key aspects of their learning (and how they are linked) are not altogether new. Inglis and Dall’alba (1998) reported on how an undergraduate Management Accounting curriculum was redeveloped to improve the quality of teaching and learning. Part of this process involved the identification of ‘key ideas’ or principles underlying the objectives of the course and a focus on what students were to learn – the aims of the course – rather than on the course content or on what the teachers were to do… [and included] skills required by management accountants in practice… [such as] thinking, problem-solving, analytical and communication skills’ (p. 199-200).

Following identification of the key ideas, the linkages between these ideas was explored revealing ‘that members of the teaching team held a range of perspectives on the course content’ (p. 200) which is not unlike the academics in this study. Of interest here is the recognition that there are key areas in a course that teaching and learning can focus on but also that the same message is being heard in 2015 regarding the need for some of the same capabilities to be developed in students. O’Connell et al (2015) in reporting on the future of accounting in business education identified that accounting graduates need a range of professional skills in order to use professional knowledge to meet the needs of their clients’. These include ‘critical thinking, problem solving, data analytics, regional and global strategic thinking’ in order to provide specific, customised advice for particular purposes ‘rather than advice and support of a more general nature’ (p. 53). Therefore, accounting graduates need to be able to find the answer, not merely to recall it from a particular source, such as an accounting standard… communicate it effectively to an audience [and] with rules and standards changing constantly, being able to recall a specific paragraph or sentence within a
standard is not necessarily feasible or the solution to a problem. Rather developing and refining the relevant skills necessary to navigate and interpret those standards for application in specific organisational contexts and to discern and communicate an answer is more important’ (p. 53).

Hence the identification of threshold concepts in financial accounting can provide the phenomenon around which capabilities might be developed and various ways of thinking and seeing these threshold concepts might be experienced and knowledge developed by students. Additionally, identification of threshold concepts can provide the impetus to seriously review the accounting degree program to take into account the important aspects of learning in the discipline and reconsider how the development of capabilities in accounting students can be achieved.

Hence, the significance of this study surrounds the identification of threshold concepts in the financial accounting stream of the accounting discipline as understood by accounting academics in Australia. Analysis of the data from interviews with accounting academics revealed the identification of two threshold concepts in the financial accounting stream – accrual accounting and double-entry accounting. An understanding of how and why the participants in this study conceived these threshold concepts as ‘thresholds’ in financial accounting is discussed below.

Accrual accounting was seen as important in bringing the accounting process together and differentiating between cash and accrual accounting. It was also important for an understanding of related concepts such as balance day adjustments, tax effect accounting, revaluations and cash flow statements. In terms of the characteristics in the Meyer and Land Framework (2003), it was evident that the integration with other concepts (such as the accounting equation and the notion of double-entry accounting) makes accrual accounting transformative. It is also viewed as troublesome where students rely on rote learning and memorisation (and use a surface learning approach) and to gain ritual knowledge of accrual accounting rather than a deep understanding of this threshold concept. The language and terms used in accounting were also identified as a source of troublesomeness for students where the term itself – accrual accounting - is a term not often used in everyday language while on the other hand, use of language in an accounting context (e.g. the term ‘capital’ being associated with the investment in the business by the owner) can differ to the everyday understanding a student may already have (e.g. ‘capital’ being the major city of a state or
territory). In all, this may make it difficult for students to associate this new knowledge and terminology with their own knowledge of the world.

Aspects of accrual accounting can be difficult to grasp when students are not open to challenging their prior understanding and experience. The complex nature of accrual accounting, in terms of bringing together accounting processes and related concepts and understanding the links between concepts, means it is difficult to isolate topics and an integrated understanding is required for accrual accounting to be fully understood. Although from this study it appears that the transformative aspect of a threshold concept becomes even more difficult when the student has no experience that s/he can at least relate to. This has implications for teaching and learning strategies in terms of creating experiential strategies (such as use of case studies and work integrated learning activities as potentially valuable ways of teaching) to engage students in their learning and provide an environment that is more conducive to, and encourages, the grasping of a threshold concept.

Additionally, accrual accounting was seen as underpinning learning in the accounting degree rather than as a border to other conceptual areas. This inevitably makes accrual accounting an important aspect of an accounting degree. There was acknowledgement that once a student understood accrual accounting it is likely that such learning would not be reversible although there was some agreement that forgetting a threshold concept does not mean that the learning has been reversed. Rather, by refreshing knowledge of the threshold concept (where it has not been actively used for a while), it could be understood clearly with very little prompting by the student.

The key findings also included the identification of *double-entry accounting* as a threshold concept that was seen as important due to its foundational nature in financial accounting. However, there was variation in what the participants in the study considered constituted double-entry accounting. Not only was there variation in the way the term double-entry accounting was described (for example “basic stuff”, “accounting process”), the components of such also varied from conceptual aspects (for example, the accounting equation, duality) to more practical aspects such as preparation of worksheets and closing entries. This highlights some of the difficulty in clearly identifying a threshold concept and the benefit of using cognitive maps to link together like terms and develop themes. In terms of the Meyer and Land Framework (2003), double-entry accounting was seen as troublesome due to the ritual knowledge gained when an academic encourages students to learn the accounting rules in
rote fashion but then subsequently expects students to have a more comprehensive conceptual understanding and be able to link concepts in a variety of ways. Providing conflicting messages in regard to the use of rote learning may impact on the perception the student has of the learning environment and encourage a surface learning approach. This finding has implications for teaching and learning as the environment created by the educator influences the learning approach used by the student. While this is not to say that foundational knowledge and remembering the “rules” of accounting is not important for student learning, it is more to highlight that teaching and learning approaches might be contemplated and/or designed to help students’ better transition to higher order thinking (Bloom et al 1956, 1971; Krathwohl 2002).

The conceptually difficult nature of double-entry accounting was also exposed when students relate their prior understanding of their bank statement with the debit and credit rules and how they are used in an accounting system to record transactions. Double-entry accounting is also seen as conceptually difficult due to the layers of understanding required where several sub concepts (e.g. accounting elements, transaction analysis, the accounting equation, conceptual framework, principles based approach) need to be understood in order to understand double-entry accounting. Language based troublesomeness evolves from the definitions of the accounting elements in an accounting context often differing to the everyday understanding of these elements or students having no exposure to such terms, for example, in the case of the term “equity”. A recognition and understanding by academics of the conceptually difficult nature of this knowledge presents as an important first step in developing teaching and learning strategies that might be introduced at an early stage in the teaching curriculum to allow students to become more familiar with the language of accounting.

The integrative nature of double-entry accounting means that students are faced with learning new concepts alongside each other and in some cases needing to trust the academic when they explain the need to accept what s/he is teaching with the view that it will all make sense at some future point. This may be, for example, when considering the integrative nature of double-entry accounting and its relevance for accrual accounting. Such a leap of faith may not be easy for a student. Knowing this, there are implications for curriculum design where, for example, the linkages between concepts within or across subjects can be mapped out for students at the beginning of a course to alleviate the notion of trust playing a big role.
Another telling source of troublesomeness for this threshold concept was tacit knowledge of accounting which may result in the academic omitting a piece of information that may be pertinent to student learning without realising it. Perhaps further compounding this situation is the elusive nature of a threshold concept which can also make it difficult for an academic to understand what causes a threshold concept to be grasped and therefore, for the academic, difficult to unlearn what has become inherently part of their own thought and being. This was revealed in the data on several occasions where academics realised there were aspects of knowledge they may not have explicitly addressed but admitted they probably should have. This study has significant implications for how student learning can be improved by identifying and making clear the threshold concepts in the financial accounting discipline and the powerful nature of a threshold concept in transforming student learning and understanding in accounting. It reveals the need for academics to be mindful of the troublesomeness students can experience particularly as a result of the tacit knowledge of an academic where such consciousness may enhance student learning.

The way of thinking and practising in the accounting discipline was a third theme that emerged from the data that forms part of the transformation a student makes. While one area of troublesomeness is discipline language, the way of thinking and practising in the accounting discipline went beyond issues of language. It included attention to detail, the realisation accounting is based on regulation such as accounting standards whereas not all disciplines are subject to this; use of professional judgement and the need to recognise there are choices and alternatives that exist and need to be accepted by students; be able to solve problems and think critically; be comprehensive; keep an open mind; be able to see patterns in numbers; use of logic; ability to see a bigger picture; and continually ask questions and not just accept what you are told. Many of these issues resonate with the notion of developing capability as identified in the Threshold Capability Integrated Theoretical Framework (Baillie et al 2013) referred to earlier. The TCITF may be a potentially valuable means of embedding threshold concepts and a way of thinking and practising into curriculum redevelopment as it can help develop capabilities in students (such as problem solving and critical thinking) that enable students to develop knowledge capability, and think and practise like a professional accountant and deal with unexpected scenarios. Variation theory would similarly be a valuable mechanism for developing teaching and learning strategies that challenge students in dealing with a variety of different situations faced by students as accountants to effectively contemplate and make decisions from a range of alternatives.
Finally, a number of other findings resulted from the analysis. Firstly, insights gained from academics revealed the existence of light bulb moments for students in the accounting discipline. Of particular note was the importance attributed by participants in the study to everyday life experiences of students that can be associated with accounting (e.g. doing bank reconciliations, preparing their tax returns) which can assist in transforming understanding and fostering the grasp of a threshold concept. This has implications for the teaching and learning strategies employed by academics in fostering a learning environment that creates experiences and/or leverages off those experiences to assist students in transforming their understanding and thereby encouraging a deep approach to learning. Academics could focus on attainment of threshold concepts rather than teaching each element of a syllabus in order to focus teaching and learning on areas of learning that may be more troublesome for students. Learning activities that require students to use their own experiences to aid understanding but also the creation of learning activities that create experiences that students with little or no experience can relate to, may provide a learning environment that encourages students to approach their learning with deeper resolve and transform their understanding. Such activities might include the use of case studies or simulations or even site visits in industry. Assessment activities that complement the threshold concept could evaluate the extent to which student understanding has transformed.

In terms of the Meyer and Land Framework (2003), this study found strong evidence and a degree of clarity for the transformative, possibly troublesome and integrative attributes of the framework. However, less clarity was experienced with two attributes - the often but not always bounded and probably irreversible attributes. While the Meyer and Land (2003) description of these two attributes clearly indicates that they are not obligatory components of a threshold concept, this study identified accrual accounting as underpinning knowledge for the undergraduate degree in accounting rather than a boundary to other conceptual areas. This raises the question as to how underpinning knowledge is conceived in the description of a threshold concept as it was clear that academics did not regard knowledge of accrual accounting as having any boundaries as such. In contrast, boundaries were identified by participants for the double-entry accounting threshold concept reported in this research. Hence, there are consequences for curriculum development as identification of a threshold concept that underpins learning in a degree may need to be considered differently to a threshold concept that has boundaries to other conceptual areas (perhaps as a prerequisite threshold concept) in terms of how a degree is structured and the sequencing of threshold
concepts in a degree. Additionally, teaching and learning strategies need to ensure that underpinning knowledge is adequately addressed.

The irreversibility attribute instigated some confusion from several academics as they grappled with what this attribute meant as it is often described as probably irreversible in that once it is grasped, it is not likely to be forgotten. However, this study found that even a threshold concept that is grasped could potentially be forgotten (albeit temporarily) as participants associated irreversibility with the need to refresh knowledge if it has not been used recently. There was, however, agreement that the student still retained this knowledge. Hence the Meyer and Land (2003) description used for this attribute may need to be amended to clarify the meaning of the irreversibility attribute. It could be described as ‘probably irreversible in that once it is grasped, it is not likely to require a great deal of effort to remember the threshold concept’ thereby removing any confusion to the notion of forgetting a threshold concept with reversibility of a threshold concept. This added clarity around meaning may assist other researchers who use the Meyer and Land Framework (2003) to more readily identify threshold concepts.

In contrast to other studies using the Meyer and Land Framework (2003), this study adopted all five attributes in considering how a threshold concept might be constituted a threshold concept. Variation in the number and particular attributes used in other studies of threshold concepts may be the result of the way some of the attributes are perceived by researchers, for example, seeing the irreversibility attribute linked to the transformative nature of a threshold concept and therefore not requiring specific analysis; or the issue of boundaries being seen as a macro issue when determining sequencing of a curriculum. From a practical perspective, in this study the analysis of the data using the five attributes and drawing out the themes and concepts that surround a threshold concept was quite complex and required a substantial investment of time. This might also explain why other studies have chosen not to examine all five attributes of the Meyer and Land Framework (2003) and highlights an aspect of study into identification of threshold concepts that future researchers might consider.

5.3 Limitations of the Study

While interpretive studies may generally be perceived to have limitations in regard to validity and reliability, the researcher in this study, to the best of her ability, dealt with these by ensuring immersion in the data, utilisation of different analytic procedures to help understand
the thoughts of the participants and making explicit how key themes were arrived at. In addition, quotes from respondents were included in the analysis to aid descriptive validity. The researcher has also been explicit in identifying any potential researcher bias that result from being a discipline expert in this field and how this was overcome.

While broad definitional and explanatory descriptions of threshold concepts were provided to participants prior to the interview, the limited knowledge participants had of this notion may have impacted on their understanding and the depth of their responses to questions. In the early stages of this research, even the researcher’s supervisors’ had some difficulty understanding some aspects of the notion of threshold concepts but as research on threshold concepts continues to expand, this limited awareness of the notion of threshold concepts may not be as prevalent an issue in the future. Although the researcher prepared for the interviews in a range of ways – by reading about interview skills, practising interview skills, reflecting on interviews undertaken during the study – there remains the issue that the researcher may not have asked particular probing questions. This study also focussed only on academic perceptions of threshold concepts. Examining the threshold concepts with students could further inform the accuracy of the threshold concepts and themes identified in this study. As such, this becomes an obvious next step in continuing research in this area.

5.4 Implications for Future Research

This study identified the threshold concepts in the financial accounting stream of an accounting degree and adds to the relatively limited literature on threshold concepts in the accounting discipline. While the participants in this study were able to reflect on extensive experience of a range of student cohorts, further research could be undertaken to determine if students experience accrual accounting and double-entry accounting as threshold concepts. This study also provides the impetus for investigating its connection with other fields of accounting such as management accounting, auditing and forensic accounting where less dominant threshold concepts suggested in the data (e.g. applicability of accounting to the broader environment) can be analysed for potential connectivity. The insights gained from the way of thinking and practising in the accounting discipline could spur further research and potentially involve collection of data from academics, students and the accounting profession.
Some enabling and inhibiting factors in achieving a light bulb moment were revealed that could be investigated in further research. One of these related to the importance of experience. The importance of experience in facilitating students in grasping of a threshold concept could be investigated further to determine if such a factor should be embedded into the existing Meyer and Land Framework (2003). This has implications for the teaching and learning environment and strategies (case-based or work-integrated) that an academic provides and uses. Further research could investigate the insights provided by the accounting academics as accounting being something where people either “get it” or “don’t get it” and that there are clearly people that cannot do accounting. Future cross-disciplinary research could also investigate whether capabilities that are explicitly part of the way of thinking and practising in the accounting discipline (such as an attention to detail) are implicit or explicit in other disciplines. The definition and description of the irreversibility and the boundedness attributes that are part of the Meyer and Land Framework (2003) might be further examined to determine their appropriateness in identifying a threshold concept and/or the way in which these attributes are described. Recognition that the irreversibility attribute, described as probably irreversible (unlikely to be forgotten), could be studied to determine if the description of this attribute could be expanded to recognise that a threshold concept could be forgotten but if able to be recalled at ease would still satisfy this attribute. Further research could also be undertaken for the bounded attribute to determine how underpinning knowledge fits in the Meyer and Land Framework (2003) and/or the boundedness attribute. Ultimately, after further examination of the attributes, consideration could be given to depicting the Meyer and Land (2003) attributes in a model to formalise the potential links and relationships.

The link between approaches to learning and threshold concepts has significant implications for teaching and learning. Creating an environment that encourages students to undertake a deep approach to learning may assist in a student grasping a threshold concept making such learning irreversible and producing higher quality outcomes for the student. This has implications for teaching practice in terms of assessment design and teaching tools used in providing such an environment. Implications also exist for sequencing of content when participants acknowledged that students were confused by having to, what they perceive as, “unlearn” accrual accounting in order to prepare a cash flow statement. This can be linked to the integrative nature of accrual accounting and its links to double-entry accounting but perhaps making these links and relationships clear at the outset as a teaching strategy may
assist in alleviating such confusion. Additionally, the structure of an accounting degree in the future may take into account the distinct boundary that was identified between double-entry accounting and preparation of cash flow statements. An important aspect of any curriculum development surrounding threshold concepts recognises that identification of threshold concepts is a starting point.

The importance of threshold concepts in understanding student learning and enhancing curriculum development cannot be understated. Developing a curriculum that extends beyond discipline boundaries and courses recognises learning occurs both within and beyond the formal study undertaken by a student and may take considerable time. Some recent significant studies in engineering, biology and law/physics, provide some insight into how other theories such as variation and/or capability theory can be combined with the notion of threshold concepts to inform curriculum development. While threshold concepts can establish what students learn, capability theory helps determine how students learn. Variation theory can be used in the learning process to develop knowledge capability in students to help them deal with uncertain or unforeseen circumstances and see the world through the eyes of a professional accountant. Research into the insights that accounting is a discipline that not all people are suited to may offer some understanding as to what attributes in people make them less or more successful in the accounting discipline.

Further research into the capabilities required of an accounting graduate combined with threshold concepts using a similar study to Baillie et al (2013) could be used to reconsider and potentially redevelop the curriculum in an accounting degree. Necessarily this would also involve an interdisciplinary approach involving other disciplines such as marketing, economics, information technology and management and potentially the common core of a first year business degree program. Considering that from the researcher’s experience, it is not uncommon for marketing students to experience difficulty in learning accounting in the common core of their business degree, the transferability of this research extends beyond the accounting discipline and can have a pedagogical benefit that can be seen in light of its connection with other disciplines but also to broader themes in education. Additionally, development of the curriculum of an accounting degree on the basis of threshold concepts, capability and variation theories may provide a basis for informing the work of policy maker’s when TLO’s in the accounting discipline are being reviewed.
While the collection of demographic information from participants in this study provided some insight into the analysis, further research could investigate the impact of teaching experience (in length of service), the age of the participants and/or the impact of practical accounting/industry experience on the classification of a concept as a threshold concept and teaching around threshold concepts.

5.5 Conclusion

This study set out to explore how accounting academics in Australia perceive threshold concepts, to identify threshold concepts in financial accounting and understand how and why the participants identified them as such. This research found that academics found it easier to account for the troublesome, transformative and integrative attributes of a threshold concept but more difficult to account for the bounded and particularly the irreversibility attributes of the Meyer and Land (2003) Framework. Accounting academics perceive that there is a light bulb moment that exists when a student grasps a threshold concept but its elusive nature makes it difficult to pinpoint how this is achieved, although several inhibiting and enabling factors were identified. One of the inhibiting factors interestingly is that not everyone seems to be able to do accounting. The irreversibility attribute of the Meyer and Land (2003) Framework provided some interesting insights from participants. Particularly, participants tended to see this attribute relating to the ability to be able to refresh knowledge rather than simply forget it.

The findings resulted in the identification of accrual accounting and double-entry accounting as threshold concepts in financial accounting. How and why they were considered to be threshold concepts was extrapolated through the Meyer and Land (2003) attributes. They were found to be troublesome for a variety of reasons that commonly included the use of ritual knowledge by students’, the existence of conceptually difficult knowledge and importantly, the troublesomeness of discipline language. Tacit knowledge was identified for double-entry accounting as a source of troublesomeness which has implications for teaching and learning (see below). They were both seen as able to transform student learning and exhibited the need for an understanding of their integrative nature and transforming such learning. While accrual accounting did not appear to have boundaries to other conceptual areas, it was recognised as being underpinning knowledge for further study in accounting while double-entry accounting had clear boundaries with more advanced accounting topics.
The grasp of these threshold concepts was considered unlikely to be reversible although it was acknowledged that they may need to be refreshed if not used.

The way of thinking and practising in accounting also emanated as a key theme from the data when participants reflected on the troublesome nature of the threshold concept they were addressing. Additionally, abstract notions were identified that related often to not just the particular threshold concept being discussed but to the discipline as a whole. Such abstract notions included the capabilities required of a professional accountant and the need for students to “think” like an accountant. Issues of language permeating the accounting degree in addition to particular threshold concepts were also acknowledged. This has links to capability theory and specifically, knowledge capability as described by Baillie et al (2013).

This study contributes to the research on threshold concepts by providing further insights into the attributes espoused for a threshold concept in the Meyer and Land (2003) Framework and support for the Meyer and Land (2003) Framework generally. It acknowledges the need to reconsider the wording of the irreversibility attribute but also the ease with which the transformative, integrative and troublesome aspects of a threshold concept can be reflected on by discipline experts and highlights the links between these attributes. The finding of a particular way of thinking and practising in accounting reveals the appropriateness in considering capability theory when identifying threshold concepts as part of a curriculum. The use of variation theory in conjunction with capability theory and threshold concepts provides a means by which capabilities and threshold concepts can be addressed pedagogically. Hence, this study supports the notion of capability theory and variation theory being useful in developing curriculum around threshold concepts and capabilities where variation theory can be used as a basis for teaching and learning strategies. The structure of the accounting degree can be a focus for future curriculum change and potentially inform policy makers when they are reviewing the TLOs in the accounting discipline (particularly financial accounting). Additionally, research into threshold concepts identifies conceptual boundaries that can assist in reconsidering the sequencing of courses in an accounting degree.

The findings of this study provide an awareness of the need for teaching and learning strategies to address the threshold concepts in financial accounting as threshold concepts can identify critical areas of a course in which students may experience difficulty. Particularly, a focus on drawing out the links and relationships related to a threshold concept as well as the difficulty language can pose for students in trying to understand the terminology and
language used in accounting can be used to enhance teaching strategies. This study can also be used to understand what capabilities may assist in developing a way of thinking and practising in accounting. Likewise, assessments can centre on threshold concepts and aligning assessment criteria with achievement of threshold concepts. Hence teaching and learning strategies can be built around these threshold concepts to enhance student learning in accounting. Additionally, tacit knowledge was identified as one of the sources of troublesomeness for double-entry accounting. Awareness by academics of the importance of making explicit knowledge or links that aid student understanding can impact on teaching practice and the teaching approach used by academics.

In conclusion, the notion of threshold concepts provides insights into areas of knowledge, skills and capabilities that can be used to understand student learning and inform teaching. It has the ability to extend beyond a discipline and become more interdisciplinary thereby providing educators with the ability to reconsider curriculum development to reflect this interdisciplinarity. Knowledge of transformative aspects of a curriculum can mean the sources of troublesome knowledge (such as recognition of tacit knowledge of academics) are addressed to enhance student learning and enable strategies, tools and resources to be directed towards the achievement of threshold concepts. Use of threshold concepts in addition to the principles of capability theory (and variation theory) offers the potential to enhance curriculum development in the accounting discipline and provide pedagogic improvements to teaching and student learning. Such development would form a sound basis for reviewing the TLO’s in the accounting discipline in terms of financial accounting but also the discipline as a whole as a result of further research in accounting.
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## APPENDIX 1 – Threshold Concept (TC) Studies in Different Disciplines

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<td>Author/s, Location, Details</td>
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<td>2. Purpose of research</td>
<td>3. Theoretical stance / research approach</td>
<td>4. TC/s Identified and Method of Identifying TC/s</td>
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<tr>
<td>McCune (2003) UK study</td>
<td>1. Both</td>
<td>2. Reporting on an ongoing Enhancing Teaching – Learning Environments (ETL) project</td>
<td>3. Constructive alignment was guiding concept</td>
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<td>TC/s Identified and Method of Identifying TC/s</td>
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<td>Case studies in phase 2 in the Biosciences of 3 Final Year courses (emerging findings in regard to ways of thinking and practising in terms of how students engaged with experimental data and the primary literature):</td>
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<td>- ‘students’ struggles to come to terms with how knowledge was generated in their subject areas and with how they might develop their own views and interpretations’ (p. 15).</td>
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<td>- Students feeling that they may not be able to ‘develop their own views or to challenge established sources’ (p. 16).</td>
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<td>Student perceptions of the T/L environments in the 3 courses that each encouraged engagement with the literature and data in different ways. Findings:</td>
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<td>- ‘Students had generally positive perceptions of the three settings’ (p. 17) and supported by interview data obtained from students. McCune cautions that comparisons between 3 different settings not possible as the comparisons did not take into account other influences that can impact on students’ perceptions such as prior experience in other courses.</td>
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<td>Students mentioned transition in program from early to latter years and demands of this on them; students of having to adapt to a teaching approach they were not familiar with; feedback &amp; guidance important particularly making clear to students what is expected of them with an assessment item.</td>
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<td>McCune &amp; Hounsell (2005) UK study Bioscience</td>
<td>Both</td>
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<td>N/A</td>
<td>This is part of the ETL project looking at bioscience. Across 3 courses: Semi structured interviews with 38 students. 12 student focus groups Semi structured interviews with 5 staff. Used data from ETLQ (completed last week of course) and LSQ (completed at start of unit), course documentation, teaching-learning materials. Student interviews transcribed by 2 project team members and analysed for key themes and issues regarding students’ perceptions of the teaching and learning environment of their course and their experiences in regards to the ways of thinking and practising in this discipline. Followed by a more intense analysis ‘seeking to systematically substantiate and refine themes initially pinpointed.’ (p. 263).</td>
<td>Two themes emerged: 1. Students’ thoughts on how they engaged with the literature and experimental data. 2. Students’ thoughts ‘of whether they were learning to communicate in distinctive ways as they moved through their studies’ (p. 263) The findings also provide indication of how WTP was facilitated in teaching-learning environments that are part of this study. Three tentative observations: 1. Strategies regarding assessment and teaching and learning promote WTP. When active learning tasks used, WTP was clearly evident. 2. Important role of feedback in promoting ‘high-quality learning outcomes’ (p. 285). 3. Student progression through program not smooth.</td>
<td>‘Analysis of questionnaires included a review of the results for individual items as well as sub-scales, and a factor analysis’ reported in earlier paper (2003 paper by McCune presented at a conference in Norway “Promoting high-quality learning: perspectives from the ETL project”). However, in the 2003 paper these findings are presented only as preliminary findings.</td>
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<td>Taylor (2006) Biology Australian and UK study</td>
<td>1. Qualitative 2. Analysed whether students understood and crossed an identified threshold concept. 3. Not identified</td>
<td>Method: Basis of Meyer and Land definition. 4 threshold concepts identified: 1. Complexity 2. Concept of change 3. Dynamic nature of biology 4. Concept of scale (taken from 2008 paper)</td>
<td>Seven academics interviewed from 4 different UK or Australian universities after provision of definition of threshold concept. Written answers at beginning and end of course (not linked to individual students) from 200 students in 1st year biology regarding hypotheses so understanding of potential threshold concept could be analysed. Pilot for a larger project. Biology discipline is very diverse containing many different areas such as biochemistry, ecology, environmental biology, cell biology, animal and plant physiology, genetics, etc…interrelated nature of biology ‘can be integrated into a larger understanding of living systems’ (p.88). For example, fundamentals of osmosis needed for understanding ‘nerve impulses in human Biology, the biochemistry of photosynthesis in plants, and water uptake in crops’ (p. 88). Case study provided on hypothesis development as an example.</td>
<td>Findings: - Approaches to teaching early undergraduate biology courses may impact on ease at which a threshold concept is grasped by students - Traditional approaches using repetition of facts still acknowledged as useful - Different approaches to teaching a threshold concept possible - Variation in teaching approaches may enhance student engagement For the 4 threshold concepts identified, they appear to be transformative and troublesome but harder to demonstrate integrative, boundedness and irreversibility (2008 paper)</td>
<td>Lack of clarity in what the proposed threshold concepts are; seems to focus predominantly on the troublesome nature of a threshold concept and transformative aspect. Different use of terminology e.g. in the case study, reference is made to a threshold experience. Note: the 4 threshold concepts mentioned are based on what is quoted in the 2008 paper referring back to the 2006 paper; however, going back to the 2006 paper, these are not clearly identified as findings but more of a discussion. No indication of how analysis of interviews undertaken and there appears to be references to discussions as well.</td>
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<td>Taylor (2008) Biology Australian study</td>
<td>1. Qualitative</td>
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<td>Interviews undertaken with biology students and graduates (most graduates also tutored / did demonstrations in 1st year courses) in 2005-2006 in an extension of the study in 2006 paper.</td>
<td>Students provided general ideas of potential threshold concepts or troublesome areas but less detail provided when compared to the teachers.</td>
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<td>2. Explored threshold concepts, troublesome knowledge and ways of thinking and practising related to biology.</td>
<td>Method: Basis of Meyer and Land definition.</td>
<td>‘A key threshold concept, or series of related concepts, identified by all graduates, was associated with experimental design, hypothesis development and data analysis’ (p. 191).</td>
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<td>3. Not identified</td>
<td>- ‘Provided with definitions and asked to provide examples of troublesome knowledge and thresholds’</td>
<td>‘Discussions with graduates to this point seem to have focused on areas encompassed by Davies and Mangan’s (2005) basic concepts…this mirrored the same argument postulated when interviewing the teachers, namely that biology has a special level of complexity, and the more fundamental threshold concepts have already been dealt with at the school level’ (p. 190).</td>
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<td>- Discussions with students then students given teacher perceptions of such and asked how ‘their experiences matched these views’ (p. 187).</td>
<td>Most of the graduates found understanding experimental design, hypothesis development and data analysis changed their thinking in biology and required that concepts be integrated.</td>
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<td>Strategies used by graduates to help teach difficult areas such as using ‘several ways of explaining, it’s like charades, you try until one way works’ (p. 190).</td>
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<td>Analysis of interviews but no mention as to how the analysis was done.</td>
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<td>Wilson et al (2010) Physics Australian study</td>
<td>1. Qualitative</td>
<td>2. Exploration of measurement uncertainty as a threshold concept.</td>
<td>3. Phenomenographic analysis to investigate student understanding of measurement uncertainty and variation in understanding.</td>
<td>Measurement uncertainty identified as a threshold concept.</td>
<td>Combination of student and academic data used.</td>
<td>Findings: Academic data: Measurement uncertainty as explained by the authors met each of the 5 characteristics that define a threshold concept apart from being bounded as this threshold concept goes beyond the study of physics and can be found in other areas such as statistics and social sciences according to Wilson et al. [1] Student data: This resulted in the identification of 3 aspects of measurement uncertainty (pattern recognition; formal understanding; meaning) where ‘a sophisticated understanding of uncertainty involved the integration of all three aspects, whilst a less sophisticated understanding emphasised only one or two of these aspects (p. 120).</td>
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<td>Threshold concepts identified in earlier research-refer to Taylor (2006, 2008).</td>
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<td>- Initial review of TC and educational theory literature and discussions of teaching in the 3 universities</td>
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<td>Used Davies and Mangan framework then to review ‘definitions of threshold concepts in biology around these abstract concepts’ (p. 6).</td>
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<td>- Sixty online survey responses from academics Aust and UK to identify ‘threshold characteristics of concepts in key areas of biology’ (p. 5)</td>
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<td>o Two groups of troublesome concepts: (1) content areas (2) abstract concepts</td>
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<td>- Data analysed using Leximancer as way of triangulation to check analysis undertaken manually</td>
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<td>- Used Davies and Mangan framework then to review ‘definitions of threshold concepts in biology around these abstract concepts’ (p. 6)</td>
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<td>- 56 student interviews (1st year students in biology) at 3 universities</td>
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<td>- 11 teacher interviews with teachers of the courses</td>
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<td>- Interviews used to collect data on topics seen as difficult or easy and</td>
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<td>Findings: Thread 1: Potential threshold concepts in biological sciences defined</td>
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<td>- Survey results and interview data revealed some commonality but also differences between expert (teacher) and novice (student) thinking in biology</td>
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<td>- ‘Students had more specific conceptual difficulties with biology, while academics identified several concepts… when academics and students were asked why the concepts were difficult… academics had a web of reasons for the difficulties and students tended to indicate a narrower range of reasons’ (p. 22).</td>
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<td>- Students had wider range of strategies for clarifying conceptually difficult areas than academics. Students used more technical approaches (tools to improve motivation, assist visualisation and memorisation) while academics used pedagogical approaches. Students identified ‘importance of the “affective” in learning’ which academics did not (p. 22). Teaching approach tends to be ‘tacit’ then ‘explicit’ however change in approach suggested ‘so that tacit ways of thinking and knowing within the discipline are “explicitly” defined’ (p. 22).</td>
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<td>- Thread 2: What types of learning activities enhance student understanding of biology and threshold concepts? TC1 Scale in molecules, cells and genes:</td>
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<td>o Interventions ‘may have been too peripheral to</td>
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<td>Biology Thresholds Matrix ‘can be used to map levels of student understanding of threshold concepts … and highlights mismatches in teacher and student expectations of understanding and articulation of topics in biology’ (p. 32)</td>
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Adapted Davies & Mangan (2007) framework to develop matrix.
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<th>Science</th>
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<td>2. Purpose of research</td>
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<td>3. Theoretical stance / research approach</td>
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<td><strong>Comments</strong></td>
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<tr>
<td><strong>Thread 2:</strong></td>
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<tr>
<td>- Leximancer then Phenomenographical analysis undertaken</td>
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<td>- Matrix developed</td>
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<td>- Interventions created and tested on undergraduate students at 3</td>
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<td>universities in Australia particularly large cohorts in first year</td>
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<td>of the program; interventions incorporated key threshold concepts;</td>
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<td>they are taken from the matrix; students underwent pre and post</td>
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<td>testing regarding their understanding of the threshold concept;</td>
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<td>learning intervention implemented before post-testing. Teacher</td>
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<td>interviews were completed regarding course design, how intervention</td>
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<td>was implemented, reflections on success or otherwise of intervention.</td>
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<td><strong>Thread 3:</strong></td>
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<tr>
<td>- Workshops used</td>
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<td>- Discussions with Biology Teaching Network throughout project</td>
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<td>- the normal course activities, or not sufficiently integrated to</td>
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<td>engage students … intervention was too “low-key” and therefore did</td>
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<td>not explicitly highlight the relevant concepts’ (p. 24)</td>
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<td><strong>Thread 2 Hypotheses formulation and testing:</strong></td>
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<td>- Considerable variation in way students perceive hypothesis</td>
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<td>formulation and testing</td>
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<td>- 5 categories of understanding created from student responses to a</td>
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<td>hypothesis question</td>
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<td><strong>Thread 3 Language:</strong></td>
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<td>- Language/discipline discourse categories developed/adapted from</td>
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<td>descriptors in Research Skills Development Framework, (University</td>
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<td>of Adelaide) and integrated into the matrix</td>
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<td>**Thread 3: Develop a community of practice of biology teachers in</td>
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<td>tertiary education**</td>
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<td>- Blog; project website, workshops,</td>
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<td>- ‘Project (UWS &amp; Dept Education and Training NSW) to apply Biology</td>
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<td>thresholds matrix into biology curriculum at stage 4 high school.</td>
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1. **Quant/Qual /both**
2. Purpose of research
3. Theoretical stance / research approach

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<th>Method</th>
<th>Findings</th>
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<tr>
<td>- Project (UTS &amp; Macquarie University &amp; Nanyang Technological University Singapore applying model ‘to investigations of student thinking about scientific enquiry in ecology and evolution for years 9/10’ (p. 31).</td>
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<td>- Longitudinal study to track progress, of students interviewed, through their program trying to work out when key thresholds are crossed</td>
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<td><strong>Threshold Concepts Identified and Method of Identifying Threshold Concept/s</strong></td>
<td><strong>Method</strong></td>
<td><strong>Findings</strong></td>
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<td>Shanahan &amp; Meyer (2006) Economics (macroeconomics) Australia</td>
<td>1. Quant/Qual /both 2. Purpose of research 3. Theoretical stance / research approach</td>
<td>First year students in introductory economics course as a common core unit to all business degree students. Sample size = 234 students in week 4 and 109 responses in week 11 from the same students in week 4. Students first introduced to a simple example of opportunity cost with 2 products and then introduced to a broader context where there is more than 1 alternative to choose from and they had to try and apply it in relation to their own lives. Week 4 responses analysed in relation to troublesome knowledge Students’ also answered questions about learning prior to tutorials and handed them in at the start of the tutorial. This was designed to enhance the students’ meta-learning capacity. In week 4 and week 11 students were asked to</td>
<td>Week 4 responses – findings: <em>some</em> (italicised in chapter) students found the concept troublesome [but] it also revealed that distinguishing the underlying types of knowledge associated with troublesome knowledge could be difficult’. (p. 107). The authors argue ‘students’ articulation of a threshold concept can be located within a framework of troublesome knowledge for interpretive purposes’ (p. 112). They argue this provides teachers with an insight into why students find a threshold concept troublesome and therefore decrease pre-liminal variation. They also suggest that such an insight can be used to track student understanding of a threshold concept and may also have implications on how the threshold concept is assessed. Comparison of week 4 and week 11 responses: 109 week 11 responses matched with week 4; week 11 responses analysed in the same way as week 4 responses in terms of a troublesome framework Findings: Ritual knowledge week 4 was 75% and in week 11 was 4% Responses that were accurate = 5% week 4 and 25% week 11 Between 5 – 10% of responses in both weeks</td>
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<td>Reimann &amp; Jackson (2006) Introductory Microeconomics UK study</td>
<td>1. Qualitative 2. Exploring threshold concepts in economics as a case study, 3. Exploratory study</td>
<td>Two threshold concepts (opportunity cost and elasticity) in economics were the basis of this case study. The threshold concepts were identified as part of the ETL project. As part of ETL project, longitudinal study redeveloping understanding of opportunity cost and elasticity by students. Data collected pre: case study in May 2002 via: - Group of students interviewed regarding teaching/learning environment</td>
<td>provide a written answer explaining what opportunity cost meant but it had to be explained in their own words. = troublesome language  • The authors’ fully acknowledged the response and subjective bias of this study.  • Issue – 4% of students still exhibited ritual knowledge in week 11 indicating that these students’ (mis) understanding of the threshold concept has not changed.  • The authors suggest there is a need to understand how threshold concepts come into view for students and empirical research needed to aid understanding of the different ways learners engage with troublesome knowledge.  • Danger in oversimplifying a threshold concept when it is introduced to students as it may encourage the adoption of ritual knowledge and prevent students from grasping the threshold concept. (p. 113).</td>
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Economics lecturers were asked to identify threshold concepts in their subject. This approach was also completed with 29 further academics in 3 universities. Forty-two threshold concepts suggested, 8 were nominated by 5 or more people. (Opportunity cost and margin most popular). *

This paper states ‘in interviews conducted during different phases of the ETL project and in different institutional and modular settings, several university teachers of Economics, including the teacher responsible for the module discussed in this chapter, identified opportunity cost as an important threshold.

- Module leader interviewed.
  
  Data collected during the case study via:
  
  - Oct 2002: Start of module pre-teaching of opportunity cost and elasticity TCs
    - students (11) answered economic questions in writing
  
  - Nov 2002: After threshold concepts taught
    - 9 student interviews (individual)
    - module leader interviewed about student responses and learning and teaching environment
  
  - May 2003: End of course:
    - Questionnaire administered (not sure who to re: ‘conceptual approach’)

Findings from interview with teacher who evaluated student responses:

Teacher chose McDonald responses as it ‘produced answers which made implicit reference to a much wider range of economic concepts and perspectives than the mobile phone question’ (p. 121).

Findings from a comparison of the 1st set of written answers with data from student interviews:

Interviews were after 2 threshold concepts were taught- showed that student responses changed very little from their written responses.

Findings from a comparison of the 1st set of written answers with the second set of written answers (5 students):

McDonald question – only limited evidence of increased understanding.

Mobile phone question – similar pattern to McDonald responses; 2 students changed their mind regarding their answer illustrating a ‘qualitative conceptual change towards a more economic answer’ in regard to sunk costs (p. 123).

‘Only 2 students vastly improved the economic quality of the answer and correctly answered the question in terms of sunk costs (without explicitly using the term)’ (p. 123).
## Economics

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<td>concept for their discipline’ followed by an explanation of how the different use of the word ‘cost’ in relation to a cost ratio makes this a threshold concept. (p. 116)</td>
<td>Elasticity ‘singled out as a threshold concept for the module’ followed by excerpts of a conversation / interview with a teacher explaining how elasticity has a transformative component. (pp.116-7)</td>
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<td>Overall, limited improvement in answers showing ‘modest positive changes in understanding’ (p.124) …suggesting that ‘students were generally starting to think like economists without, however, explicitly referring to the economic principles under investigation. Opportunity cost did not feature explicitly in any of the answers to the mobile phone question, although nearly all of the answers referred to it implicitly’ (p. 124). More economic terminology used for McDonald question in the second iteration of responses and ‘much less evidence of obvious economic terminology in both answers to the mobile phone question. ‘The increase in the use of discipline-specific terminology in the McDonald’s question is in line with Dahlgren’s (1978) study where the same phenomenon was observed…evidence of economic terminology does not necessarily imply that an answer is also economically sophisticated.’ (p. 124). Findings from the students’ perceptions of the questions: Students related better to mobile phone question due to personal experience (as a consumer) as opposed to McDonald question (as a supplier). Students did not perceive elasticity as a threshold concept although they did believe that it was</td>
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"My comment: does this mean that not using terminology is evidence of conceptual understanding though?"
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<td>economic principles that underscore the discipline and make a would-be economist think like an economist. (p. 117)</td>
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<td>important. Opportunity cost was also not perceived by students to be a threshold concept because opportunity cost did not seem important and teacher did not highlight it as a particularly important aspect. The authors note that student perceptions may have been influenced by their prior knowledge and/or the curriculum with many concepts being treated as equally important. Teacher acknowledged that integration of the threshold concepts across the course was undertaken rather than teaching elasticity and opportunity cost as standalone topics but that there was a risk that other concepts may be excluded as not being as important as threshold concepts. Provided awareness to teacher of the examples students can relate to.</td>
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<td>Eckerdal, McCartney et al (2006) Computer Science USA, UK and Sweden</td>
<td>Two concepts are being put forward as being threshold concepts in computer science education: • Abstraction • Object orientation. Object orientation identified from prior literature as 'it is widely acknowledged that object-oriented programming is difficult to teach' (p. 106).</td>
<td>N/A</td>
<td>Constructivism: Eckerdal, McCartney et al (2006) describe constructivism as a theory of learning where students construct their own framework of knowledge and keep refining it in order to learn. Threshold concepts are seen therefore as part of this framework and are described as 'points where students have difficulty learning' (p. 104). Threshold concepts 'closely tied to the constructivist tradition… their use of “troublesome” follows from Perkins discussing challenges that constructivists must face’ (p.104). Mental models: Eckerdal, McCartney et al. (2006) describe a mental model as ‘one person’s internal model of a system’s properties and behaviour’ (p. 104). The linkage to threshold concepts occurs when students have difficulty forming mental models at points where threshold concepts are identified. The authors acknowledge that mental models and threshold concepts are both transformative but they also indicate that there are some mental models that require minimal learning effort and are subjective and can differ according to the individual while threshold concepts tend to be difficult to learn and accepted aspects in a discipline.</td>
<td>Breadth-first approach is the source from the Computing Curricula 2001 that identifies core concepts if this is the approach used for teaching computer science. However, they acknowledge that not all of the core concepts in this course would be threshold concepts and further investigation would be needed to determine the identification of such threshold concepts in this discipline. Fundamental Ideas = 'set of ideas that are central to the discipline' (p. 105) and 'when new concepts are presented, they are related to the appropriate Fundamental Ideas that the students know, thus providing context’) (p. 105). Authors believe that threshold concepts and fundamental ideas overlap in terms of being integrative and needed for a computing professional. But fundamental ideas not seen as transformative (unlike threshold</td>
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### Computer Science and Computer Programming

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<tr>
<td>Vagianou (2006) Introductory programming Greece / UK</td>
<td>N/A</td>
<td>Suggests program-memory interaction as a threshold concept</td>
<td>Suggests program-memory interaction as a threshold concept using Meyer and Land characteristics.</td>
<td>Brief explanation of each of the characteristics and how they are met for this threshold concept.</td>
<td>Paper introduces Program Working Storage as a concept that can help student transition in introductory programming courses from end user to programmer. Discussion follows suggesting threshold concept of program memory interaction; Program Working Storage as a conceptual framework/model.</td>
<td>Explanatory paper that looks at different suggestions. Threshold concepts only a very small part of this and threshold concept is not empirically tested.</td>
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how students do not learn. The authors argue that misconceptions and threshold concepts are both integrative and that misconceptions can result when a student does not integrate knowledge or integrates it incorrectly. Misconceptions can result from students using incomplete knowledge to develop their own way of dealing with a concept and then compounding the misconception when trying to incorporate further knowledge. They argue that it can be difficult for students to “undo” their misconception once they have established it.

**Breadth-First:** Use of core concepts can assist in determining the threshold concepts in a discipline (core concepts a subset of threshold concepts). The authors suggest using the concepts from the “Breadth First” approach from the Computing Curricula to begin investigation into threshold concepts. This approach = specific to computing.

**Fundamental Ideas:** framework revolves around the use of core concepts that ‘are central to the discipline’ (Eckerdal et. al., 2006, p. 105).
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<tr>
<td>Boustedt et al (2007)</td>
<td>1. Qualitative 2. Investigated threshold concepts in computer science as well with empirical evidence from instructors and students. 3. Not identified</td>
<td>Two threshold concepts determined, being pointers and object-oriented programming.</td>
<td>33 concepts identified by instructors through unstructured conversational interviews; discussions with researchers; and use of a questionnaire and interviews with computing conference participants. These concepts then tested on students (so far) to identify if students experienced any of the concepts as threshold concepts. Interviewers agreed to a list of 5 concepts that kept on being mentioned in the earlier instructor interviews. In the interview, students were asked to nominate difficult concepts, the interviewers would then select 1 of the concepts and interview the student in depth about the integrative, transformative and irreversible criteria of that concept.</td>
<td>Findings: Identification of 2 threshold concepts. These are very broad. Authors suggest that other threshold concepts may exist as a result of this study and they plan to investigate these further. Variation in student understanding yet to be investigated of these 2 threshold concepts. Further investigation also expected whether 'the learning of a Threshold Concept is an identifiable stage that all learners go through, or whether it is more of an individual phenomenon’ (p. 508) Suggestion that students’ learning experiences impact on the threshold concepts they identify. Authors want to interview novices and compare to graduating students’ perspectives. Once threshold concepts “precisely identified”, next step 'to design curricula and assessment tools to help students cross these thresholds more easily’ (p. 508).</td>
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<td>Zander et al (2008)</td>
<td>1. Qualitative 2. Identification of threshold concepts 3. Not identified</td>
<td>Same study as 2006 Eckerdal paper but more detail provided regarding method and one of the threshold</td>
<td>Unstructured conversational interviews with 36 academics in June 2005 at a conference asking interviewees for concepts that met the threshold concept criteria; 33 threshold concepts suggested. Greater</td>
<td>Findings: Identification of 2 threshold concepts (object oriented programming and memory and pointers) with interview extracts shown. Observations by researchers: (1) Timing of interview important – where a</td>
<td>Described the different sources of core concepts in computer science curriculum - Breadth-first approach - Fundamental ideas approach - Curriculum guidelines of professional bodies.</td>
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<td>and Sweden</td>
<td>concepts is now referred to as 'memory and pointers' rather than just 'pointers'.</td>
<td>focus from academics on troublesome/difficult to learn aspect of threshold concepts.</td>
<td>Questionnaire and interviews in November 2005 at a conference where a poster was presented resulting in discussions with researchers. Results similar to June 2005 results ‘but more carefully tied to the defining characteristics of threshold concepts’ (p. 108) due to collection of data via questionnaire. Semi-structured interviews with 16 graduating students (at time of publication) based on above results and literature (over 7 institutions, 3 countries). Asked students to identify troublesome concepts that they recall were difficult to learn and then selected one of them and addressed all the criteria in the interview using the concept selected. Prior to these interviews, the researchers devised a list of 5</td>
<td>significant time elapsed since threshold concept was learned, authors’ suggest it is reasonable that the threshold concept is irreversible / unforgettable; troublesome and transformative nature of the threshold concept they found harder to evaluate as ‘the student may have forgotten that there was a problem at all or may be unable to describe clearly what made the concept troublesome, and may not remember what his or her understanding was before mastering the concept. Conversely, if an interview is conducted while the student is still grappling with a particular concept, or when he or she has very recently mastered it, the troublesome and transformative criteria are easier to investigate, but irreversible is harder. Such interviewees may be able to describe their problems vividly, but it is impossible to tell whether, if and when they master the concept, they will then forget it’. (p. 110).</td>
<td>(2) Issue of integrative criteria –the researchers ask ‘is it integrative only if it integrates concepts the student already knows? Or can a concept be integrative if it connects a number of things that are only learned later?’ (p. 115). (3) When should data be gathered about student learning of threshold concepts? ‘If too early, there is no way to tell if the concept will be later forgotten; if too late, the student may not remember that there was a problem, or may not be able to remember how he or she perceived the subject before mastering the concept’ (p. 115).</td>
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<td>Shinners-Kennedy (2008) Computer Science</td>
<td>Qualitative Identification of a threshold concept in computer science</td>
<td>Potential threshold concepts based on their previous work (academic interviews; literature). Where the student interviewed mentioned one of these, then that was the concept that was focused on in the interview. If not, one of the concepts mentioned by the student was chosen. Interviews. Threshold concepts were identified on the basis that it was the subject of more than one interview. Analysis of interviews undertaken to determine if requirements of threshold concepts met.</td>
<td>Descriptions /explanations provided to support troublesomeness, integrative, transformative &amp; irreversibility attributes of a threshold concept for 'state' in context of computer science. Author argues it can be seen from other contexts as well. Boundedness attribute not addressed.</td>
<td>Author argues that 'state' is a threshold concept in terms of: <em>troublesomeness:</em> - computing students have knowledge issues (ritual, inert, tacit) with finding errors in programs they have created because 'they frequently forget to use an appropriate variable to record the state of important items' (p. 123). <em>terminology</em> - 'state is counter-intuitive for students <em>integrative</em> - 'every technique and tool in the programmer's</td>
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<td>2. Identification of a threshold concept in computer science</td>
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<td>explanations provided but not empirically tested.</td>
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<td>3. Not identified.</td>
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**1.** Quantitative /Qualitative /both
**2.** Purpose of research
**3.** Theoretical stance /research approach

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**Potential threshold concepts identified based on their previous work (academic interviews; literature).** Where the student interviewed mentioned one of these, then that was the concept that was focused on in the interview. If not, one of the concepts mentioned by the student was chosen. Interviews. Threshold concepts were identified on the basis that it was the subject of more than one interview. Analysis of interviews undertaken to determine if requirements of threshold concepts met.


1. Qualitative Identification of a threshold concept in computer science
2. Not identified.

Meyer and Land characteristics used to identify 'state' as a threshold concept.

Mappings /explanations provided to support troublesomeness, integrative, transformative & irreversibility attributes of a threshold concept for 'state' in context of computer science. Author argues it can be seen from other contexts as well. Boundedness attribute not addressed.

Author argues that 'state' is a threshold concept in terms of:

*troublesomeness:*
- computing students have knowledge issues (ritual, inert, tacit) with finding errors in programs they have created because 'they frequently forget to use an appropriate variable to record the state of important items' (p. 123).
*terminology*
- 'state is counter-intuitive for students
* integrative
- 'every technique and tool in the programmer's...
### Computer Science and Computer Programming

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<th>Threshold Concepts Identified and Method of Identifying Threshold Concept/s</th>
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<tr>
<td>Moström et al (2008)</td>
<td>1. Qualitative Research question: ‘How is abstraction manifested in students’ transformative experiences’” (p. 127).</td>
<td>Threshold repertoire is concerned with supporting versatile and efficient management of the state space' (p. 125) transformation and irreversibility ‘programming solutions are built as networks of interacting components’ (p. 126).</td>
<td>Transformation biographies completed by 86 students spread over the USA, Sweden &amp; UK however majority of responses from USA &amp; UK. Students were computing majors in second half of their program. In the biographies students asked to ‘identify and describe a computing concept that transformed the way they see and experience computing. (p. 127). Abstraction alluded to by many students so 4 researchers each read the biographies and selected those that alluded to abstraction. Where 3 researchers agreed on the same biography, the biography was included in the sample.</td>
<td>Findings: Abstraction related topics: Modularity -‘ability to abstract code into larger chunks, whether modules or classes, is an important part of learning to program. Without this ability, programming is a daunting task’ (p. 128). Data abstraction – ‘important skill for these students. If the student does not understand how to manage related data by actually treating them as a single unit, even small systems will seem impossible to manage’ (p. 128). Object-oriented concepts – ‘many students did not seem to understand what object-oriented programming actually means.’ (p. 129). Code reuse – Sometimes mentioned in a listing and unclear whether this exhibited real understanding or repeating standard information; some discussed ‘reuse code written by other people’ (p. 129; some exhibited clear understanding; ‘students discussed different aspects of reuse’ (p.129). Design patterns – ‘the evidence suggests that the</td>
<td>Not quite sure whether this is the best method. The authors cite some limitations which are quite valid such as students writing what they think the instructor wants as many of the biographies were used as part of student assessment.</td>
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## Threshold Concepts
### Identified and Method of Identifying Threshold Concepts

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<td>2 researchers chose the same biography, discussion resulted and consensus reached as to inclusion or not. Forty-seven of the 86 biographies were included in the sample. Abstraction-related topics were then coded into general topics of: 'modularity, data abstraction, object-oriented concepts, code reuse, design patterns, complexity, and other concepts'(p. 127). A different researcher then analysed each of the groups. Results are then explained and quotes used from the biographies to support explanation.</td>
<td>essence of design patterns is often deep, subtle and not very easy to understand at first. …. biographies describe a shift in perspective, moving from just making a program to creating a carefully designed solution' (pp.129 -30). Complexity – this was ‘typically referred to as one aspect of programming they now take into consideration. Frequently they were indirectly talking about procedural abstraction or storing data’ (p. 130). Other concepts – ‘the recognition of how things work at different abstraction levels was the transformative experience [for 3 students’ (p. 130). Very small number of students illustrated deep understanding moving beyond the information provided. Abstraction covers the whole discipline and ‘was also found on different levels … students discover and build on abstraction in different ways … the transformative experiences showed great differences in the impact on the students. Many students say the transformation changed their way to program, some say it changed their view of the subject area, and a few described a change in their whole world view’ (p. 131). Abstraction related topics:</td>
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## Computer Science and Computer Programming

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<tr>
<td>Rountree &amp; Rountree (2009)</td>
<td>N/A</td>
<td>Looking at the issues regarding threshold concepts in computer science discipline.</td>
<td>Not identified.</td>
<td>Suggest recursion and generics as potential threshold concepts with brief explanation as to how each of the Meyer and Land characteristics are met. Not empirically tested.</td>
<td>N/A</td>
<td>Findings:</td>
<td>Validation of threshold concepts: ‘In the empirical sense, it is not possible to validate threshold concepts because what is a threshold concept for one person may not be for another. The best we can achieve is a sense of “many” or “most” learners finding a particular topic meets the requirements of a threshold. Does this lack of validation matter for CSE? No, we think not, because practitioners define the subject; we define the</td>
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- It appears in diverse areas of the discipline;
- Many student biographies refer or allude to abstraction;
- Meets transformative, irreversibility, integrative, troublesomeness criterion

‘There is no evidence from these data, however, that abstraction in general is considered the transformative concept: none of the biographies claimed that learning abstraction was transformative. The biographies sometimes included more than one abstract concept, especially when discussing object-orientation, but none could be read as abstraction in general’ (pp.131-2). Disagrees with literature.

Abstraction is not a threshold concept
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<td>Park &amp; Light (2010) Nano-science &amp; technology US</td>
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<td>Variation theory used to ascertain variation in student understanding</td>
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<td>The threshold concept was identified via data collected from the instructor and students in a US university.</td>
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<td>Potential threshold concepts and (2) the interdisciplinary nature of such threshold concepts.</td>
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| - Instructor was asked to compile a list of ‘key nano-related concepts addressed in the course’ (p. 263) and then construction of concept map by instructor. Followed by interview with instructor where interview involved discussion of the links on conceptual map and instructor allocating concepts as being important, difficult and threshold after being provided with a brief definition of a threshold concept by Meyer and Land. Using the concepts identified by the instructor, 21 students were asked to prepare 2 concept maps (1 at the start of the subject and 1 at the end of the subject) that described and explained relationships. | Instructors-11 concepts identified as key concepts and 1 potential threshold concept being surface area-to-volume ratio. Also identified an important and difficult concept and potentially a threshold concept as surface energy; 2 other concepts identified as important and difficult but not potentially threshold (surface tension; surface forces. Students-38 additional key concepts identified by students as well as 11 identified by instructor on at least 1 of the pre/post concept maps completed by students. Students categorised concepts as difficult, important, threshold. Agreement by students (with instructor) with 8 believing surface area-to-volume ratio was important and 9 believing it to be threshold; 9 believing surface energy or surface forces to be difficult, 5 as important and 3 as threshold. There was 36% consensus between instructor’s and students’ choices when categorising concepts as | Limitations (by authors): irreversible nature and potential boundaries not investigated use of concept maps solely only provided limited and broad data on how students construct their understanding. student group chosen were all engineering majors from the same class. Reason for collecting data from instructor: ‘the identification process drew upon the instructor’s expertise as a scientist in the field, as a student who learned these concepts, and most significantly as a teacher with over two decades of experience teaching these concepts, developing learning outcomes, constructing curricula and reflecting on
Computer Science and Computer Programming
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1. Quant/Qual /both
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3. Theoretical stance /
research approach

Threshold
Concepts
Identified and
Method of
Identifying
Threshold
Concept/s

Method

Findings

Comments

between the concepts. Students
could add/drop their concepts.
At the end of the course
students completed a survey
that required them to undertake
the same classification process
as the instructor. The student
concept maps were
investigated in detail as was
the instructors’ concept map in
comparison to the student
concept maps.

difficult, important or threshold. Further evaluation
found that ‘difficult and threshold concepts appear
to differ substantially with, for the example, the
most cited difficult concepts, surface energy/forces,
cited only 3 times as a threshold concept. And as
noted above, the most cited threshold concepts,
surface area-to-volume ratio not being cited at all as
a difficult concept’ (p. 268).

student difficulties in
understanding these concepts. It
requires the expert’s thoughtful
reflection on his experience and
on students’ experience of nanophenomenon’ (p. 275).

Quantitative analysis /
preliminary analysis /
development of codes:
-2 student concept maps
chosen randomly and
instructors concept map
1st analysis:
-8 sets of student concept maps
(pre-and-post) Analysed
according to ‘(1) concepts
(number of concepts, change in
the pre/post list of concepts)
(2) links (number of links,
change in the pre/post link
between concepts) (3) format
of concept maps and (4)
number of conceptual levels’.
(p.265)

179 | P a g e

Forty-two (21 students’ x 2) concept maps analysed
for concepts and conceptual links resulting in
significant variation in student understanding, in
particular, five different patterns of expression were
found which are ‘constituted by the relationships
between five categories of concepts:
-NA-nanoscience, nanoscale/size,
-NE-nanoscale particles (atoms, molecules),
-SV-surface, volume surface area to volume ratio,
-SE-surface energy, surface force, surface tension,
- PR- size dependent properties (size dependent
thermodynamic properties, solubility, and melting
point)’ (p. 268).
Student understanding according to 5 patters are
Isolated, Unconnected, Detached, Limited and
Integrated.
In the paper the authors explain each pattern and
provide a diagrammatic example of 1 of the


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<td>Researcher and 2 experts in engineering and science did the coding. Comparison across the 4 areas revealed 85.94% reliability. Discussion then resulted for the concept maps where all 3 did not agree until agreement was reached. Researcher coded the remaining concept maps. 2nd analysis (qualitative): - using 1st analysis results</td>
<td>student’s concept maps as evidence. An analysis of student concept maps at the start and end of the course illustrated that 7 students exhibited the highest understanding (integrated) and this increased to be 14 after the course. Also 6 of the concept maps at the beginning were in the lower patterns of isolated and unconnected while only 1 was found in these lower groups at the end of the course. Further analysis to verify the threshold concept (surface area-to-volume ratio) was a critical part in developing level 5 understanding. The results were: - 9 students selected the threshold concept surface-area-to-volume ‘exhibited the highest level of understanding (type 5 -integrated); o 3 were identified as having type 5 understanding in their pre concept maps o 6 changed from a less sophisticated understanding to an integrated understanding - The remaining 5 students displaying pattern 5 understanding selected other concepts; o 4 had type 5 understanding at the start of the course - Post concept maps of students that exhibited pattern 1-4 understanding did not select</td>
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<td>surface-area-to-volume as being a threshold concept; Authors of paper argue that integrative nature of the threshold concept is definite although individual student interviews would be needed as evidence. Also seen by authors as transformative due to impact it had on changing student understanding. Students that did not undergo a change in understanding also did not select this threshold concept indicating that students need to recognise the importance of a concept in transforming understanding when choosing threshold concepts. Preliminary finding: this threshold concept is not difficult or troublesome in itself; it is the integrative nature of it that creates the troublesomeness. Authors acknowledge that they have not addressed other components such as irreversible nature or boundedness of threshold concept except that by implication students are 'crossing the boundary between the macro level and the nano level' (p. 276).</td>
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<td>Sorva (2010) Computer programming Finland</td>
<td>1. N/A</td>
<td>3 threshold concepts: - Program dynamics - Information hiding - Object interaction</td>
<td>Threshold concepts in paper not backed by empirical evidence by Sorva. Sorva admits 'none of the 3 is an entirely new suggestion; I modify, extend and strengthen the cases made for some proposed threshold concepts in the literature' (p. 3). The program dynamics threshold concept contains explanations of how the particular threshold concept is integrative, transformative, troublesome, is bounded and irreversible. References are made to prior literature to support these claims. &quot;The remaining 2 threshold concepts are not so clearly delineated along the lines of each of the threshold concept characteristics.&quot; Sorva identifies that the &quot;loose&quot; definition of what constitutes a threshold concept has led to various interpretations and makes</td>
<td>Sorva believes 'explicitly linking threshold concepts to Brunerian Fundamental Ideas gives structure to the ongoing debate on threshold concepts' (p. 1) and that a threshold concept may involve at least 1 but often more than 1 fundamental idea. Fundamental Ideas explained in Eckerdal et al (2006) review. Sorva acknowledges agreement with Zander et al’s thoughts regarding the relationship between fundamental ideas and threshold concepts of a discipline as fundamental ideas develop over a longer time while threshold concepts are transformative and that during the development of a fundamental idea, threshold concepts may appear at times during this development of the fundamental idea. Sorva also identifies that they are both integrative and characterise a discipline. However, fundamental ideas span beyond the discipline into everyday life whereas threshold concepts tend to have disciplinary boundaries. Sorva argues that 'mastering a threshold concept transforms the student’s everyday understanding of one or more fundamental ideas into a more specific disciplinary understanding' (p. 5) and that 'a fundamental idea is not itself transformative, but the way it is related to a discipline by a threshold concept may well be!' [and] the proposed relationship between fundamental ideas and threshold concepts may also in part explain why threshold concepts are so troublesome to learn. The explanations used to support how Sorva believes fundamental ideas and threshold concepts are linked but not empirically supported. Sorva suggests that there are also 'transliminal concepts' and uses an excerpt from a student interview from Zander’s paper and provides a new interpretation. That is, 'student 3 has crossed a transformative threshold from an earlier (merely) high-level view of programs to the low-level view based on the idea of addressable memory. Encountering the pointer data type in a programming language has been a catalyst for this transformation: the transliminal concept of pointer – which requires the low-level 'lens' provided by the threshold concept of computer memory - has brought the student to the threshold and served as a point of departure for developing a more general view of memory' (p. 6). Not quite sure about this.... isn't this occurring</td>
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<tr>
<td><a href="#">Rountree, Robins and Rountree (2013) New Zealand</a></td>
<td>N/A</td>
<td>Authors suggest the Meyer and Land definition be expanded as threshold concepts require ‘the successful’</td>
<td>N/A</td>
<td>N/A</td>
<td>Authors ‘propose a synthesis of views from TCs, Fundamental Ideas (FIs) and the Knowledge / Strategies / Mental Models (KSM) Framework’ (p. 268). Authors suggest that an expanded definition ‘… to clarify the relationship between TCs and Fundamental Ideas, and to account for both the</td>
<td>I find this model very confusing. It may have more relevance to computer programming? Perhaps the attraction of threshold concepts is the ease at which people can relate to it and can interpret it; can combine it</td>
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<td>acquisition and internalisation not only of knowledge, but also its practical elaboration in the domains of applied strategies and mental models’ p. 265).</td>
<td>threshold concepts identified and method of identifying threshold concept/s</td>
<td>important and the problematic characteristics of TCs in terms of the Knowledge / Strategies / Mental Models (KSM) Framework defined in previous work’ (p. 265).</td>
<td>(\text{To be a fundamental idea, four criteria need to be met according to Schwill (1994) in Rountree, Robins and Rountree:})(^1)</td>
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<td>1. ‘A horizontal criterion: the idea is relevant, descriptive or applicable across many disciplines or sub-disciplines.</td>
<td>(\text{I think they are essentially saying that a threshold concept is not just about learning knowledge; it encompasses other things such as being able to develop strategies, being able to see the world in a new way or through a new lens?})</td>
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<td>2. A vertical criterion: the idea will pervade all levels of sophistication within a discipline, from elementary through to highly advanced material.</td>
<td>(\text{I don’t think this has wide applicability to other disciplines.})</td>
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<td>3. A criterion of time: the idea, once identified, is soon seen as highly important, and remains important throughout the discipline’s history.</td>
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<td>4. A criterion of sense: the idea has meaning in “everyday life” i.e. it applies to ordinary language and thinking, not just to a particular discipline or skilled activity’ (p. 277).</td>
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<td>Essentially there are master/big fundamental ideas identified and under these there are specific ideas – e.g. big idea is algorithmisation, specific ideas are worst-case-analysis, divide-and-conquer. The specific ideas also need to meet the four Fundamental Ideas criterion.</td>
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The authors believe the relationship between fundamental ideas and threshold concepts is that they are orthogonal (they don’t overlap; are mutually independent).

They suggest horizontal element needs to be elaborated more …and then go on to discuss KSM.

They describe learning as the acquisition of knowledge.

The authors had a previous paper about learning and teaching programming language. They created a programming framework that contained Knowledge, Strategy and Mental Models (named as KSM framework in current paper) as 3 domains and relate how students’ progress through these domains in terms of the design, generation and evaluation aspects of programming.

In this paper, they describe the Revised Blooms’ Taxonomy (RBT) as having four knowledge dimensions:

They then relate the RBT to KSM suggesting that factual and conceptual fall under Knowledge and procedural and metacognition fall under Strategy and that Mental Models are not really covered by RBT. They amend the KSM framework to remove...
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<td>the design, generation and evaluation aspects of programming and replace this with ‘a very general concept of progress from elementary to advanced levels of understanding/mastery/complexity’ based on RBT’ (p. 279).</td>
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<td>KSM framework – how TC and FI fit into the framework?</td>
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<td>Authors suggest that fundamental ideas ‘reside primarily’ under Knowledge (p. 279). Under vertical category, RBT is relevant</td>
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<td>Threshold concepts span the three domains of the KSM framework which may or may not include FIs</td>
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<td>They suggest that ‘passing the threshold requires the successful acquisition/internalisation not only of knowledge at some level, but also its practical elaboration into the domains of applied strategies and mental models’ (p. 280). This is the part they suggest be added to the characteristics of a threshold concept…. more specifically, ‘passing the threshold requires the successful acquisition and integration of a broad range of cognitive resources and learning mechanisms’ (p. 283). Specifically, they suggest that an additional criterion is ‘a TC incorporates both a unit of knowledge and strategies for applying it and it</td>
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enables a new range of mental models to be constructed’ (p. 284). The authors believe this makes the definition more rigorous and specific, more objective. They justify this addition with reference to the other characteristics of a threshold concept as follows:

- Troublesome – unusually broad learning requirements may be the source of the troublesomeness and there is a need to integrate knowledge, strategies and mental models
- Integrative – combination of knowledge, strategies needed to apply knowledge and ability to generate a new mental model (particularly in programming)
- Transformative – they enable new mental models and ability to see the world differently
- Liminal space – gradual process of learning
### Information Systems

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<tr>
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<th>2. Purpose of research</th>
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<tr>
<td>Cope &amp; Staehr (2008) Australia</td>
<td>Both</td>
<td>Different ways threshold concepts are experienced by students and test whether the notion of information systems as social systems is a threshold concept. Aim of paper-introduce threshold concepts to information systems teachers.</td>
<td>Phenomenographic perspective of learning</td>
<td>Notion of information systems as social systems is a threshold concept. Method of identification is based on a discussion of the Meyer and Land characteristics of a threshold concept.</td>
<td>Questionnaire to 30 students at beginning and end of unit to test student understanding and analysed from a qualitative perspective according to the 2 educationally critical aspects of (1) people as part of information systems and (2) attribution of meaning. Information from the questionnaires under these 2 categories grouped according to stage of understanding into 3 areas being (1) beginning, (2) consolidating and (3) established. The criteria for each of these groupings were provided in the paper.</td>
<td>Findings: - Significant increase in students as consolidating/establishing for both of the educationally critical aspects evaluated. - Highlighted that students were entering the unit with a very low level of understanding of IS as a social system even though they had undertaken two units of IS prior to this unit. Acknowledged that this could be attributed to the fact that the first two units placed emphasis on ‘technical aspects of IS and development of IS’ (p. 359). IS as a social system is covered later in the degree ‘after a sound technical basis has been established’ (p. 359).</td>
<td>Paper is predominantly focusing on educationally critical aspects literature and less on threshold concepts.</td>
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<td>Yorke-Barber et al (2008) Australian study Information</td>
<td>Qualitative</td>
<td>Identification of threshold concepts needed by 4th year undergraduate engineering students need ‘to produce high</td>
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<td>1 threshold concept identified - (1) ‘critical evaluation of information resources to establish their authority, quality and credibility’ (p. 1).</td>
<td>Surveys - academic coordinators (who coordinate the project and thesis) Surveys - students of above Surveys - librarians Similar survey questions for both.</td>
<td>Academic responses-stumbling blocks and strategies they use to help them provided in a table in paper. It appears academics were also asked which information skills were most important for students as data shown about this in paper.</td>
<td>Interesting statement in this paper....'there are many reasons for a threshold concept approach to information skills, amongst which is the need to understand the student perspective. Assumptions</td>
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<td>'Knowing the research topic and compiling a search strategy. 2. Locating, critically evaluating and tracking information research. 3. Referencing and citing information' (p. 5) This differs to the earlier threshold concept mentioned i.e. 'critical evaluation of information resources to establish their authority, quality should not be made about students' prior knowledge or what they may find difficult in information research. Threshold concepts take into account students' prior knowledge e.g. students know how to find information; but the process of learning research skills takes this understanding from a basic level to a more sophisticated knowledge (Davies 2006). A threshold concept approach encourages active learning by engaging students in information research. Learners do not absorb information passively but actively construct it themselves. Threshold concepts imply that learners continually increase their knowledge by incorporating new information and concepts. When current knowledge is integrated then transformation occurs, revealing new perspectives' (p. 2).</td>
<td>Student responses provided in table in paper as well. Students and academics mentioned particular databases they would search and both groups agreed as to how they would refine the results of their search. Authors of this paper suggest the stumbling blocks mentioned are threshold concepts for information research but they qualify this by stating that further analysis may alter this (note: data analysis acknowledged as not complete in paper). They identify a recurring theme as 'the need for students to know their topic and to have started thinking about it so that the relevance of information skills training is immediately apparent' (p. 5). 3 threshold concepts identified in a table as: 1. 'Knowing the research topic and compiling a search strategy. 2. Locating, critically evaluating and tracking information research. 3. Referencing and citing information' (p. 5)</td>
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<td>and credibility' (p. 1). The authors of this paper go on to state that information research does not have discipline specific threshold concepts as it is not a discipline in its own right and that 'information research is itself a threshold concept in that it is an integral step in students' research projects' (p. 5). This is followed by a description of how information research meets the troublesome and integrative and refers to Davies who says that if a threshold is integrative they are also irreversible and transformative. *</td>
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<td>* Contradiction with the threshold concepts identified – is it 'information research' or 'critical evaluation of information resources to establish their authority, quality and credibility' (p. 1). No reference to the Meyer and Land criteria in justifying the second threshold concept mentioned above. No indication of how the results were analysed; how many academics and students were surveyed; when they were surveyed.</td>
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<td>Fouberg (2013) USA</td>
<td>Students identified threshold concepts on the basis of Meyer and Land’s characteristics.</td>
<td>Students suggested 'combining metacognition and geographic concepts to enable students to recognise their preconceptions build or reconstruct their schema and transform their understanding of a discipline' (p. 65).</td>
<td>Reflective student essays analysed and coded using Qualrus program (qualitative software). Coding completed in 3 steps: 1. core geographic concepts selected 2. evidence of threshold concept characteristics 3. evidence of constructivist elements of learning.</td>
<td>Students also provided with documentation about threshold concepts. Later in the semester, students chose one concept in geography they believed was a threshold concept and wrote an essay explaining why this was the case in terms of the Meyer and Land approach.</td>
<td>Data: 80 student reflective essays. 11 honours students asked to 'analyse their own learning to discover their threshold concepts’ (p. 65). Results – reflective essay analysis: - 28 different concepts mentioned - 71 parts of writing mentioned a geographic concept that was paired with a code for a characteristic of threshold concepts - Integrative characteristic mentioned more frequently (54.93%) - Most frequent concept mentioned was 'commodity chains' followed by 'core-periphery'; several students integrated the two geographic concepts of commodity chains and core-periphery and also saw their understanding of the concepts as irreversible and/or transformative...in their essays, several students described the entire course in terms of threshold concept traits, without discussing any specific geography concepts; other students also summarised their learning over the course, citing a transformed understanding of the world but not mentioning any specific geographic concepts that helped them transform their knowledge’ (pp. 69-70). Results – honours’ students’ essays: - 6/11 students chose ‘cultural landscape’ as a threshold concept * - After coding, 5 threshold concepts were identified ‘including cultural landscape (6), Author asserts that essay required of honours’ students contained metacognition aspects and reading about threshold concepts whereas the 80 reflective essays did not make students aware of metacognition or threshold concepts. Author believes that differences in threshold concepts selected by the 2 groups of students is due to the different academic levels of the student (regular class and honours class), the small class of honours students potentially having more attention on an individual basis as well as the understanding of metacognition and threshold concepts that the honours students had available to them.</td>
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### Geography

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<td>1. Quant/Qual /both</td>
<td>characteristics of a threshold concept 'and why the geographic concept functioned as a threshold concept for them' (p. 71). Each student then placed their essay in a word cloud. Same coding process used for honour students’ essays.</td>
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<td>identity (1), world cities (1), globalisation (1), region (1) and diffusion (1) (p. 73)</td>
<td>students spoke pre essay and discussed what threshold concept they would write about in their essay?</td>
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<td>Scott et al (2010) New Zealand</td>
<td>1. Both 2. Identification of threshold concepts in introductory electronics. 3. Not identified.</td>
<td>3 threshold concepts identified. Used Meyer and Land Characteristics. 3 threshold concepts identified: 1. Thévenin’s theorem 2. Dynamic resistance (DR) 3. Feedback.</td>
<td>3 focus groups with students (13 students in total); 2 online surveys with students (early in semester = 64 respondents; late in semester = 52 respondents) Paper based course appraisal survey at the end of the semester (87 respondents); Interviews with students by independent researcher; Informal observation of students.</td>
<td>Authors suggest that ‘a high density of threshold concepts accounts for the reputation for troublesome learning in, and low retention following, these courses’ (p. 1) Authors suggest ‘that the bimodal distribution of marks that is commonly observed in electronics teaching is a hallmark of a Threshold Concept’ (p. 1) Authors state that no reliable link found between threshold concepts being understood and student performance on final exam questions.</td>
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Authors cite insufficient room in paper to describe extensive process used to identify and justify the threshold concepts identified. Authors highly confident of the threshold concepts that are explicitly taught based on (1) their correlation with 5 threshold concept characteristics of Meyer and Land and (2) subsequent observation of students. Some descriptions and student quotes used but not for all aspects of a threshold concept for each of the threshold concepts identified as highlighted by the authors.

Authors tried to use bimodal mark distributions on 4 assessments (quiz, exam questions) to argue that students either get or don’t get the threshold concept but results inconclusive with all except for the quiz which the authors believe has a clear bimodal
### Introductory Electronics

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<tr>
<td>Scott et al (2012a) New Zealand</td>
<td>Threshold concepts suggested: 1. Thévenin’s theorem/modeling 2. Dynamic resistance / linear approximation 3. Reactive power / phasors 4. Feedback / operational amplification 5. Transdependence / dependent sources</td>
<td>The first 5 threshold concepts identified through observation of students and discussions with lecturers. They are analysed against the Meyer and Land characteristics of boundedness, irreversibility, integrativeness and transformativity with explanations. But not explicitly analysing troublesomeness as a Meyer and Land characteristic.</td>
<td>Findings - Comparison of 5 threshold concepts with Meyer and Land criteria:  - Boundedness satisfied for all apart from transdependence  - Irreversibility was hard to assess for the authors so they interviewed 9 retired engineers to test this characteristic covering 17 ideas including the 5 threshold concepts suggested. They found ‘no evidence that our TC’s are any more irreversible than other concepts’ (p. 3)  - Integrativeness is met for all the threshold concepts  - Transformativity satisfied for all threshold concepts</td>
<td>*Although these are mentioned and explained as potential threshold concepts, they have not been discussed any further in the paper. The authors state at the outset that it is difficult to make an objective assessment of the irreversibility of a threshold concept and that they believe it is derived from the transformatory aspect. They define the integrative characteristic as ‘where an idea recurs in diverse threads, it will necessarily open portals of understanding between the threads, exposing “the previously hidden interrelatedness” in the words of Meyer and Land (2003)” (p. 3). In</td>
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distribution. They explain that the inconclusiveness is due to “clutter” i.e. Many implicit and explicit threshold concepts being present - not a weakness in the theory surrounding threshold concepts.

Students asked about exposure to electronics pre university and only found significant higher score for switching circuit question (which was highlighted as a key concept not a threshold concept). No figures or diagrams shown to illustrate this.
### Threshold Concepts

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<th>Method Findings Comments</th>
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<tr>
<td>1. Holistic current flow</td>
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<td>2. Graph understanding</td>
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<td>3. 3D to 2D mapping</td>
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The 2nd indicator makes use of concept maps and the application of topological metrics to the concept maps … although they anticipate this could be an issue as they have found that ‘constructing a concept map that is large enough for the metrics to reflect the integrative nature of some concepts is proving to be a challenge. Some initial work has been reported by Jaffer et al (2012)’ (p. 5). ***

Inventories in the literature. 1 inventory contains 4 of the 5 threshold concepts; the other inventory was limited to 1 threshold concept.

‘We also observe that our postulated TCs can be discerned in other disciplines, often far removed from engineering. This raises the possibility that TCs may be so integrative because they run across disciplines’ (p. 6).

In analysing integrativeness of the threshold concepts cited, the authors seem to look at how much the threshold concept is used both within their discipline but also outside their discipline with too much of a focus on outside of the discipline as follows with little regard to how it is defined below*. Examples of integrativeness used by authors include ‘thevenin’s theorem is used as a model for innumerable things from a power station to an electric guitar, from a flashlight battery to an MP3 player. Among EE ideas it is one of the most widely employed of all models … however it is easy to provide examples from without engineering’ (p. 3); ‘dynamic resistance is a term generally limited to the context of active devices in electronics. However, the concept is in wide use by other names in other disciplines’;
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| Scott et al (2012b) | 1. Both | Authors refer to their previous paper where 5 threshold concepts were identified. | Created a test (threshold concept inventory assessment tool) for one of the threshold concepts and suggest that 1 question can be used to test the threshold concept but that precursor questions are also required to test the concepts integrated with the threshold concept. Hence their assumption is that a student who answers the threshold concept question has understood the threshold concept and they assumed that the students would also get the precursor questions correct as well. Test is multiple choice; strong use of graphs; and non-numeric (substantially). Sample size of students sitting the test is 119. Of these ‘74 answered the TC question correctly, but 54 also answered the precursor questions perfectly’ (p. 13). The remaining 20 students were then interviewed. Test results overall were compared to those students who had difficulty with the precursor questions. | Findings: 20 students interviewed and researchers found that most students guessed the answers to questions and could not display a thorough understanding of the threshold concept. The authors admit that ‘the number of correct guesses was elevated because students were able to eliminate some of the possible answers through reasoning not connected with the concept central to the question’. Hence need to improve the quality of the distracting answers in the multiple choice questions (p. 13). In comparison to the overall test result compared with performance on the precursor questions, the authors found ‘that students who did not do well on the test overall tended to be the same students that had trouble with precursor questions’ (p. 13). | 'Between 2009 and 2011 we carried out a detailed project to identify the TCs within the curriculum...a major achievement of that project has been the “levelling” of the syllabus to ensure that no course covered too many or too few TCs’ (p. 12). |
## Dental Education / Healthcare

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<td>Clouder (2005), UK</td>
<td>One threshold concept – caring</td>
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<td>Findings/Conclusions: Threshold concepts are a way of exploring the troublesome nature of caring as being not only complex but also 'a less tangible aspect of learning to be a health (care) professional' (p. 513) where common sense notions of caring are replaced with recognition of the personal, moral and ethical challenges they will face when caring as a health care professional.</td>
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<td>Excerpts from 2 student interviews are used to illustrate how the troublesomeness and irreversibility elements of the definition are met. The integrative nature of the threshold concept is also addressed through explanation. This threshold concept is important as students develop their own sense of identity as a healthcare professional and realising that being a healthcare professional is more complex when they have to practice it in terms of 'caring'. Students may find it challenging as the authors state that 'students frequently commence programmes with a rather predictable set of ideas about being a healthcare professional that are refined to result in 2 research projects have provided data for this paper: (1) 12 occupational therapy students took part in unstructured interviews that took place every 10-12 weeks over their degree regarding their transition to a professional. Data also included course material that was analysed as well as participant observation that helped enhance the context of the environment students were experiencing. (2) On-line discussion forums by undergraduate physiotherapy students who, for the first time, are undertaking clinical placement. They use the discussion forums to reflect on critical incidents. 'Data are cross-sectional in nature, drawn from analysis of critical incidents posted to the online discussion forum and from face-to-face group feedback involving approximately 260 students' (p. 507).</td>
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<td>Clouder also cites Tronto’s (1993) caring framework that contains four phases of care and explains which phases are particularly troublesome and/or transformative for students. Clouder also likens Perry’s (1988) scheme of cognitive and ethical development to the idea of liminality.</td>
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<td>1. Teacher need to reconsider how they prepare students for practice, what practice actually is and how students can address the challenges they are likely to face. In particular, students need to leave their program 'having accrued some sense of emotional capital (Cousin, 2003), self-awareness and reflective capability in order to fulfil their caring responsibilities but to do this we need to construct a framework for learning, assessment, support and guidance' (p. 514).</td>
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<td>2. Reconsider mode of assessment for</td>
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<td>Kinchin et al (2011) UK</td>
<td>1. Qualitative 2. Used threshold concepts to investigate how students can see the link between their conceptual understanding gained through academic study and experiential understanding based on practical</td>
<td>They illustrate how they believe product visualisation is a threshold concept in dental education when undertaking complete denture jaw registration. This one selected on basis of the academic background of Cabot (one of the authors) as well as observations of the authors in undergraduate</td>
<td>Senior undergraduate students and non-specialist staff were asked to explain their understanding of complete denture jaw registration; often taught in a linear way. Dentists preparing for the UK Overseas Registration exam with the General Dental Council also were asked to explain their</td>
<td>practice based learning with more physical care giving rather than observing at a distance. 3. Increase dialogue between students and students and staff when in a practice environment to assist students in reflecting on their experiences and uncertainties they are encountering and make this an explicit rather than implicit part of the curriculum. 4. Increased support for students through online discussion forums and exhibit that other students may also have similar issues. Use of online forums rather than face to face discussion may relieve any student self-consciousness that students may encounter in face to face discussion.</td>
<td>Produced an excellent diagram illustrating how threshold concepts fit in with conceptual learning (learning in the classroom) and experiential learning (learning in practice) in dentistry (p. 2). Focused more on transformation of learning and integrated nature but not on other attributes of the definition of threshold concepts.</td>
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<td>Kobus (2011) UK</td>
<td>exposure to dentistry.</td>
<td>dental education.</td>
<td>understanding of this same task.</td>
<td>They argue that from a dental education perspective, a consideration of threshold concepts can have implications for curriculum and teaching. Removal of unnecessary content can result when priority is given to the integration of prior understanding rather than focussing on the acquisition of new knowledge; explicit linkages of conceptual and experiential understanding; and review of the curriculum to ensure that it allows cumulative but also segmented learning to allow for integration. Consideration of threshold concepts, the authors believe may mean that the curriculum can focus on thresholds to be crossed rather than coverage of curriculum content. It also encourages discipline specialists to think about the curriculum and the linkages between dentistry and educational research (Kinchin, Cabot et al. 2011).</td>
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<td>1. Qualitative</td>
<td>Findings are based on observations and other literature on the topic.</td>
<td>Kobus distinguishes between 2 different knowledge structures based on work by Kinchin: 1. Linear – akin to ‘clinical procedures and skills learnt through experiential learning’ (p. 46) &amp; 2. Hierarchical – a network of understanding underlying chain of practice and developed through conceptual learning.</td>
<td>Kobus provides a concept map illustrating that threshold concepts may help students in their transformation of learning by bridging the gap between practice and theory; that is, threshold concepts ‘may have a function in transforming student understanding by integrating chains of practice with networks of understanding’ (p. 49). A model (figure 3) is provided that integrates teaching, assessment and the consequences rote learning. It illustrates that rote learning through memorisation of facts and reinforced through reproductive assessment methods does not assess understanding and how linearity in teaching does not reveal networks of understanding. Kobus acknowledges that ‘for this model to Theoretically the paper explains the gap between theory and practice and relates this to linear and hierarchical knowledge structures. Information about threshold concepts is provided in terms of a description of each of the attributes and general explanation of what a threshold concept is in terms of a web of concepts. Kobus cites that ‘filling the gap between theory and practice is possible by application of threshold concepts as they transform and integrate knowledge structures’ (p. 48). Further information regarding</td>
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<td>Kobus (2012) UK</td>
<td>Troublesome aspects of knowledge analysed to identify potential threshold concepts.</td>
<td>Preliminary observations by Kobus (at one clinical school) are that ‘chains of practice (i.e. clinical procedures) are often taught in isolation from the underlying conceptual knowledge (e.g. infection control, anatomy or ethics)’ (p. 46). Explanations of sources of troublesome learning in this discipline and Kobus mentions that the transformative and integrative nature of threshold concepts can (if put into curriculum) link linear and hierarchical knowledge structures.</td>
<td>work, students must develop networks of understanding. The assumption that students always form such networks through conceptual learning cannot be made’ (p. 49) but Kobus provides other literature that argues that ‘if teachers do not make underlying networks of understanding explicit and present only fragments of their understanding as chains of knowledge, the students can only be passive observers who will adopt surface learning strategies’ (Kinchin, in Kobus, p. 49). Kobus asserts that students will not be able to grasp threshold concepts if their networks of understanding have not formed.</td>
<td>the observations is not provided.</td>
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<td>Dental curricula constructed around ‘division of knowledge into linear and hierarchical structures’ (p.27). Kobus identifies that ‘Kinchin and others advocate that learning how to link the theory with practice might be possible through the acquisition of threshold concepts’ (p. 27).</td>
<td>Clinical teachers – discrepancies in the curriculum in terms of the official curriculum and what is actually being taught; Kobus suggests that there is only limited understanding of the curriculum; one-to-one interaction seen as important in the clinic environment. Students-curriculum overloaded; one-to-one interaction seen as important in the clinic environment; unsure why some topics are studied; students report difficulty with applying theory when in</td>
<td>Next part of the research Kobus will interview academics not involved in the clinical aspects of teaching as well as senior staff involved in development of the dental curriculum.</td>
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<td>Pilot Study: Interpretive and explorative approach used. Semi structured individual interviews with 4 undergraduate students and 4 clinical teachers; also observations by Kobus in clinic and lecture theatre to write interview questions.</td>
<td>the clinic.</td>
<td>Teachers appear unclear how to link theory and practice but expecting students to do this. May be due to tacit knowledge. Further research needed to determine what the threshold concepts might be in dentistry. In main phase of study, further exploration of troublesome knowledge will be undertaken in the context of becoming a dentist.</td>
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<td>Author/s, Location, Details</td>
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| Coghlan and Graham (2009) Ireland | Threshold concept identified – Viewing product development as a CAS (complex adaptive system). | The MNPD (Managing new product development) course is undertaken by final year undergraduate students from 2 different disciplines – manufacturing engineering and business. Aim of this course is to enable ‘students to understand the contributing factors to shorter lead times when developing marketable and manufacturable new products, choices in structuring the development process and the integration of differing functional capabilities during the process’ (p. 191). | Student survey – 68 / 80 student responses received. Results:  
• Lecturer stimulated critical thinking 92-95%;  
• 90% of students were highly satisfied with the assessment approach and remaining 10% were very highly satisfied;  
• Majority of students rated the course good or excellent (99%)  
• The authors also provide student comments that verify this.  
• Feedback from the project was also provided by 2 students providing further evidence of student satisfaction. | The companies that support the project are complementary as well as evidenced by comments by management.  
Interesting to note that the authors state the project-based approach used and the resources used are not special and have been used previously. However, the important aspect is how the threshold concept is embedded in the course using a combination of these tools and resources. |
| Management |
|------------------|------------------|------------------|------------------|
| **Author/s, Location, Details** | **Threshold Concepts Identified and Method of Identifying Threshold Concept/s** | **Method** | **Findings** |
| Coghlan and Graham Cagney (2013) Ireland | Qualitative | 'Insights on how a method for engaging with insider inquiry in an undergraduate course...emerged to be a threshold concept!' (p. 1). Not identified. | Course is called Exploring Organisational Experiences. It is optional and aimed at final year students. Assessment in course included: - two major papers of 4000 words - reflective journal - three short assignments - final exam. The focus was on the process of learning to attend to insider inquiry and on developing the skill of employing the general empirical method, rather than on any particular organisational issues that students may have discussed. The structure of human knowing acted as an empirical method for the course participants and was integral to enabling the students to engage in insider inquiry’ (pp. 12-3). |

Threshold concept identified is 'multi-sensory holistic immersion' which is a process where two approaches to inquiry are juxtaposed according to Evered and Louis (1981) in Coghlan and Graham Cagney where “inquiry from the inside” involves researchers as actors, immersed in local situations generating contextually embedded knowledge which emerges from direct experience [while] 'inquiry from the outside' refers to traditional science where the researchers’ relationship to the setting is detached and neutral [and] researchers act as onlookers, and they apply a priori categories to create theoretically universal, context free knowledge’ (p. 4).

The authors compared insider inquiry and the general empirical method with the Meyer and Land characteristics of a threshold concept. The authors found in the past that students had difficulty in thinking differently and changing their learning process. Hence the authors believed double-loop learning was required to help students deal with this change. 'Double loop learning involves changing the frame by which questions are asked’ (Argyris, 1982, in Coghlan and Graham Cagney, 2013, p. 13). The authors elaborate that ‘students were challenged to create a new mental model for themselves for how they would engage in and learn in the course and achieve good grades. Attending to cognitional processes is difficult for undergraduate students to grasp. While not everything that is difficult to learn is a threshold concept, attending to the method of inquiry form the inside meets most of the characteristics of a threshold concept’ (p. 13).
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<td>Gray and Blake (2013) Australian study</td>
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<td>Baillie and Johnson (2008)</td>
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* The authors are focusing on troublesome knowledge as an indication of a ‘threshold’ based on Meyer and Land as per below: ‘Meyer and Land (2003a, 2003b) have suggested that troublesome knowledge indicates the existence of a ‘threshold’, which they describe as ‘akin to a portal, opening up a new and previously inaccessible way of thinking about something’. Associated with a threshold is a central concept, the ‘threshold concept’. Crossing the threshold means the threshold concept is attained and the student has ‘a transformed internal view of subject matter’ (p. 129). How data was analysed is not clear apart from looking for troublesome knowledge (e.g. coding, etc); quotes cited as representing views.
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<th>Author/s, Location, Details</th>
<th>1. Quant/Qual /both</th>
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<th>3. Theoretical stance / research approach</th>
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<td>Male and Baillie (2011a)</td>
<td>Qualitative</td>
<td>Identification of potential threshold concepts in engineering. This is part of a project where threshold concepts are being used to inform a complete overhaul of the engineering curriculum.</td>
<td>Basis of Meyer and Land's description of threshold concepts and information from Cousin's paper</td>
<td>Interviews: -10 engineering academic interviews (8 individual; group of 2) -2 tutors -Cousin's paper introducing threshold concepts provided pre interview -interview questions provided in paper Focus Groups: -2 student focus groups held -group 1 had 7 students in chemical engineering -group 1 was also attended by a chemical engineering academic who became the disciplinary co-facilitator -group 2 had 5 senior students in engineering who tutored in 1st year engineering unit and corrected exams for such *</td>
<td>Findings: An example provided describes how threshold concepts in 'materials' were developed -five threshold concepts determined by teaching team; further nine identified through interviews and workshops -they were considered to be threshold concepts because: - academics reflected on misconceptions and errors by students as evidenced in assessments, comments and questions by students; students reflected on their own experiences - troublesome concepts according to students arise as 'students forget to apply parts of them' (p. 255). The authors of this paper consider that this may be because students have ritual knowledge of the</td>
<td>* does this mean they were the post graduate students? Threshold concept theory used through this paper. Description of threshold concepts mentions transformative, troublesomeness, irreversibility and integrative aspects and reasons for troublesome knowledge such as ritual, conceptually difficult knowledge etc. But no mention of boundedness? Also reference to language being enhanced with threshold concepts. In the next paper 2011b the reference is made to the threshold concept being troublesome 'for reasons such as being inert, ritual...' (p. 2 of 2011b)</td>
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| **Findings** |
| **Comments** |

- professor of the unit became the disciplinary co-facilitator in the focus group

  Workshops:
  Foundation teaching team meetings
  - participants were people highly interested in learning and teaching or senior academics
  - discussions in meetings provided data
  - this group responsible for planning first two years of Engineering Science
  - participants aware of threshold concepts via a previous workshop by Baillie and Meyer
  - this team identified possible threshold concepts

  Student workshop
  - 13 students (mostly senior)
  - individual time allowed at start
  - in groups, time given to collect ideas and then groups focused on answering specific questions (questions provided in paper)

  Staff / student workshop held after student workshop
  - 7 students, 8 academics
  - small groups created and they 'discussed concepts only and that perhaps application is needed for transformation to occur; they also acknowledge that conceptual difficulty may be the reason for this.
  - ritual understanding from secondary school teachings may also cause this e.g. students retaining assumptions from secondary school and not realising that they were studied as a specific case rather than being applicable as a general assumption.

  The authors of this paper state that more investigation is required to determine the applicability of transformative and troublesome aspects of a threshold concept across different student cohorts.

  This project is using threshold concepts as part of a curriculum renewal project at UWA.
  Work still being undertaken regarding negotiation of threshold concepts via workshops still to be held in Australia (Melbourne), the UK and Sweden.
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<td>potential threshold concepts identified in the student workshop’ (p. 253)</td>
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<td>3 workshops at Oxford University</td>
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<td>Male and Baillie (2011b)</td>
<td>1. Qualitative 2. Description of the development and testing of methodology used to identify and investigate threshold</td>
<td>Previous 2011a paper explained details of data collection. This paper now shows the method in 2 phases - diverging and integrating. Part of the data collection described in 2011a paper is the diverging phase</td>
<td>Workshops across Australia (Perth and Adelaide at time of paper) and New Zealand (Auckland at time of paper) with engineering academics -workshops used to negotiate and investigate the threshold concepts already identified, investigate their features and identify any other potential threshold concepts Analysis of data: -Content based analysis undertaken (particular focus was troublesome and transformative characteristics) of workshop handouts completed by participants (standard handout), notes from interviews (recorded and unrecorded interviews) and interview transcriptions -development of an inventory of threshold concepts ‘by identifying threshold concepts underlying related concepts that participants reported as transformative and troublesome’ (p. 254).</td>
<td>Evaluation of methodology: -undertaken by John Bowden via attendance at project meetings and the first regional meeting, designing and analysing results of evaluation forms collected from workshops. Notes taken by facilitators were also part of</td>
<td>* 2011a paper describes 2 interviews with tutors as well that are not mentioned in this paper. Threshold concept theory used in this paper and the authors of the paper describe it as ‘forming the framework for our study’ (p.2). New to this paper (and not mentioned in previous paper)</td>
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**1.** Quant/Qual /both

**2.** Purpose of research

**3.** Theoretical stance / research approach

**Threshold Concepts Identified and Method of Identifying Threshold Concept/s**

**Method**
- interviews with academics*, focus groups with students and tutors
- workshops with academics and some postgraduate students

In the integrating phase, the following workshops were undertaken and were reported in the 2011a paper and include student workshop, Staff / student workshop held after student workshop - Workshops across Australia (Perth and Adelaide at time of paper) and New Zealand (Auckland at time of paper) with engineering academics.

**Findings**

**Comments**

is threshold capability theory (combination of threshold concept theory 'with capability theory including variation theory' that authors state was 'found to be useful in this study' (p. 2). TConcT - framework

TCapabT - useful

Description of threshold concepts mentions transformative, troublesomeness, irreversibility and integrative aspects and reasons why threshold concepts can be troublesome such as ritual, conceptually difficult knowledge etc. But no mention of boundedness. Also reference to language being enhanced with threshold concepts. I thought it was knowledge that had these characteristics eg. ritual knowledge rather than reference to ritual TC?

The authors of the paper state that their methodology design focused on student experiences' however they did also use a lot of academic advice through focus groups and discussions with the teaching team. They do acknowledge that 'students, academics, and tutors provided
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<td>2. Identification of threshold concepts in engineering</td>
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<td>3. Not identified.</td>
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<td>Suggesting object-orientation and recursion as threshold concepts. Based on Meyer and Land (troublesomeness, integration, irreversibility and transformation)</td>
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<td>Questionnaire online to 102 students in 1st year at the end of a class to test ability of questions to distinguish concepts with/without threshold concept characteristics. Questions based on following characteristics – troublesome nature, irreversibility, integration and transformation of understanding. Authors suggest that irreversibility, integration and transformation ‘can only be tested when the threshold has been crossed, or at 1. First Questionnaire: questions ‘were identified by the linear analysis as being significant discriminators – (1) I would find &lt;the concept&gt; easy to explain to another student, (2) understanding &lt;the concept&gt; has transformed the way I think about the subject, (10) I would find &lt;the concept&gt; hard to forget now I understand it’ (p. 5). ‘Linear discriminant analysis and logistic binary regression demonstrated that 3 of the</td>
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<td>Development of a Threshold Concept Inventory is described as being 'central to the methodology ... each item includes sufficient description for engineers to identify the concept, relevance in the course or engineering practice, ways the concept can be troublesome, and ways to help students' understand the concept' (p. 4)</td>
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<td>different perspectives. Academics understand the concepts they plan to teach and why they are important for future parts of a course. They glean understanding of students' experiences from students' questions and from assessments. Students have experiences of concepts they found troublesome and that have felt transformative, and by 3rd and 4th year are able to identify 1st year concepts that they found transformative. Tutors have understanding from their own recent experiences as students, are aware of students' experiences based on interactions in tutorials, and see evidence of misunderstanding assessments' (p. 3)</td>
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<td>Results provided followed by discussion but results are not clearly explained. Authors acknowledge that ‘further analysis of the data captured in these three investigations may help to answer some of the questions raised [in the paper], and prompt a refinement of the question set’ (p. 10).</td>
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<td>45 students. This was done during 1st year and surveys undertaken 6 times over a 5-week period. Use of the clickers meant individual progress and cohort progress could be monitored. Students who exhibited ‘either sudden jumps in their perception of understanding of specific concepts…or students whose perception of understanding after the material had been covered had remained low’ (p. 3). ‘These students were asked specific questions about their experiences whilst tackling the concepts. At the end of the module, the students were given an oral examination on their understanding of free and forced vibrations, and their test scores were compared against their perception of understanding (p. 4). Questionnaire to same students as above ‘to test the discriminating power developed in the 1st investigation on a different set of concepts’ (p. 2). Sample size was 46 students whose progress had been tracked. Similar to 1st questionnaire although fewer of the questions used.</td>
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<td>Knight, Callaghan, Baldock &amp; Meyer (2013), Australia Civil Engineering</td>
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## Engineering

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<th>Method</th>
<th>Findings</th>
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- it was found that 'critical flow is a more important predictor than physical modelling in each regression' (p. 13).

- They are concerned that the results may be influenced by the teacher's subjectivity and through what teacher emphasises in class and his/her own personal and academic background and thoughts. They suggest that 'comparative studies should be carried out with experts and students in other open catchment hydraulic courses' (p. 15).
### History

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<th>Purpose of research</th>
<th>Theoretical stance / research approach</th>
<th>Method</th>
<th>Findings</th>
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<td>Macdonald and Black (2010) UK</td>
<td>1. Qualitative 2. Tutors reflecting on teaching practice using threshold concepts and troublesome knowledge to identify difficult areas and strategies to deal with any difficulties; suggestions for professional development of teachers 3. Not identified</td>
<td>“Exploring History: medieval to modern 1400 – 1900” is a second year history course delivered via distance education. Sample-5 tutors. Network created through online and face-to-face communication with tutors. Method: (1) One-day workshop – threshold concepts and troublesome knowledge discussed in relation to history and this course in particular identifying troublesome knowledge rather than threshold concepts (‘as tutors seemed to find this concept easier to identify and apply to their practice’) and strategies used to deal with the troublesome knowledge identified (p. 75). (2) After workshop, wiki established to allow for further reflection when teaching the next cohort of students. Output from workshop available on wiki as well. Once a month participants visited wiki, provided reflections and any lesson plans and/or handouts that they felt were relevant. Analysis: Reflective account of wiki and workshop contributions that are evidenced with quotes. The analysis / reflection is</td>
<td>Troublesome areas identified:  - Process of learning history: the development of historical imagination (thinking like a historian)  - Process of learning history: the integration of knowledge and understanding (being able to work through a lot of resources, undertake critical analysis, deal with a range of alternatives)  - Content: difficulties posed by numerical data in terms of being able to place raw data into a historical context; so the difficulty is the source i.e. The raw data rather than other sources such as textbooks etc. The authors align this to Perkins’ thoughts on conceptually difficult knowledge. Aims:  - Process of learning history: the development of historical imagination o ‘build students’ confidence in working with the weight, complexity and unfamiliarity of alien knowledge encountered in remote periods’ (p. 80) - Process of learning history: the</td>
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<td>'informed by O’Brien’s (2008) analysis’ (p. 77) where O’Brien interviewed academics in different disciplines regarding threshold concepts and found a lot of variation in what was perceived to be a threshold concept, discrepancies between what was taught compared to what was identified as a significant concept. O’Brien reported on the difficult issues students found in the course based on academic reflections, academics’ pedagogical aims in terms of challenging areas of the course, strategies used and why they used particular strategies. The authors’ of this paper explain that based on O’Brien’s experience, they wanted to use the notion of threshold concepts ‘to stimulate a systematic discussion on the teaching of History, with the aim of inspiring staff to talk about their subject and the difficulties they encounter in teaching it, as a springboard and precursor to creative discussion and sharing of appropriate teaching strategies’ rather than identify threshold concepts (pp. 72-3). *</td>
<td>integration of knowledge and understanding  ○ ‘to guide students and construct links between areas of the course material’ (p. 80)</td>
<td>Interventions / Strategies:  - Process of learning history: the development of historical imagination  ○ ‘counter-factual approach in which students are expected to think in new ways’ such as getting students to think about what may have happened if a particular part of history did not occur (p. 81)  ○ Use of role plays where students’ ‘model historical ways of thinking, together with some critical analysis’ (p. 81).  - Process of learning history: the integration of knowledge and understanding  ○ Use of discussion to explain the links.  - Content: difficulties posed by numerical data  ○ Use of discussion and illustrating with the use of...</td>
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<td>Sendziuk (2012) Australian study</td>
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<td>Discusses 2 threshold concepts and another threshold concept suggested by the author of this paper.</td>
<td>Not identified.</td>
<td>Threshold concepts: 1. 'The need to engage with the past on its own terms*; and 2. To contextualise and interrogate sources of historical evidence* (p.1) 3. 'Why is history important? ***(p. 2)</td>
<td>Discussion of the literature in history and a previous study completed by other authors. Also provides a recollection of the course the author teaches in and the strategies he used to help students engage with the past, contextualise evidence from history and to understand the importance of history.</td>
<td>an example. The authors believe this is a new approach to professional development that starts with discussion and identification of troublesome areas of a course, followed by the aims / intentions and then the strategies used to deal with the difficult areas.</td>
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APPENDIX 2 – Ethics Approval

Ref: Ethics Appl. 752

Tuesday, December 16 2008

Sonia Magdziarz
School of Accounting & Law
Building 108, Level 15

Dear Sonia,

I am pleased to advise that your application for ethics approval for a Research Project has been approved by the Chair of the Business Portfolio Human Research Ethics Sub-Committee. Approval has been granted for the period from 15 December 2008 to 31 August 2015.

The RMIT Human Research Ethics Committee (HREC) requires the submission of Annual and Final reports. These reports should be forwarded to the Business Portfolio Human Research Ethics Sub-Committee Secretary. Annual Reports are due in December for applications submitted prior to September the year concerned. I have enclosed a copy of the Annual/ Final report form for your convenience. Please note that this form also incorporates a request for extension of approval, if required.

Best wishes for your research.

Yours sincerely,
APPENDIX 3 – Cousin Document

Section 1: Introduction to threshold concepts

An introduction to threshold concepts

Glynis Cousin, Higher Education Academy

Introduction

The idea of threshold concepts emerged from a UK national research project into the possible characteristics of strong teaching and learning environments in the disciplines for undergraduate education (Enhancing Teaching-Learning Environments in Undergraduate Courses - http://www.strp.org). In pursuing this research in the field of economics, it became clear to Erik Meyer and Ray Land (2003, 2005, 2006), that certain concepts were held by economists to be central to the mastery of their subject. These concepts, Meyer and Land argued, could be described as 'threshold' ones because they have certain features in common. The purpose of this brief piece is to outline these features and to point to the distinctive value of a threshold concept approach for curriculum design.

Overcoming the ‘stuffed’ curriculum

If we want to develop an understanding of the pedagogy of the subject we teach, we have to start somewhere and making sense of what seems central and often difficult to grasp by most learners, is a good place to begin our inquiry. A tendency among academic teachers is to stuff their curriculum with content, burdening themselves with the task of transmitting vast amounts of knowledge bulk and their students of absorbing and reproducing this bulk. In contrast, a focus on threshold concepts enables teachers to make refined decisions about what is fundamental to a grasp of the subject they are teaching. It is a ‘less is more’ approach to curriculum design.

Recognising threshold concepts

So how do we recognise threshold concepts? Meyer and Land present five key characteristics of a threshold concept:

1. Grasping a threshold concept is transformative because it involves an ontological as well as a conceptual shift. We are what we know. New understandings are assimilated into our biography, becoming part of who we are, how we see and how we feel. To illustrate, Meyer and Land (2006, p.3) give the example of a cook who comes to realise that understanding the concept of physics of heat transfer as a function of temperature gradient is key to the chef’s art. ‘Imagine’, they wrote ‘that you have just poured two identical cups of tea; you want to cool down one as quickly as possible, you add milk to the first cup immediately, wait a few minutes and then add milk to the second’. Intuitively, you might think the first cup will be the cooler but it is the second because ‘in the initial stages of cooling it is hotter than the first cup with the milk in it and it therefore loses more heat because of the steeper temperature gradient’. Once this principle is understood, trainee chefs will shift their attention from ingredients to the pots and pans selected for particular dishes. This kind of ‘turn’ in understanding a subject marks an important initiation into any subject culture.

2. A threshold concept is often irreversible; once understood the learner is unlikely to forget it (this does not exclude subsequent modification or rejection of the concept for a more refined or real understanding). One of the difficulties teachers have is that of retracing the journey back to their own days of ‘innocence’, when understandings of threshold concepts escaped them in the early stages of their own learning.

3. Another characteristic of a threshold concept is that it is integrative in that it exposes the hidden interrelatedness of phenomena. Mastery of a threshold concept often allows the learner to make connections that were hitherto hidden from view.

4. A threshold concept is likely to be bounded in that ‘any conceptual space will have terminal frontiers, bordering with thresholds into new conceptual areas’ (Meyer and Land, 2006, p.6). One important caution is to be aware that a threshold concept can be a form of disciplinary property and as such, its presentation in a curriculum may carry an inherent tendency to invite congealed understandings. This implies a curriculum design perspective that aims for a research-minded approach to mastery in which there is always space for questioning the concept itself. An essentialist reading of threshold concepts is best resisted by sustaining a sense of their provisional explanatory capacity.

5. A threshold concept is likely to involve forms of ‘troublesome knowledge’. David Perkins defines this as ‘that which appears counter-intuitive, alien (emanating from another culture or discourse), or seemingly incoherent’ (in Meyer and Land, 2003, p.7). From this view, mastery of a threshold concept can be inhibited by the prevalence of a ‘common sense’ or intuitive understanding of it. Getting students to reverse their intuitive understandings is also troublesome because the reversal can involve an uncomfortable, emotional repositioning.

In my own work (Cousin, 2006) I have explored some of the emotional issues that make learning troublesome since it is important to temper the implicit suggestion in the idea of a threshold concept that the difficulty of its mastery inheres in the concept itself. While this is very often the case, we need to be aware that this difficulty cannot be abstracted from the learner or the social context. In this relation, the idea of liminal states provides a useful metaphor to aid our understanding of the conceptual transformations students undergo, and the difficulties or anxieties that attend these transformations.

Liminal states

Meyer and Land (2006, p.22) suggest that learning involves the occupation of a liminal space during the process of mastery of a threshold concept. This space is likened to that which adolescents inhabit - not yet adults; not quite children. It is an unstable space in which the learner may oscillate between old and emergent understandings just as adolescents often move between adult-like and child-like responses to their transitional status. But once a learner enters this liminal space, she is engaged with the project of mastery unlike the learner who remains in a state of pre-liminality in which understandings are at best vague.

The idea that learners enter into a liminal state in their attempts to grasp certain concepts in their subjects presents a powerful way of remembering that learning is both affective and
mastery of a threshold concept can be inhibited by the prevalence of a ‘common sense’ or intuitive understanding of it.

4. Recursiveness and exercusiveness
It is not novel to point out that learning is a recursive process but in the instance that there needs to be a number of ‘takes’ and looping back on the conceptual material to be grasped, the threshold concept perspective refreshes the critique of a simplistic, linear, learning outcomes approach. “We would argue, similarly” write Land et al. (2004, p. 202), “for the notion of learning as exercusiveness, as a journey or excursion which will have intended direction and outcome but will also acknowledge (and indeed desire) that there will be deviation and unexpected outcomes within the excursion; there will be digression and revisiting (recursion) and possible further points of departure and revised direction. The eventual destination may be reached, or it may be revised. It may be a surprise. It will certainly be the point of embarkation for further excursion.”
In short, there is no simple passage in learning from ‘easy’ to ‘difficult’; mastery of a threshold concept often involves messy journeys back, forth and across conceptual terrain.

Conclusion
In introducing the idea of threshold concepts, I have tried to show that attention to what might be difficult, emotionally and conceptually, in any subject area will allow teachers to develop a focus for their teaching. There is growing international interest in the explanatory and practical potential of the threshold concept perspective and I hope I have given enough of a taster to prompt readers to explore the relevant literature.

References

Dr. Glynnis Cousin
Glynnis.Cousin@heacademy.ac.uk
Senior Adviser, Higher Education Academy, York Science Park, Innovation Way, York YO10 5BR.

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APPENDIX 4 – Spreadsheet for Interview Contacts

Note: Identifying information has been removed.
APPENDIX 5 – Participant Details for Date of Interview

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APPENDIX 6 – List of Interview Questions

Are there any concepts in the financial accounting stream that you have found DIFFICULT to convey to students (and/or your students find them difficult to understand)?

- With the assumption that the students are doing the work asked of them and they do not have any major learning difficulties.

If several are suggested, which concepts present the most difficulty?

For each of the concepts identified:

- Why do you think this concept is difficult to teach and/or students find difficult to understand?
- Is the concept identified integrated with other concepts and/or other knowledge?
- Does the concept identified have a boundary/border where it then leads to a new threshold concept/new conceptual area?
- Do you believe it is possible for students to ‘unlearn’ the concept/s?
- What strategies have you used in lectures/ tutorials to teach this concept?
- How do you know whether a concept has been grasped by a student?
## APPENDIX 7 – List of Codes and Definitions

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Other Definitions:

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<tr>
<th>Tacit knowledge (Perkins)</th>
<th>Knowledge not explicitly identified, taught or learnt; understandings in community of practice but often not explained or exposed to novice or newcomers. Knowledge that educators frequently neglect to teach because educators are not aware they use the knowledge, or find it difficult to identify.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inert knowledge (Perkins)</td>
<td>Learner has knowledge but not actively associating it with their world. Abstract knowledge without context or application.</td>
</tr>
<tr>
<td>Ritual knowledge (Perkins)</td>
<td>Routine nature but needs to be more meaningful for a student to engage with it. Habitually used without understanding.</td>
</tr>
<tr>
<td>Conceptually difficult knowledge (Perkins)</td>
<td>Ritual knowledge and misunderstanding (student has ritual responses but intuitively, their beliefs / interpretations are discovered when confronting qualitative problems. Often counter-intuitive.</td>
</tr>
<tr>
<td>Troublesome language</td>
<td>Language taken for granted by academic</td>
</tr>
<tr>
<td>Foreign (alien) knowledge (Perkins)</td>
<td>Foreign knowledge conflicts with own knowledge. Requires different way of thinking from that familiar to students.</td>
</tr>
<tr>
<td>Interdisciplinary concept (M&amp;L)</td>
<td>Prior concepts now difficult in a different discipline</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>Fear of uncertainty (Baillie &amp; Johnson, 2008, p.137-138)</td>
<td></td>
</tr>
<tr>
<td>Discipline language (M&amp;L)</td>
<td>Language that creates a particular way of seeing/thinking in a discipline.</td>
</tr>
<tr>
<td>Transformative</td>
<td></td>
</tr>
<tr>
<td>Language</td>
<td>Extended understanding of discipline language</td>
</tr>
<tr>
<td>Links</td>
<td>Understand concept links</td>
</tr>
<tr>
<td>Reasoning</td>
<td>Academically reason and present to others</td>
</tr>
</tbody>
</table>
APPENDIX 8 – Individual Cognitive Maps

PARTICIPANT 1

Difficult to go back to their “natural” way of thinking

Student’s own experience put barrier there

They find it easier to accept Bal sheet/income statement

Not just an end product; but also input to decision making

Indoctrination of emphasis on five accounting elements

Have more of an open mind to this

Purpose?

Cannot relate to their own experience of cash or budgets

Why do a balance sheet/income statement?

Purpose?

Student’s own experience put barrier there

Why businesses are doing what they’re doing

Seen as part of the “mechanics” of accounting rather than decision making tool

They find it easier to accept Bal sheet/income statement

Why you are doing what you're doing

Have more of an open mind to this

Why do a balance sheet/income statement?

Not just an end product; but also input to decision making

Confusion between expenses and liabilities

Lack of awareness

Why you are doing what you're doing

Why businesses are doing what they’re doing

Realisation that accounting language is different to personal life

Usefulness in a broader sense

Arbitrary nature of definitions

Lack of awareness

Usefulness in a broader sense

Even more difficult for grey areas

Realisation that accounting language is different to personal life

Needed to understand ratios

Once understood, frees them to explore the world, go on to the next step

Perception that accounting is numbers based

Needed to understand ratios

Once understood, frees them to explore the world, go on to the next step

Perception that accounting is numbers based

Usefulness in a broader sense

Students come in with perception that accounting is really “solid”

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Perception that accounting is numbers based

Usefulness in a broader sense
PARTICIPANT 2

Not understanding what it means to the financial statements

Language creates issues

Theory:
- Qual've characteristics
- Concepts
- Accounting standards

Conceptual framework

Duality of transactions

The way the brain operates determines understanding

DOUBLE ENTRY

GST

CONSOLIDATIONS
PARTICIPANT 3
Can do process but not understand why doing it

- Needed to do reversing entries
- Needed to do journal entries

Steps involved in manual process can be confusing

Students caught up on WHY the rules operate as they do e.g. increase in asset = debit

Wanting to attach good and bad to debit and credit e.g. debit is good, credit is bad

EVERYTHING COMES BACK TO THE
DEBITS AND CREDITS

CONCEPTUAL FRAMEWORK

- Concepts behind conceptual framework
- Why the conceptual framework exists

RECORDING PROCESS

Steps involved in manual process can be confusing

Confusion between general journal and general ledger

Use of general and/or special journals

Format of recording transaction

Posting procedures

From different journals To subsidiary ledger and general ledger
PARTICIPANT 4

Understand purpose of effects
Language important here
Difference between cash and credit transactions
At least two effects
Contradiction with real life e.g. debit bank does not mean actually going straight to bank to deposit cash
Need to understand Use increase/decrease
Contradiction with real life e.g. debit bank does not mean actually going straight to bank to deposit cash

Duality is the recording mechanism
Duality of transactions
Avoid the word 'algebra'
Keeping equation balanced
Debtor's MV Inventory
Costs v Value 3 departures from cost
Professional judgement needed

What are we trying to report?
What is a transaction?
How do businesses work?
Two effects
Debit / credit
Or, plus/minus

User approach justifies recording process
If cannot do the mechanics, difficult to exercise prof judgement e.g. expenditure
Should it go in the balance sheet or income statement???
If don't know that's possible, how do you know you have a choice

Financial reports are good starting point
Know why figures are needed
Know what figures are trying to say
Now need to learn how to produce them

To develop an accounting system, need to know what output is wanted out of system first

Accounting not a perfect physical science...just some ideas...
PARTICIPANT 5

Normal balance of an asset, etc..

Accounting equation

People just get it or don't get it!

Adjusting entries

Transaction analysis

is the base/foundation

Debit/credit

Journal entries

BASIC STUFF

Ledger accounts

Just "rules"

But students want to know "why" it's a debit or a credit

CASH FLOW STATEMENTS

Cannot rote learn; deeper understanding needed to do cash flow statement

Distinguish between cash and accrual

Need to see a bigger picture
Need to understand how it will apply in the real world
PARTICIPANT 6

Threshold = putting the whole process together in accrual accounting

Threshold = accept & understand accrual accounting

Need to understand why it's done

Accrual accounting is part of the process

To see that cash flow statement preparation is a different process

Need to understand and accept it

ACCRUAL ACCOUNTING

Process

Accounting equation

Basic accounting principles

Worksheet

Accrual accounting

Closing entries

Special journals

Financial Statements
PARTICIPANT 7

ACCOUNTING REGULATION

Definition of reporting entity

Needs of GPFRs users

Principles based approach to accounting standards

Need to see final product first e.g. rules based

Understand how it all fits together

PROCESS

Source documents

Record

Summarise

Classify

Need to understand whole process

Prior knowledge for Consolidations

CONSOLIDATIONS

Not a foundation to a further threshold concept

Completion of worksheet; not journals

Preparation of consolidated financial statements

Seeing topics as being separate

Financial statements reflecting economic reality not legal perspective

Qualitative characteristics

TAX EFFECT ACCOUNTING

Understanding of business processes in general

How a business works

Transaction cycles

Need to see bigger picture; not just technical skills

Difficult to forget broad concepts once understood; technical aspects could be forgotten
PARTICIPANT 8

But need to understand where a report comes from
Need to understand WHY we do this

Manual accounting taught even though students likely to use computerised system in future
Assists with auditing reports
Need to understand how it all fits together

Duality
Accounting jargon
Need to understand the 'impact'
Ability to work in a team
Even with people you do not like

Foreign
Foreign currency transactions
Preparation of a cash flow statement
Applying different particular accounting standards
Accounting for assets

Foreign
Bank statement in their minds causes confusion

Debits & credits
Impact on equity of revenues and expenses
Balance sheet & Income statement

Accounting elements eg, what is an asset
Everything flows from the foundation

Understanding brings on the a-ha moment for some students
Normal balance of accounts
Specific accounts

How they work together

Ethics is also important

Need good attention to detail, wishing/wanting to know/thinking outside the box/challenging what they've been told...results in them knowing/learning more

Analogy of a train ride...“accounting is very much like a train ride. It gets on very quickly and then it just gets up steam and we just keep on going... so if you don't get the first one or two, three weeks, then you're going to miss out on everything in the end because everything is based on the first couple of weeks” p.14

Students taught basics in university and then continue learning through professional associations and working in the real world

Students taught basics in university and then continue learning through professional associations and working in the real world
PARTICIPANT 9

In time standards will change to fit framework

Standard overrides f/work

Inconsistency between accg standard and framework

Reason that accounting is very integrated

Everything hangs on that

Principles based approach

Students struggle with; prefer rules based

CONCEPTUAL FRAMEWORK

ACCOUNTING ELEMENTS

Definitions

Recognition criteria

Different meanings

Depreciation

Allowance for doubtful debts

Recognition criteria

Depreciation

Allowance for doubtful debts

ACCOUNTING ELEMENTS

Debits & Credits

Need to learn early

Learn mindlessly

Bank statement causes confusion

Then concentrate on WHY a change occurs; not HOW to change it

WHOLE WORLD MODELLED ON 3 ELEMENTS

ASSETS

Difference between cash and accrual

LIABILITIES

difficult

EQUITY

REV, EXP

AS SUBSETS OF EQUITY

Need to learn early

ACCRUAL ACCOUNTING

Getting stuck on why the rules are the way they are causes problems

Example: Capital

Geography context major city

English context uppercase letter at start of sentence

Finance context shares

Being good at maths does not necessarily mean you will be good at accounting

Need to be good at seeing patterns in numbers - can look at income statement and balance sheet and see relationships

Some of the terms used in accounting are common English terms but have different meanings in an accounting context*

Apart from equity which students not likely to have exposure to but different meanings still an issue

* requires a shift in thinking
PARTICIPANT 10

Accrual accounting permeates everything

Posting to General Ledger

General Journal

Debits & credits

What an account looks like

Income statement, balance sheet

Income statement, balance sheet

Impact on accounting equation

Movement between cash accounting and accrual accounting troubles students

Not realising that the same sort of information is used for cash and accrual

Seems easy to students once they get it

Integration across different topics for most of the degree

Sometimes too focused on process rather than WHY you are doing something, WHO are you preparing this information for?

Need to understand the purpose of accounting

BASIS UNDERSTANDING OF RECORD KEEPING

CASH FLOW STATEMENTS

BALANCE DAY ADJUSTMENTS

Bad & doubtful debts

Need to understand why we have accounting periods

Having two alternatives causing confusion

Balance sheet approach

Income statement approach
PARTICIPANT 11

Comes down to 5 elements

Tending to worry more about the mechanics of where things are going rather than the theory behind how things such as heritage assets, biological assets, extractive industries are measured

Accounting equation

Double entry is extension of accounting equation

Journals

Debits & credits

Separate entity concept

In Financial Statements

Appreciate relevance of equity

BUILDING UP A PROCESS... WHAT ARE THE ELEMENTS AND HOW ARE THEY MEASURED?

Impact on profit of different valuation methods

Accruals concept

Measuring for accounting period & accruals

Timing is the issue

Deferred tax liability & deferred tax asset

Consolidated accounts

TAX EFFECT ACCOUNTING

Inventory

Measuring for accounting period & accruals

Deferred tax liability & deferred tax asset

Difference measurement

Accounting Taxation

MEASUREMENT

of profit of assets & liabilities

Impact on income statement and balance sheet

Very full curriculum with a lot to cover in short space of time...not sure if emphasis is right in getting students to understand double entry accounting

CONSOLIDATED ACCOUNTS

Consolidated accounts prepared using spreadsheet; accounts NOT adjusted in books of individual companies

Inter-entity trading; Control v ownership intergroup transfers

Eliminations from group perspective

Some structures are complex

Major hurdle for students to get over
PARTICIPANT 12

**ACCOUNTING LANGUAGE**

- Need to break it down
- Knowledge of accounting standards
- Accounting equation
- Accounting rules in Australian context
- Transaction analysis rules
- Debit/credit rules
- Need to understand not memorise
- Effects of transactions on elements
- Identity them
- Know what they mean
- Complex accounting system but all comes down to 5 accounting elements
- Unpack it to the foundation and show them the links
- Knowing the differences between accounting profit & taxable profit
- Understand impact on other financial years
- More complex than double entry

**BUSINESS ENVIRONMENT**

- Impact on reporting
- Then can be applied in any context
- Need to understand every concept
- This links to every stage of their learning
- Need to make students "think"
- Relate to what they might encounter in their daily lives
- Language of accounting
  - Not like students’ everyday language
- Technical aspects
  - Deferred tax assets
  - Deferred tax liabilities
  - Adjustments
  - Changes in tax rates
  - Terminology
    - Used in accounting
    - Different for different disciplines
  - Unpack into simple terms
    - Eg. "cost" has different meaning in economics and accounting

**TAX EFFECT ACCOUNTING**

- Develop their level of thinking
- Difference in tax rules v accounting rules
- Need to visualise what has happened for accounting profit to be what it is

**DOUBLE ENTRY ACCOUNTING**

- Accounting language
- Business environment
- Knowledge of accounting standards
- Need to understand in any context
- This links to every stage of their learning
- Need to make students "think"
- Relate to what they might encounter in their daily lives
- Language of accounting
  - Not like students’ everyday language
- Technical aspects
  - Deferred tax assets
  - Deferred tax liabilities
  - Adjustments
  - Changes in tax rates
  - Terminology
    - Used in accounting
    - Different for different disciplines
  - Unpack into simple terms
    - Eg. "cost" has different meaning in economics and accounting
It all makes sense

Need to understand what is happening around you

Need to think like an accountant and not everyone can do this

In accounting, the penny will drop

Would happen in other disciplines too

Need to keep an open mind and see that past prejudices might get in the way of their learning

Realising that accounting is dynamic

You either get it or you don't

Think like a professional

Problem solving, critical thinking, eye for detail, being comprehensive

To be a professional

Way of thinking

You either naturally like it or you don't and therefore have to work really hard at it

Need to have debits & credits

Go to the 'bank' account and take it from there

Relationship between set of financial statements and how the statements come together

Only intuitive once you have actually done a set of books; for client, own business, employer

Most challenging part
PARTICIPANT 14

Foreign word and foreign concept; means nothing to students

Need to know why it's done

Always wanting the "right" answer

Underpins everything

No boundary

Profit

what is it? where does it go?

Idea of balance sheet

Accounting equation

what is position?

Idea of the balance sheet

Complexity means learning new things all the time; "staircase" analogy

Needed to do impairment, revaluations, tax effect accounting, consolidations

Linked to

ACCRUAL ACCOUNTING

Paradigm shift

Includes balance day adjustments

Accepting that you have to account for something that you haven't received a bill for yet

Underpins everything

Complexity means learning new things all the time; "staircase" analogy

Required to do impairment, revaluations, tax effect accounting, consolidations

No boundary analogy accounting, consolidations

Profit

what is it? where does it go?

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what is it? where does it go?

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Accounting equation

what is position?
"It is interesting, because you realise that, to teach even the most basic concept they've got to have an understanding of really, all the interrelations and all the links." (p.11)

"It's not the concepts themselves that is maybe difficult. Maybe it's the relationship between them. It's those linkages." (p.11)
APPENDIX 9 – Combined Cognitive Maps

DOUBLE ENTRY COMBINED
- Explaining analysis of entry as it is recorded
- Format of recording transaction
- Confusion between general journal and special journals
- Making accounting different to other disciplines eg. marketing, HR, economics, finance
- Bank statement in their minds
- Understanding brings on the a-ha moment for some students
- Transaction analysis
- Source documents
- Record
- Summarise
- Classify
- Trial Balance
- Reports
- Double entry is extension of accounting equation
- Ledger accounts
- Double entry combined

ACCOUNTING PROCESS (7)
- Basic understanding of record keeping (10)
- Double entry bookkeeping (11)
- Double entry accounting (12)
- Accounting standards
- Accounting jargon
- Need to understand the impact of accrual accounting
- It takes time
- Language creates issues
- Then can be applied in any context
- "Basic stuff" is the base/foundation
- Appreciate relevance of equity
- Need to make students "think"
- Relate to what they might encounter in their daily lives
- Tending to worry more about the mechanics of where things are going rather than the theory behind how things such as heritage assets, biological assets, extractive industries are measured

FOUNDATION (8)
- Double entry (2)
- Recording process (3)
- Accounting process (7)
- Basic understanding of record keeping (10)
- Double entry bookkeeping (11)
- Double entry accounting (12)
- Accounting rules in Australian context
- Accounting rules in foreign
- Impact on reporting
- Conceptual framework
- Accounting elements
- Adjusting entries
- Accounting standards
- Basic characteristics
- Need to understand the impact of accrual accounting
- Not understanding what it means to the financial statements
- Separate entity concept
- Need to understand every concept
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DOUBLE ENTRY (2)
- Recording process (3)
- Accounting process (7)
- Basic understanding of record keeping (10)
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- Accounting rules in Australian context
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APPENDIX 10 – Post-It-Notes on Whiteboard
APPENDIX 11 – Analysis Breakdown Sample

Potential threshold concept: DOUBLE-ENTRY

ID of TC

IV2:

INT: [gap] Um…well, I think always, um, even though they have knowledge of, they do a little bit of it initially I think some of them still struggle a bit with double-entry. So um you know duality of every transaction I think they still, some of them have got a background from

IV3:

INT: Well even the steps involved in the recording process, there’s a lot of steps and I think what makes it hard is, like, you know, in prac, you know, in practice, you’re not, like we’re trying to say okay the first thing you need to do is get your source documents, record it into the journals but a lot of companies nowadays do everything on computer, you’ve only got the general journal so they’re not getting special journals so the kids are confused it’s like you know the steps involved there are so many steps you know if you’re using special journals then you’ve got to go to the subsidiary ledger and then you’ve got to do, that’s quite time confusing to keep going through that process of picking out those, the steps and you know … you’re side tracking you’re not just doing, okay, here’s the transaction and put it into the journals, you also have to think about okay does this have … should I go … if it’s in the general journal then I need to immediately put it in the ledger, if it’s in the cash receipts journal if it’s in the other column then I have to then also do it in the ledger and you know, has it got a subsidiary ledger attached to it and ...

IV3:

INT: Yeh it’s all linked together type of thing so you know if you’re not understanding debits and credits when we do it in topic 2 when I get you to do you know show the opening journal entry for a partnership you know even some of them you know, another concept is journals, the general journal and the general ledger, they can’t, some of them just can’t get that. You ask them to show you know show me the general journal and they actually give you the general ledger and they show you the balance, you know, type of thing. I don’t know and even things like having credit entries first instead of doing debit entries first I mean that can vary it’s not rare but I have a few a semester but just to show you that some people just can’t you know get into that type of way of …