

Issues Surrounding Threshold Concepts in Research Methods and Statistics

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Abstract

Among all the courses students take during their higher education, which one would receive the highest number of votes for super-boring, ultra-difficult, and most anxiety producing? The hearsay evidence gathered should put Research Methods and Statistics course at the top of the list. Kyei-Blackson (2009) posits that many students perceive Statistics to be difficult, unpleasing and boring. Ball & Pelco (2006) highlight that Research Methods courses are challenging to teach and learn because of the technical complexity of the course material and the fact that students' interest in this material can unfortunately be quite low. These findings are consistent with research showing that students' interest in research declines as a result of taking a Research Methods course, and the assertion that learning it does not equate with positive feelings about them (Holmes and Beins, 2009, in Sizemore & Lewandowski, 2011). Teachers of Research Methods and Statistics courses may assume that the students would react more positively if the concepts were placed in an applied or clinical context. However, it is equally possible that students have little interest in this course regardless of the context (Sizemore & Lewandowski, 2011). It is further suggested that if teachers of Research Methods & Statistics want to increase students' interest, and not just their knowledge, it may be advisable to use more clinical and applied examples. One of the reasons why such a discipline is so difficult for the students is the existence of what Perkins (2006) calls threshold concepts, most of which are considered as troublesome knowledge, hence proving difficulties to teach and learn, by both teachers and students.

Key Words: *Thresholds concepts, Liminal space/state, Conceptual space, meaning frame, Ontology, troublesome knowledge, Terminal frontiers, threshold space, pedagogy, precursor concepts.*

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I. Introduction

Schwartzman (2010) posits that the analytic framework used in thresholds concepts research maintains that there are particular concepts in a given discipline which cannot easily be assimilated or accommodated within one's existing meaning frame. Any aspect of the term, no matter how familiar, may suddenly present an unexpected and incomprehensible problem. To accommodate such new and troubling knowledge will require a difficult reconceptualization and a reformulation of one's meaning frame. According to him, a meaning frame is 'an orienting frame of reference' in and through which we are able to make meaning. It is 'a structure of assumptions within which one's past experience assimilates and transforms new experience, a habitual set of expectations' (p. 30). Such structures, 'embody the categories and rules that order new experience, shaping how we classify our encounters with the world: what we take in and how we act. According to Meyer & Land (2005), the reformulation of such a powerful frame will clearly also effect a shift in the learner's subjectivity. It gives rise to a state of uncertainty in which the learner, may oscillate between old and emergent understandings (Cousin, 2006, p. 4). Learning threshold concepts is often the point at which students experience difficulty and are often troublesome as they require a letting go of customary ways of seeing things. This entails a very uncomfortable ontological shift, as, in many respects, we are what we know. Hence the super-ordinate and non-negotiable characteristic of a threshold concept is its transformative capacity. Such concepts seem to have an integrating function in the sense that they bring what formerly appeared to be disparate elements into a coherent relationship, much as the addition of a particular jigsaw piece may bring other pieces together to provide a new and meaningful perspective. One's understanding of the above is that it is not easy to master threshold concepts as the brain has to process everything. Hence mastering of such concepts is not an event but a process.

Threshold concepts

The idea of threshold concepts came about through discussions with university teachers of Economics as part of the ETL project (2005), a major investigation into teaching and learning in four contrasting subject areas.

Among the array of concepts to which students are introduced within undergraduate degree courses, like Bachelor of Education, some seemed to have powerful influences on their subsequent learning. Most of these are seen by both staff and students as troublesome knowledge (Perkins, 2006), proving difficult both to teach and to learn, but once understood, they have an important transformative effect on students' understanding. Meyer & Land (2003) described them as 'threshold concepts', with the notion of 'opportunity cost' in Economics being a particularly clear example. So just like 'opportunity cost' in Economics, level of significance/ significance level, standard deviation, variance, to mention just these in Statistics can be such concepts, conceptual/theoretical framework, research design, validity and reliability in Research Methods. People then refined the description of threshold concepts further by recognizing that, as conceptual gateways' into more advanced ways of thinking about topics and subject areas, they are by definition transformative, irreversible (unlikely to be forgotten, or unlearned only through considerable effort) and integrative (exposing the previous hidden interrelatedness of something). It was also suggested that the new 'conceptual space' opened up by such transfigured thought is in turn bounded, possessing terminal frontiers, bordering with thresholds into new conceptual spaces. (Meyer & Land, 2005, pp. 373-374). A threshold concept can be likened to a portal, opening up a new and previously inaccessible way of thinking about something. It represents a transformed way of understanding, interpreting, or viewing something without which the learner cannot progress. (Meyer & Land 2003, p.1) The threshold concept theory argues that in each academic discipline there exists concepts that, once grasped, allow new and previously inaccessible ways of perceiving and thinking about the subject to emerge (Meyer & Land, 2003). There are points in learning threshold concepts at which students experience difficulty because mastering these requires letting go of usual ways of seeing and thinking about subject matter (Meyer & Land, 2005, 2006).

Debate on threshold concepts

The search for threshold concepts can create a form of 'transactional curriculum inquiry' (Cousin, 2008). There is no consensus on whether threshold concepts could be found in every discipline; whether they should be thought of as concepts, competencies, or experiences; or whether they constitute a single entity or a cluster of interconnected competencies.

Thinking about and identifying these concepts in one's discipline is 'easier' and more productive when discussing the existence of and the nature of potential threshold concepts with lecturers from different disciplines. Based on findings from teaching, lecturers can refine their definition of what a 'threshold' is in their courses, and some can revise the list of potential of such concepts in their disciplines. In particular, the Electronics Engineering lecturer developed a threshold concept inventory for use in Electronics Engineering (Scott, Harlow, & Peter, 2014). One of the themes that emerged at the start of the study, and continued to be reflected throughout was the significance of the students' experience of encountering these concepts. This finding resonates with Land (2011) who observed that identifying the source and nature of the conceptual or other difficulties experienced by students can help them move from their *stuck places*. Perkins' (2006) framework of 'troublesome knowledge' has been a central facet of Threshold Concepts theory (Meyer & Land, 2003). According to him, knowledge can be troublesome because it is conceptually difficult, alien, inert, tacit, or ritual. Students' reflections on troublesome knowledge, however, suggested that this framework is missing at least one essential element. When seminar students wrote about their own experiences with these concepts, they universally described their learning as troublesome, but some of the most frequent words they used did not fit neatly into Perkins' categories. They often described their own learning process as 'stressful,' 'debilitating,' 'frustrating,' and 'intensely emotional'. They reported that they were 'shocked,' 'upset,' 'hopeless,' and 'very anxious'. In all three seminars they consistently used at least some emotional language to explain their encounter with troublesome knowledge. The difference between scholars and students in this case seemed to be one of perspective. After hearing a number of peer's recount stories of their own encounters with these concepts, one student seminar participant observed: *'One thing that I have noticed is that threshold concepts are not just about knowledge, they also are about confidence'*. Reflecting on their own encounters with these concepts, many of them noted that their learning could not be disentangled from their sense of confidence related to that learning. Because these concepts are difficult to master and are troublesome, the learning process is characterized by struggle and difficulty. McGrane (2013) describes her students' narratives of these concepts as an experience with 'punctuated equilibrium, we climb, we plateau, we slip, we plateau, and we climb again'.

Repeatedly in the seminar, students emphasized that crossing a threshold involved both mastering the concept and also feeling comfortable in their new knowledge.

This common student perspective echoes research by Strayhorn (2012) on the importance of an undergraduate student 'sense of belonging' for learning. He defines belonging as 'the experience of mattering or feeling cared about, accepted, respected, valued by, and important to the group'. To permanently cross a threshold, these students insisted, they needed to believe that they belonged to the other side. Threshold concepts are disciplinary (Meyer & Land, 2013). In all the seminars, students expanded the definition of these

concepts to include learning that reached across or beyond academic disciplines. However, they found these concepts so useful as a tool for reflecting on their own learning that they resisted bounding it within disciplines. This means that some concepts are interdisciplinary and not confined to a particular discipline.

Liminal space/state

Thresholds create a state of 'liminality', a space and/or time of transformation from an earlier understanding, to a new, required state which "entails a shift in the learner's ontology or subjectivity". Schwartzman (2010) states that liminality is viewed as a transformative state in the process of learning in which there is a reformulation of the learner's meaning frame and an accompanying shift in the learner's subjectivity. The liminal state entails an envisaging (and ultimate accepting) of an alternative version of self, contemplated through the threshold space. Blackie, Case & Jawitz (2010) portray this as the learner's 'emergent being'. It is argued that The Threshold Concepts Framework - with its emphasis on transformation through troublesome knowledge and shifts in subjectivity - can be considered as a counter-discourse to the commodification of learning. Barnett (2007) said: 'The student is perforce required to venture into new places, strange places, and anxiety provoking places. This is part of the point of Higher Education. If there was no anxiety, it is difficult to believe that we could be in the presence of a Higher Education' (p. 147). Since the inception of threshold concept theory many researchers in this field have focused on identifying threshold concepts using the attributes identified by Meyer & Land (2003). According to Meyer & Land (2003), after initially encountering threshold concepts, students may spend time in a 'liminal' state before crossing the threshold to deep understanding.

The pedagogy of threshold concepts

A study on teaching and learning of hard-to-learn threshold concepts was carried out in first-year Electrical Engineering, leadership, and in Doctoral writing courses. This was envisioned to produce disciplinary case studies that lecturers could use to reflect on and refine their curriculum and pedagogy, thereby contributing to discussion about the relationship between theory and methodology in Higher Education research (Shay, Ashwin, & Case, 2009). A team of seven academics investigated lecturers' awareness and emergent knowledge of threshold concepts and associated pedagogies and how such pedagogies can afford opportunities for learning. The lecturers also explored the role of threshold concept theory in designing curricula and sought to find the commonalities in these concepts and their teaching and learning across the four disciplines. The research highlighted new ways of teaching these concepts to help students learn those that are fundamental to the disciplines they are studying and expand their educational experiences. Given that much of the international research in this field focused on the identification of these concepts and debates their characteristics exploration of what happens when lecturers use this theory to re-envision their curriculum and teaching helps to address a gap within the field, say Barradell, 2013, Callaghan, Baldock, & Meyer (2013).

By addressing an important theoretical and practical approach the study made a considerable contribution to teaching and learning at the tertiary level in general and to each discipline, like Research methods and Statistics, in particular. Their collaborative examination of the structure of their various disciplines and the curriculum and pedagogy made a substantial impact on what and how lecturers taught, and assessed students' understanding of these concepts. In searching for strategies to foster and monitor students' progress in learning, the lecturers developed new pedagogical approaches and assessment instruments. They also developed the educational research skills necessary for quality teaching and establishing students as lifelong learners. They also came to recognise and acknowledge the importance of precursor concepts that learners need to have mastered before they can grasp more difficult concepts. One of the themes that emerged in the four disciplines under study was that of the value of knowing about student experiences and what it meant for them to be stuck. The study enabled all lecturers to become aware of the impact of their teaching on students' learning. Using this knowledge, they strove to listen and adapt their teaching to their students' needs. How fast the students mastered these concepts varied, and this emerged as a strong constraint that lecturers needed to accommodate in order to help students transition from being a novice to being a disciplinary expert. Their learning experiences and achievement supported the idea that phase transitions and their anticipatory signatures (e.g., loss of stability) are common across a broad range of complex systems and disciplines, including human learning. The focus was on variability and changes in their understanding of these concepts. Through deconstructing their curricula, lecturers experienced a phase transition in their own understanding about teaching threshold concepts. They have been linked to ontological shifts (Meyer, Land, & Baillie, 2010), changes in identity. Therefore, it is crucial to uncover why some students find it troublesome to understand and to express knowledge of these concepts even in disciplines like Research Methods and Statistics. Equally important is to determine why and how some students undergo a transformational, or even a creative, experience in the liminal space of learning. Apart from coming up with the threshold concepts the study went on to establish why some students find it troublesome to understand and to express knowledge of such concepts and equally important determined why and how some students undergo a transformational phase.

The previous study was built on earlier work in which the lecturer in the first-year Electrical Engineering course identified threshold concepts in Electronics Engineering and investigated the impact of a threshold-concept informed curriculum and pedagogy (Harlow, Peter, Scott, & Cowie, 2011; Scott, Harlow, Peter, & Cowie, 2010) on students' learning. In the same vein lecturers in Research methods and Statistics should identify specific threshold concepts so that it helps them in curriculum design and pedagogy. The University of Queensland's Occupational Therapy Department identified five threshold concepts, designed their curricula around them and flagged their importance to students by describing them in their Student Guide. In the 2014 United Kingdom Research Excellence Framework (REF) an impact case study submitted by Durham University on the impact of threshold concepts on higher education pedagogical practice worldwide was rated equal first in the UK. In the threshold concepts literature, aspects of research learning have been found to be troublesome in other disciplines, such as Taylor's (2006) work on hypothesis development in Biology and Kiley's (2009) study of research learning in Doctoral students. Seventeen nursing students were interviewed in depth about their experiences of learning about research. Learning narratives were gathered and these were analyzed using a thematic narrative analysis, specifically focusing on difficulties encountered by students.

II. Conclusion

It is a common belief that every discipline, inclusive of Research Methods and Statistics, has concepts which are difficult to master. While there still exists debates on the most appropriate term to call these concepts, this paper raised, presented and discussed such as *threshold concepts*. One of the reasons why most students label Research Methods and Statistics as a difficult and troublesome course of study is that this discipline has concepts which, *allegedly* or *supposedly*, have always given problems to both teachers and students alike. It, however, should be understood that mastering of these concept is not an event, but a process which takes place in the brain. During the mastery of these threshold concepts, one has to go through what is called the liminality space or state, a time of transformation from an earlier understanding, to a new, required state which 'entails a shift in the learner's ontology or subjectivity. Institutions take note of the ontology of these threshold concepts during curriculum development of any discipline, including that of Research Methods and Statistics.

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