CONCEPT MAPPING AS A TECHNIQUE FOR SCAFFOLDING CONCEPT LITERACY IN ACCOUNTING: THE CASE OF AN EXTENDED PROGRAMME

by

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Abstract

While great strides have been made to improve accessibility to higher education in South Africa, the educational excellence that is required to build a strong economy remains elusive, as evidenced by low throughput numbers. Research suggests that students' lack of conceptual understanding might be at the heart of the problem. This study investigates the value of concept mapping as a scaffolding technique to improve conceptual understanding. Postpositivism served as the epistemological framework for the research. The quantitative dimension involved a quasi-experiment with a test and a control group, whereas the qualitative dimensions included questionnaire responses and observation. It was hypothesised that Accounting students in an extended programme who were introduced to the concept mapping technique would have an improved grasp of Accounting concepts, as would be indicated by an improvement in their marks when completing an explantory paragraph of Accounting concepts after the intervention. Qualitative data on students' experience of using visual aids, and concept mapping in particular, were also analysed. Students' post-intervention marks of the test group showed no improvement, and therefore no proof can be offered to support the claim that concept mapping improves conceptual understanding. An analysis of students' attitudes towards concept mapping did, however, show enthusiam for the technique. Limitations of the study included the absence of a pilot study and the time required to become familiar with concept mapping. An unforeseen constraint on the study was the low student participation.

Key words: concept mapping, concept literacy, throughput, scaffolding, Constructivism, rote learning, meaningful learning, visual aids, core concepts, extended programme

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Chapter 1: Introduction

1.1 Aim of the research

The purpose of this study is to investigate the effectiveness of concept mapping as a scaffolding technique in students' acquisition of concept literacy in an Accounting course. The research is based on the premise that the multimodal nature of concept maps allows students a deeper conceptual understanding of subject-specific terms than linear, text-based strategies on their own.

Concept mapping, based on Ausubel's Assimilation Theory, is a learning tool that was designed by Novak (2002) to mirror the knowledge or cognitive structures created in the mind of the learner when assimilating new concepts with prior knowledge (Leauby, Szabat & Maas, 2010:281; Novak & Cañas, 2008:7; Simon, 2007:274; Safayeni, Derbentseva & Cañas, 2005:2; Maas & Leauby, 2005:76 & 79; Carnot, Feltovich, Hoffman, Feltovich & Novak, 2003) and to make such knowledge explicit (Novak, 2010:111; Simon, 2007:274).

1.2 Introduction to the chapter

This chapter discusses the ongoing problems of access and underpreparedness of university students, and how it affects throughput, despite the many interventions available. The initial attempts at offering a solution to the problem of throughput will be discussed briefly. From this discussion, the importance of mastering core concepts in core disciplines as a factor vital to success will emerge. As will be seen, studies that have attempted to improve concept literacy have had limited success so far. These studies made use of a variety of means (Jonker, 2016; Madiba, 2014; Gablasova, 2012; Paxton, 2009), including the use of concept mapping across various disciplines, such as Religion (Pui-lan, 2010), Health (Brennan, Brownson, Kelly, Ivey & Leviton, 2012), Nursing (Clarke, 2015), Biology (Kinchin, 2000) and Accounting (Leauby *et al*., 2010:287; Simon, 2007; Maas & Leauby, 2005).This explains the rationale for the present study. The chapter concludes with the research questions and hypotheses of the study, and a preview of the chapters that are to follow.

1.3 Context and rationale

1.3.1 Access and underpreparedness in South African Higher Education

The global objectives of access and excellence in higher education (Beckham, 2000:15) are of particular significance for South Africa given its problematic background, as these objectives need to be aligned, on the one hand, with rectifying the injustices of the past (Volbrecht & Boughey, 2004:58), and the need to be competitive internationally, on the other (Novak, 2010:22). Since 1994, the objective of equality in access to higher education (CHE, 2013) has been the focus of Higher Education in South Africa, as can be seen in numerous policy documents, including the *Education White Paper 3* (Department of Education, 1997), *National Plan for Higher Education* (Ministry of Education, 2001), *Strategic Plan 2011-2015* (Department of Higher Education and Training, 2010) and *Revised Strategic Plan 2010/11-2014/2015* (Department of Higher Education and Training, 2011). This move was particularly aimed at redressing the disparities that existed in the country before the establishment of democracy (Badsha & Harper, 2000:27).

There has been an increase of 80% in Higher Education participation since 1994 to a total of more than 900 000 enrolments by 2010 (CHE, 2013:39). More significantly, towards the end of the 1990s, large numbers of Black students were enrolling in previously White only institutions (Badsha & Harper, 2000:28), with Black students making up almost half of the total number of students at the University of Cape Town by 2004 (University of Cape Town, 2017). Black students made up 79% of the total enrolment across the sector by 2010 (CHE, 2013:39). At present, approximately 50% of the students at the University of Pretoria is Black (*Bureau: Institutional Research & Planning*, 2016), 57% at the University of the Witwatersrand (2015) and 72% at the University of the Free State ([n.d.]).

However, it was soon realised that access in itself does not guarantee success, let alone the excellence in education that is the desired outcome. It is apparent that there is a vast discrepancy between the "elementary cognitive level" required at school and "higher-order thinking skills" required at university (Joseph & Ramani, 2004:238). Furthermore, university students do not have the necessary proficiency in their field of study, be it Accounting (Wilson, Abraham & Mason, 2014:56; Maas & Leauby, 2005), Chemistry (Novak, 2002:77) or Science (Norris & Phillips, 2003:235). This lack is especially noticeable with first year students (Nkomo & Madiba, 2011:155). Students who manifest these problems are considered insufficiently

prepared for tertiary education, and the term now often used for such students is "underprepared". Koh (2014:456) reports that underpreparedness has been identified as one of the primary reasons for students not completing their courses on time, if at all. It is therefore clear that underprepared students are a factor in the attainment of the dual ideal of educational success and excellence.

1.3.2 Initial attempts at a solution: extended and augmented programmes

There have been many attempts to address the problem of underpreparedness. Before the advent of democracy in South Africa, academic support was made available to the small numbers of Black students who had been allowed entrance into a university (Volbrecht & Boughey, 2004:59). Subsequently, a variety of support courses, influenced by differing philosophies, began to emerge in response to the issue of underpreparedness encountered in the larger numbers now able to access higher education, with the intention of providing equal opportunities for all (Mckenna, 2012:51; Boughey, 2010:5). As the numbers of students increased, the format of academic support, or academic development as it came to be called (Volbrecht & Boughey, 2004:63), began to take on many forms, from add-on support classes for small groups of students, to bridging or foundation courses and extended or four-year programmes, to absorption into and adjustment of mainstream courses (Mckenna, 2012:52; Volbrecht & Boughey, 2004:63), and, ultimately, "institutional transformation" (Boughey, 2010:11). Support for students who are considered underprepared has, therefore, in many cases, moved "from the margins to the mainstream" (Volbrecht & Boughey, 2004:65). However, the varied nature of educational support is a response to more than the changing face of the student body: it also forms a bridge between the ailing school system (Jonker, 2016:5) and tertiary education. Thus, some higher education institutions currently offer subject-specific academic development courses that are obligatory for all first year students.

Despite the proliferation of intervention types, the disappointing throughput rates since the introduction of the DHE's policies on wider access to higher education, in particular for previously disadvantaged students, continue to cause concern and offer evidence of the failure to intervene constructively (CHE, 2013:40). The CHE (2015) report gives the throughput rate for completion of a three-year degree in the prescribed time as 23% for Black students, 25% for Coloured students, 27% for Indian students and 43% for White students (CHE, 2015:63). It takes another three years (the degree consequently being a six-year degree) for Black student

throughput to reach 55%, for Coloured student throughput to reach 51%, for Indian student throughput to reach 61% and for White student throughput to reach 65% (CHE, 2015:63). Thus, it takes twice the minimum completion time stipulated for half of the enrolled Black and Coloured students to pass, both of which groups fall within the category of previously disadvantaged. Even though the Indian students have a higher eventual throughput (61%), two thirds of the students need six years to achieve this outcome, with only 27% passing in the prescribed minimum time.

The CHE report also shows that extended degree programmes hardly fare better, with two-thirds of the previously disadvantaged students taking six years to pass (CHE, 2015:64). In the extended programme of the University of Pretoria, where this research is based, the throughput rate in the allotted time for previously disadvantaged students shows a steady drop from 20% in 2008, which is already low, to 8% in 2011 (*Bureau: Institutional Research & Planning*, 2016). This extended programme is not exclusive to previously disadvantaged students; rather, it is open to any student who has not attained the minimum requirements to study for either a BSc or a BCom degree. It is therefore interesting to note that the pass rate for white students on the programme for the same period is not much better. The 2008 pass rate of 15% dropped to 6% in 2010 before recovering to 14% in 2011 (*Bureau: Institutional Research & Planning*, 2016). While this is higher than the pass rate for previously disadvantaged students, it is hardly indicative of success, and suggests that the problem of unpreparedness might now be wider than previously thought, at least at foundation year level. What is certain, though, is that this situation is plainly a great drain on both time and finances, and thus unsustainable.

Despite the interventions proposed in numerous Higher Education policy documents in the years since the transition to a democratic government, the educational challenges persist and we are clearly in need of alternative solutions. It is apparent that the idea of that which disadvantages a student educationally is multi-faceted, being more than simply an issue of access (Mckenna, 2012:52).

A particularly crucial issue arising from the multilingual South African context is language access (Carstens, 2015:2; Mckenna, 2012:52; Nkomo & Madiba, 2011). Some would argue that the majority of students have been sufficiently socialised in English by means of popular media; however, this language socialisation is of a non-academic nature (Boughey, 2012:144). As present research emphasises the importance of language usage in the expression of content

knowledge, the challenge, for many students, is therefore both conceptual (content) and linguistic in nature (Madiba, 2014:68; Gablasova, 2012:13).

Context-specific language links to epistemological access, the "traditions of inquiry that were developed and refined by the disciplines over time" (Jonker, 2016:5). Gajo (2007:568) sees discourse as "structured by both the subject and the linguistic paradigms, which are at the same time structured by it" and that "the process of putting subject knowledge into discourse corresponds to a process of mediation". Students new to the higher education environment are bewildered by the unspoken rules of engagement in the various university disciplines (Mckenna, 2012:58; Boughey, 2012; see also Lessard-Clouston, 2008:32). Because of the unfamiliarity of the academic context, students therefore often contextualise subject-specific information within their own, known backgrounds (Boughey, 2005; Meyer & Land, 2005:379; see also Novak, 2010:44). Novak (2010:44) goes so far as to consider students and teachers, in many ways, to be culturally "significantly different".

Unless "the gaps between the respective worlds students and lecturers draw on" are bridged, this divide remains (Boughey, 2005:240). The fact that what constitutes the discourse of a discipline is often unclear, as it is based on implicit knowledge, is a further complicating factor in the acquisition of academic literacy (Dalton-Puffer, 2011:196). At the most fundamental level, the lack of epistemological access speaks to the lack of conceptual understanding of subject-specific terminology, as a discipline is accessed through its vocabulary (Gablasova, 2012:35). Without a clear grasp of the terms that inform a discipline, all knowledge scaffolded onto a faulty conceptual understanding will be problematic.

We consequently need to look at ways of improving students' understanding of the concepts that are essential to their core subjects and not only their knowledge of appropriate terminology and, in doing so, to improve their access to the epistemologies of their chosen subject. The next section elaborates on the idea of conceptual understanding and concept literacy.

1.3.3 Challenges in mastering core concepts in core disciplines

For this discussion, it is necessary to clarify the relationship between a term and a concept. The vocabulary of general language is made up of words, whereas the vocabulary of a scientific discipline is made up of specific terms that collectively make up its 'terminology' (Alberts,

2001:76). These terms represent concepts or "units of meaning" (Croft & Cruse, 2004:7) that can be considered as "the building blocks of human knowledge" (Jonker, 2016:55). While a term may be represented by a definition, a conceptual understanding of the term is essential to get hold of its deeper significance (Novak, 2010:43). Furthermore, as terms and concepts are inextricably linked, acquisition of one must be accompanied by acquisition of the other to facilitate conceptual or meaningful understanding.

Concepts themselves are interrelated and cannot exist in isolation (Croft & Cruse, 2004:7; Novak, 2002:552). Knowledge, then, according to Novak (2010:133), is "a well-organized framework of concepts and propositions". Accordingly, in order to understand a subject, knowing the interrelations between its concepts is necessary. For a learning area, specific concepts that are central to the subject are similarly interrelated so that understanding the core concepts of a subject leads to understanding the subject.

From the idea of conceptual understanding has emerged the term "concept literacy", which is defined as the ability to "read, understand and use the learning area-specific words, terms and related language forms which are part of knowledge formation in the different disciplines or content areas" (Young, Van der Vlugt & Qanya, 2005). From this definition, the link between understanding a concept and the language needed to express that understanding is made clear. In fact, according to Vygotsky (1986:107), words are the "functional tools" needed to express concepts, without which concepts cannot be communicated.

While concept literacy is a recent idea (Madiba, 2014), this relationship between language and content (Gablasova, 2012:13), or what Gajo (2007:565) calls "*the linguistic issues in subject knowledge and the subject issues in linguistic knowledge*" [author's emphasis], has been recognised for some time. In fact, according to Gablasova (2012:13), "part of mastering the subject-matter is the learning of the appropriate way of communicating it". This suggests that scientific concepts have to be taught through classroom instruction, as opposed to the acquisition of everyday concepts, which are acquired spontaneously (Vygotsky, 1986:157).

Vygotsky (1986:150), however, warns against the rote teaching of concepts as this may result in "simulating a knowledge of the corresponding concepts but actually covering up a vacuum". Similarly, Novak and Gowin (1984:94) point out that students might show proficiency in solving problems because certain solutions have been memorised, yet fail when unfamiliar problems are set. This is evidence that the concepts have been learned but not understood.

Some of the literature refers to the term threshold concepts as distinct from core concepts in that threshold concepts (Meyer & Land, 2005:373) are seen as providing an essential gateway into a discipline "without which the learner cannot progress" (Knight, Callaghan, Baldock & Meyer, 2014:126). However, while it is indisputable that the identification of the threshold concepts for a specific discipline is complicated (Knight *et al.*, 2014), the authenticity of the Threshold Concept Hypothesis has been questioned (O'Donnell, 2010). Core concepts rather than threshold concepts is therefore the term employed in this research.

1.4 Overview of the empirical literature

1.4.1 Studies in understanding concepts

An awareness of the connection between language and conceptual understanding has given rise to empirical studies investigating the effectiveness of a variety of programmes and language scaffolding techniques to improve learning. These include Content and Language Integrated Learning (CLIL) programmes (Gablasova, 2012), switching between languages (translanguaging) (Paxton, 2009), and using multilingual-glossaries (Jonker, 2016; Madiba, 2014).

Gablasova (2012) studied a CLIL programme in two schools in Slovakia with 72 high school children, with Slovak being the home language and English the foreign language. She sought to verify the quality of the content learning by investigating technical vocabulary acquisition. In general, the knowledge acquisition of the students studying in a foreign language was found to be comparable in breadth but not in depth with that of first-language students, thus pointing towards a lack of conceptual understanding. The students had been specially selected to participate in the CLIL programme, based on their good academic records. The context of that study therefore does not reflect the context of the current research, which is based on educational underpreparedness.

In identifying language access as a contributing factor to the problem of inadequate throughput among students, Paxton (2009) investigated the use of students' home languages as a scaffolding tool for epistemological access. Students used codeswitching to describe subject-specific terms in their home languages in order to create multilingual glossaries. According to Paxton (2009), this created a familiar and non-threatening setting in which to grapple with a subject's technical terms, resulting in multi-faceted understanding. While this research is in

keeping with current ideas on effective support, no systematic research was done to assess the effectiveness of the intervention, or to ascertain to what extent conceptual understanding, in fact, had taken place.

In the study conducted by Jonker (2016) in a Humanities extended degree programme at the University of Stellenbosch, multilingual subject-specific glossaries (English, Afrikaans and isiXhosa) were similarly used as scaffolding to enhance subject-specific vocabulary attainment, although the glossaries were in this case provided for the students rather than created by the them. In this scenario, terminology attainment was facilitated in small tutorial groups (about 22 students), and the teaching approach was the students' own construction of knowledge. Jonker (2016:220) attributes the improved pass rate experienced to, among other things, students' enhanced understanding of the threshold concepts of the relevant subject. On the other hand, an analysis of the students' written assignments indicated that students were unable to apply the knowledge and this suggests a lack of conceptual understanding (Jonker, 2016:214).

The UCT Concept Literacy Project, which was started in 2007, appears to have the most comprehensive scaffolding approach (Madiba, 2014) to facilitate conceptual understanding. The project, which was first applied to Statistics, Economics and Law in a pilot project, is to be implemented in two phases: firstly, the development of multilingual, online glossaries and, secondly, the development of concept literacy by means of the multilingual glossaries. The project is therefore aimed at providing a scaffolded approach to learning by means of multilingual, multi-modal, online glossaries and follow-up tutorials conducted by multilingual tutors. The follow-up tutorials, however, have so far been limited to isiXhosa-English and Tshivenda-English. Transcriptions of the tutorials indicate greater insight into the subject concepts, yet, as in the previous study, no performance assessment was done to measure the success of the intervention in facilitating concept literacy.

1.4.2 Dearth of studies on the pedagogical effectiveness of concept mapping in facilitating concept literacy in Accounting

Concept mapping has been used across many disciplines, including Religion (Pui-lan, 2010), Health (Brennan, Brownson, Kelly, Ivey & Leviton, 2012), Nursing (Clarke, 2015) and Biology (Kinchin, 2000), amongst others. Great interest in the use of concept mapping has also been shown in the field of Accounting (Leauby *et al.*, 2010:287). Yet, even though enthusiasm is generally expressed for the technique (Greenberg & Wilner, 2015:25), few empirical studies

exist on the pedagogical effectiveness of concept mapping in Accounting in facilitating concept literacy. A summary of research into the effectiveness of concept mapping in Accounting by Leauby *et al.* (2010:287) suggests that, though there are indications that concept mapping facilitates concept literacy, none of the studies supports this assertion by means of measurable results, either because of the limited number of participants, or the "less than rigorous design" (Leauby *et al.*, 2010:287) of the research, or the lack of investigation of peripheral variables that might have influenced results (Leauby *et al.*, 2010:287; Simon, 2007:305).

In one such study, Maas and Leauby (2005) looked at the effect of using concept mapping with a group of 35 students who had enrolled for an introductory Accounting module. To measure the effectiveness of the intervention, the end-of-unit test results of the group were compared to that of a control group of 29 students. While no outright conclusion can be drawn from such a limited sample size, the results were impressive enough to suggest further investigation into the inclusion of concept maps in the Accounting curriculum (Maas & Leauby, 2005).

Simon (2007:274) conducted a study with two groups of final year undergraduate Accounting students in which pre-created and student-created concept maps were used. When creating their own maps, an activity all students found challenging, the stronger students were able to create more complex maps with better linkages than poorer students, but even the stronger students needed to have misconceptions corrected. The students who took part in the study found concept mapping useful. This was especially true for Asian students, which, as Simon (2007:274) remarks, might indicate that second-language speakers find a representation of knowledge that is less language intense more accessible. However, because of the nature of the research, no absolute conclusion can be drawn from this observation. While this study was conducted with a large number of students, it did not assess whether there was any improvement in student scores and therefore no measurable proof is offered of the effectiveness of concept mapping in enhancing learning.

In the most comprehensive study, Leauby *et al.* (2010:289) compared the results of a cohort of first-year Accounting students with those of a consecutive year, to assess whether concept mapping improved learning. Both groups were taught using traditional methods, but for the second group concept mapping was included in the curriculum, ranging from familiarising students with the technique to the students eventually creating their own maps and being assessed on these. The results did not support the study's original hypothesis that concept mapping would enhance leaning, although students did view the technique as advantageous.

No studies have been conducted in South Africa on the pedagogical effectiveness of concept mapping in facilitating concept literacy as yet. The current study consequently aims to add to the research on the use of concept mapping in Accounting education, as urged by Leauby *et al*. (2010:287-289).

1.4.3 A few notes on Accounting education

As this research is based within the Accounting discipline, it is necessary to mention a few issues pertaining to education in Accounting that are relevant to this study. According to Leauby *et al*. (2010:284), "the effective use of accounting knowledge is based on a thorough understanding of an integrated conceptual and technical business framework". It is thus expected that students should be able to apply what they have learnt as they continue with their study of Accounting. Nevertheless, in Accounting education, students very often focus on rote learning of information, rather than on the critical thinking required for decision making (Flood, 2014:88; Needles 2014:42; Maas & Leauby, 2005:76). In such an environment, students see Accounting as a technique that must be learned in order to pass examinations (Lucas & Mladenovic, 2014:136) and rote learning would thus appear to be the most appropriate learning style. Indeed, Lucas and Mladenovic (2014:135) state that Accounting students who see knowledge as factual are inclined towards rote learning whereas Accounting, in fact, requires abstract reasoning. This lack of abstract reasoning surfaces when Accounting students enter the workplace and it becomes apparent that students do not have the abilities that the workplace needs (Greenberg & Wilner, 2015:25; Hassall & Joyce, 2014:394).

Having recognised these needs, the focus of Accounting education has changed from "traditional textbook and rules-based knowledge" to an "emphasis on output skills" (Needles, 2014:28). Flood (2014:88) calls for the need to "strenuously interact with core concepts in Accounting". The Constructivist learning theory of making sense of the material being learnt and building on prior knowledge is identified by many researchers as being the solution to the Accounting education conundrum (Lucas & Mladenovic, 2014:127; Byrne & Willis, 2014:146). Nonetheless, students do not have the ability to adapt their learning strategies independently (Leauby *et al*., 2010:284), and therefore strategies need to be developed to assist them.

Concept mapping has been identified as a strategy that addresses all of the concerns expressed here. On the other hand, Leauby *et al*. (2010:287) point out that, because of the seemingly contrary nature of concept mapping when compared to the "number crunching" practice

traditionally used when teaching Accounting, it is viewed with suspicion in Accounting circles. Yet, Accounting, being a hierarchical discipline, is suited to the concept mapping strategy (Leauby, *et al.*, 2010:288). These issues add impetus to the need for rigorous empirical research into the feasibility of using concept mapping in Accounting education, as Leauby *et al*. (2010:287-289) urge.

1.5 Research questions

The following main research question has arisen from the real-world problem and gaps identified in the literature:

Is concept mapping an effective technique for scaffolding concept literacy among first-year Accounting students in an extended curriculum programme?

This question can be divided into two sub-questions, namely:

1. How does concept mapping affect students' comprehension of subject-specific concepts and their associated terms?
2. What are the opinions of students about concept mapping as a technique for scaffolding comprehension and memory of subject-specific concepts and their associated terms?

1.6 Hypotheses

The following hypotheses will be tested in this research:

- The performance of students in the test group will significantly improve from the pre-intervention test to the post-intervention test, based on their individual test scores.
- There will be very little improvement in the performance of students in the control group from the pre-intervention test to the post-intervention test, based on their individual test scores.
- The performance of students in the test group will improve more than the students in the control group, based on the differences between their pre- and post-intervention test scores.

1.7 Chapter preview

Chapter 2 provides a theoretical overview of Constructivist theories of learning that support the use of concept mapping as a scaffolding tool for meaningful learning. Chapter 3 explains the methodology, based on a Postpositivist research paradigm, which was used in this study, and

describes the instruments by which the quantitative and qualitative data of the test and control group participants, the Accounting students in an extended programme, were collected. In Chapter 4, the descriptive and inferential statistics of the collected data are described and the findings analysed and discussed. The qualitative data are analysed using content analysis. To conclude, Chapter 5 reflects on the use of concept mapping in facilitating meaningful learning with reference to the results of this study, acknowledges the limitations of the study, and offers suggestions for future research.

Chapter 2: Theoretical overview

2.1 Introduction

The aim of this research is to investigate the effectiveness of concept mapping in attaining concept literacy in an Accounting environment. The previous chapter explained the need for concept literacy by describing the problems currently experienced in higher education and the attempts that have been made to solve these problems, especially in the foundation year of students' studies. The influence of concept literacy on educational success was thus established, and, from a summary of key studies that investigated ways to improve concept literacy, the fact that there is as yet no clear solution to this issue became apparent.

This chapter first problematises the practice of rote learning, and advocates teaching methods that encourage deep learning. One of the learning theories that encourages profound engagement with the learning process is Constructivism, and thus an overview is given of Constructivist theories of learning. The role of the Vygotskyan notion of scaffolding in constructivist approaches to teaching and learning is accentuated, with particular emphasis on concept mapping as a type of scaffolding. Ausubel's Assimilation Theory, with its strong focus on meaningful learning, will be shown to have given birth to the concept mapping model. Having thus established the legitimacy of the theory that underpins concept mapping, concept mapping will be discussed in detail by providing reasons for its effectiveness and describing the importance of its format.

2.2 The problem of rote learning

The issue of rote or surface learning is complex and needs some clarification. The problem is that rote or surface learning can produce good results at school level. In fact, rote learning is often encouraged by the type of assessment used at schools (Novak 2010:234; Simon, 2007:278), especially where verbatim recall is required, as in, for example, short answers and definitions (Novak & Cañas, 2008:4). Students who are focused merely on passing tests need do no more than rote learn answers (Lucas & Mladenovic, 2014:128), as information can be memorised without needing to relate it in any way to previously held knowledge (Novak, 2010:23). Novak and Cañas (2008:11) elucidate the extent of the problem by declaring that rote learning "contributes very little at best to our knowledge structures, and therefore cannot underlie creative thinking or novel problem solving." The lack of conceptual understanding

becomes especially pronounced once there is a need to apply the learned knowledge at higher levels (Nkomo & Madiba, 2011; Norris & Phillips, 2003; Novak, 2002:549; Taber, 2000). Novak (2010:38) therefore calls the rote learning favoured by many schools "disempowerment".

In contrast, the main purpose of education should surely be "*to empower learners to take charge of their own meaning making*" (Novak, 2010:13) [author's emphasis]. If students are interested in gaining the knowledge inherent in a task, they are more likely to employ deep learning (Lucas & Mladenovic, 2014:128). New knowledge is then assimilated so that the focus moves from the specific wording, or verbatim recall, to conceptual understanding. Constructivism sought to address this issue, and the Constructivist theories of learning will be discussed below.

2.3 Constructivist theories of learning

For about a century, Behaviourism was the predominant educational viewpoint (Novak & Gowin, 1984:152). As it focused on modifying behaviour, it advocated rote learning in a teacher-centred classroom. Behaviourism ignored a fundamental aspect of the human mind: we form concepts in our minds and then label them by means of language symbols (Novak & Gowin, 1984:152). Thought and language are thus "interfunctional" (Vygotsky, 1986:1). In consequence of this new understanding of learning, significant research went into the field of education in the twentieth century, and resulted in the emergence of Constructivist theories of learning.

2.3.1 What do constructivist theories of learning entail?

Educational theorists of the twentieth century recognised the necessity of understanding the psychology of the learning process in order to address the problem of inadequate concept literacy (Novak, 2002:562). The ideas of the theorists most pertinent to the current research will be discussed here.

2.3.2 Piaget

Jean Piaget (1896-1980), working in Switzerland, was the forerunner in the study of human cognition, to which he dedicated sixty years of his life (Novak & Gowin, 1984:154). While some of his theories are criticised now for their emphasis on developmental stages of cognitive functioning (Novak, 2010:55; Novak & Gowin, 1984:154; Piaget, 1980:5), he is nevertheless admired by many of his peers for his groundbreaking work into children's speech and thought processes, which revolutionised educational research (Novak, 2010:55; Vygotsky, 1986:12).

Piaget, in attempting to understand the process of learning, developed the Theory of Cognitive Development, which contends that every being attempts to make sense of its environment and to determine its future actions by developing knowledge structures or schemata. Balance between these schemata and the environment is sought and this necessitates ongoing adaptation of the environment, to fit in with pre-existing schemata ("assimilation"), or adaptation of the schemata, to accommodate new information from the environment ("accommodation") (Lucas & Mladenovic, 2014:127; Lutz & Huitt, 2004; Huitt & Hummel, 2003; Piaget, 1980:8; Nielsen, 1980). This "self-regulation" of "cognitive conflicts" results in cognitive development (Zarotiadou & Tsaparlis, 2000:38). Prior knowledge is therefore consistently relied upon in the stored schemata, because knowledge "always includes a process of assimilation to previous structures" (Piaget, 1971:4). Piaget postulated that all human beings progress through various stages of learning development or "adaptation" from childhood to adulthood, each stage becoming increasingly sophisticated and, as the complexity of thought increases, the schemata likewise become more complex and hierarchical to adequately store acquired knowledge (Piaget, 1980:8-70). In fact, "the learning of a new operational concept depends heavily on the child's previous level of cognitive development" (Lourenço & Machado, 1996:153). Piaget saw learning as taking place instinctively and incidentally, without the requirement of an educational setting and with the child learning through self-activated discovery (Nielsen, 1980).

Originally, his theories were embraced as they seemed to explain the problem of poor learning among children, and curricula were adapted to include tasks according to "cognitive operational capacity presumably required for understanding" (Novak, 2010:52). However, the theory of the developmental stages of learning has been disproved as present research indicates that children are developmentally ready to learn at a much younger age than at first supposed, and that poor learning is rather the result of insufficient preparation for learning and inadequate teaching (Novak, 2010:54).

Several of Piaget's contemporaries investigated and theorised the learning process, most notably Lev Vygotsky (1896-1934) and John Dewey (1859-1952). While these theorists worked independently and consequently have divergent ideas, they differ primarily on whether they consider the principal source of learning to be experience (Dewey), an individual experience (Piaget), or a social experience (Vygotsky) (Lutz & Huitt, 2004:1; Vygotsky, 1986). However, they also share many themes regarding the construction of knowledge so that the combined

educational philosophy, Constructivism, emerged from these individual ideas (Lutz & Huitt, 2004:13; Huitt & Hummel, 2003).

Constructivism maintains that the human brain is wired to take in information from birth, and to construct meaning by interpreting new knowledge against the backdrop of what is already known (Byrne & Willis, 2014:146; Lucas & Mladenovic, 2014; Taber, 2000:64). For some, this aspect of "what is already known", or prior knowledge, is seen, from the Constructivist viewpoint, as fundamental to learning (Byrne & Willis, 2014:146). For others, it is the fact that each student must construct his or her own meaning (Novak, 2010:81), as each individual will have his or her own filters for constructing meaning, derived from parents, the environment and his or her own personality. For Novak (2010:81), this is an essential point, as it differentiates between "the psychology of learning" (individual construction of knowledge) compared to "the epistemology of knowledge" (knowledge construction within disciplines). In either case, the fundamental idea underlying Constructivism is that "the development of meaning is more important than the acquisition of a large set of knowledge or skills that are easily forgotten" (Lutz & Huitt, 2004:8). A further essential aspect of the acquisition of knowledge, according to Dewey in particular, is student readiness – being curious about the upcoming subject and having the necessary expertise to accomplish the task – and social interaction (Lutz & Huitt, 2004:8). Lucas and Mladenovic (2014) state that, according to Constructivist principles, students' approach to learning is not necessarily dependent on their learning styles but rather on their "perception" of the task, which is not necessarily the perception originally intended by the lecturer. In this case, "perception" refers to the particular way a student views the world and which affects the way he or she approaches the subject.

2.3.3 Vygotsky and the notion of scaffolding

While Vygotsky (1986:11) acknowledged Piaget's theory of learning as "the best of its kind", his own theory developed "in exactly an opposite direction". Unlike Piaget's belief that learning is self-activated and individual, Vygotsky believed that learning is socially mediated and that conceptual thinking emerges from the "tasks" that interaction at various levels of society sets (Vygotsky, 1986:108), because higher mental functions are the result of "mediated activity" (Vygotsky, 1986:xxiv). He also saw language as the necessary medium through which such conceptual learning takes place (Novak, 2010:80; Novak & Cañas, 2008:15; Vygotsky, 1986:108).

From Vygotsky we have two concepts that are of particular interest to the present research. Firstly, Vygotsky's Zone of Proximal Development is the area in which learning takes place, beyond but not out of reach of the present knowledge base of the student; it is that which is achievable with adequate support (Novak & Cañas, 2008:15; Walqui, 2006:162; Vygotsky, 1986:187). Secondly, such adequate support, or mediation, refers to any instrument that makes it possible for a student to reach the next level of achievement and may be animate, for example a teacher, or inanimate, for example an online programme. This mediation is sometimes known as the More Knowledgeable Other. As discussed in the previous paragraph, language therefore becomes a powerful instrument of mediation (Walqui, 2006:161).

Although the concept of scaffolding, which refers to connecting the current level of a student's knowledge to the next higher level (Fennema-Bloom, 2009:33), did not originate with Vygotsky, it was soon seen as a suitable metaphor for his Zone of Proximal Development (Brownfield, 2016:14; Novak, 2010:80; Walqui, 2006:163). Based as it is on the construction of knowledge by means of support from a More Knowledgeable Other, scaffolding can be seen as socio-semiotic in nature (Walqui, 2006:160), which is in keeping with Vygotsky's strong emphasis on the social nature of learning.

The approach of scaffolding is traditionally top-down, with the More Knowledgeable Other guiding the student until he or she increasingly operates independently. While Vygotsky's original idea was that the mediator should be more knowledgeable than the student in order to scaffold learning, subsequent researchers have acknowledged the role that peer collaboration can play in scaffolded learning (Novak & Cañas, 2008:15; Walqui, 2006:167). For example, the effectiveness of group work in knowledge acquisition might be due to the group members operating within the same Zone of Proximal Development (Novak, 2002:551). It is now suggested that mediation can operate in four ways: mediation by a more knowledgeable person, group mediation, learning through teaching less knowledgeable students, and self-directed learning (Walqui, 2006:168).

2.3.4 Schema Theory

Schema Theory, first posited by Bartlett in 1932, can be seen as a variant of the scaffolding premise (Brewer & Nakamura, 1984:3), as it sees previously constructed knowledge, or background knowledge, as essential for the attainment of new knowledge in an interactive process between learner and text (Widmayer, 2005; Carrell & Eisterhold, 1983:556). Succinctly formulated, Schema Theory deals with "the relationships between old and new knowledge"

(Brewer & Nakamura, 1984:71). Schema, also referred to in the plural form of schemata, is the name given to the higher order knowledge structures, representing units of knowledge (Rumelhart, 1980:34).

New information is built onto existing schemata and "all aspects of that schema must be compatible with the input information" (Carrell & Eisterhold, 1983:557). As such, new information may be added to previous knowledge without adaptation, or existing structures may be adapted to accommodate new knowledge, or a new structure or schemata may be created altogether. If the information is not understood according to its intended meaning, in other words, the constructed schemata are defective, comprehension suffers (Brewer & Nakamura, 1984:29). Schemata are stored in subject-specific or context-specific knowledge structures, which can be at novice or expert level, depending on the stage of development. Schema building is influenced by genres (for example letters, reports and brochures) and text types (for example descriptive, persuasive and instructive), and is culturally driven (Widmayer, 2005).

Schema Theory further distinguishes between bottom-up (data-driven; from the specific to the general) and top-down (concept-driven; from the general to the specific) processing. This illustrates the hierarchical nature of Schema Theory (Carrell & Eisterhold, 1983:557). On the other hand, Widmayer (2005) maintains that the structures are not necessarily hierarchical but rather "meaning-driven".

The function of schemata in learning can be illustrated in several ways. Information imbedded in a schema is recalled more easily than a list of unrelated facts (Brewer & Nakamura, 1984:44). Schema Theory supports the idea that problem-solving ability is incremental and results from an accumulation of experience and perspectives (Widmayer, 2005). Thus, the more developed a student's schemata are in a certain body of knowledge, the more easily recall takes place (Brewer & Nakamura, 1984:47). As will be seen in the next section, there are clear links between Schema Theory, which attempts to provide a "valid metaphor for explaining students [sic] knowledge structures and ability to recall information", and Ausubel's Assimilation Theory (Widmayer, 2005), as, for example, both require that new concepts should be compatible with existing conceptual knowledge to be assimilated.

2.3.5 Assimilation Theory

Ausubel (1962) developed Assimilation Theory to explain the learning process that facilitates meaningful learning. He asserted that we think in concepts (Simon, 2007:277) and that meaningful learning can only take place when new concepts or information are linked to the student's prior knowledge – the most important single factor in acquiring new knowledge (Greenberg & Wilner, 2015:18; Novak, 2010:63; Simon, 2007:278; Safayeni *et al.*, 2005:2; Ausubel, 1962) - and expressed in clear concepts and language (Novak & Cañas, 2008:3). Secondly, the prior knowledge of the student should be relevant and made applicable to the new information (Novak, 2010:59). The quality of the learning will be decided by the quality of the knowledge structures the student has already built (Novak, 2010:23). Thirdly, the student needs to cooperate in the process of meaningful learning (Novak, 2010:59; Novak & Cañas, 2008:3-4; Carnot *et al.*, 2003:6-7). The instructor has little control over whether students cooperate in their learning or not; if students make no effort to assimilate the new information (Novak, 2010: 60), or insist on rote learning of the definitions, procedures and statements, they will not benefit from meaningful learning, no matter what learning strategy is used (Novak & Cañas, 2008:3).

Conceptual knowledge structures are strongly hierarchical through the process of "subsumption", which is a term that Ausubel used to describe the linking of more specific concepts (the least inclusive) to more general concepts (the most inclusive) (Novak, 2010:63, Simon, 2007:278; Ausubel, 1962). Through the interactive process of "subsumption", links or relationships between concepts are identified and they create a network of connections (Novak, 2010:63). The overall meaning of a concept emerges from all the identified relationships (Novak 2010:65). Novak (2010:67) states that information that is gained by means of this "subsuming" process can be recalled long after it has been learned, in contrast to rote learning, which needs continuous reinforcement.

Ausubel's Assimilation Theory evidences clear links to Constructivism (Lucas & Mladenovic, 2014:127) and, in particular, Piaget's Cognitive Development Theory. However, in the process described by Ausubel, both the newly-acquired knowledge and the existing knowledge structures are adapted and changed, which is a departure from Piaget's viewpoint (Nielsen, 1980). Moreover, while both Piaget and Ausubel's ideas suggest that learning is a process that needs time, they differ in that Piaget refers to the time it takes a learner to progress from one developmental stage to another, whereas Ausubel is concerned with the "adequacy of the

relevant conceptual framework a person has in a *specific* domain of knowledge" (Novak, 2010:75) [author's emphasis].

Ausubel suggests that, for learning to be effective, new concepts should be introduced to young learners in the form of well-constructed examples of the subject-matter to aid them in constructing feasible knowledge structures, whereas older learners would be experienced enough to create such knowledge structures for themselves (Nielsen, 1980). Maas and Leauby (2005:78) point out that students who have not been schooled in relating newly acquired concepts to prior knowledge might find this process difficult, especially when they attempt to link concepts of increasing complexity to weak knowledge structures. Often students are limited in developing their ability to think in more meaningful or creative ways. Consequently, in order to activate prior learning and to guide students towards the correct structuring of new information, Ausubel proposes the use of advance organisers (Novak, 2002:559). These advance organisers, similar to those advanced by Schema Theory, function as pre-learning tasks that assist in "coaching" or scaffolding knowledge.

Because of this emphasis on guided knowledge construction, Assimilation Theory is seen as teacher-centred, or "Learning through transmission". It is, for example, important that the teacher is able to establish the learner's prior knowledge so that he or she can be adequately guided in assimilating new knowledge (Novak, 2010; Simon, 2007:278). Furthermore, the teacher needs to organise the knowledge structures and continuously evaluate student learning (Novak, 2010). As such, Assimilation Theory is only practicable in an educational environment (Simon, 2007:277). This also differs from Piaget, who believes that an educational environment is not required for learning to take place (Nielsen, 1980).

In the next section, "Learning through transmission" will be compared to "Learning through discovery" to establish the validity of the teacher-centred approach favoured by Ausubel's Assimilation Theory.

2.3.6 Learning through transmission and Learning through discovery

From the previous discussion, we see that learning can be either facilitated through the lecturer (Learning through transmission) or by the students themselves (Learning through discovery) (Alcina, 2009:3-4). In the first instance, the lecturer makes the cognitive processes necessary for significant learning evident to students in an organised manner, the lecturer thus being the

focus of the activity. In the second instance, the student is the focus of significant knowledge acquisition by means of self-directed learning, which might include lecturer facilitation (or any other type of Knowledgeable Other – see Section 2.3.3), but which primarily means that the learner selects and learns information he or she has identified as important (Alcina, 2009:3-4; Novak and Cañas, 2008: 3; Simon, 2007:278; Kirschner, Sweller & Clark, 2006:78). Learning through discovery, also known as inquiry learning, is favoured by Constructivists and has become a "widely recommended" approach to teaching (Novak & Cañas, 2008:4), as it is seen as a measure to counter the prevalent mode of rote learning (Novak, 2010:63). Tasks are set without providing answers, with the idea that learners will discover the required concepts for themselves.

This approach has been questioned because of the unlikelihood that someone would construct the meaning of a complex idea independently without "at least a rudimentary conceptual understanding of the phenomenon they are investigating", and, furthermore, because of the lack of research to prove the effectiveness of this type of learning (Novak & Cañas, 2008:4; see also Novak, 2010:63; Kirschner *et al*., 2006). Indeed, rote learning has been erroneously equated to teacher-centred learning approaches and significant learning to learner-centred learning approaches, while, in practice, both strategies may be effectively used to foster significant learning (Novak and Cañas, 2008:4; Simon, 2007:278). In fact, as Novak (2010:63) declares, what we need now "is not more emphasis on inquiry learning, but rather more emphasis on *meaningful* learning" [author's emphasis].

Ideally, the relationship between teacher-centred and student-centred learning would be a gradual shift in reliance on the former to the self-reliance of the latter (Simon, 2007:278). The theory behind this is that when students are able to choose what and how to learn they will be motivated to take responsibility for their own learning. In reality, this can take up more time than a student has available and presumes that the student knows what knowledge is missing (Simon, 2007:278), and may not be suitable for a first-year student (Kirschner *et al*., 2006:83). In short, how can the student know what the student does not know? Zarotiadou and Tsaparlis (2000:48) also report that, even in learner-centred approaches, students seem to benefit from the accessibility of a teacher rather than from working in isolation. Thus, the teacher-centred approach followed by Ausubel's Assimilation Theory has validity.

Having established the theoretical underpinnings of this study, I now turn to Concept Mapping as a particular strategy in scaffolding the learning of concept literacy.

2.4 Concept mapping as scaffolding tool

2.4.1 Introduction

In the section on the Constructivist theories of learning (Section 2.3), the role of scaffolding in the facilitation of learning was considered. Many scaffolding tools are available for use in the classroom, such as those suggested by Walqui (2006:170; see also Carstens, 2016) - modelling, bridging, contextualisation, building schemata, re-presenting text and developing metacognition. In this section, the contention that concept mapping is an ideal scaffolding tool that leads to meaningful learning will be put forward, by means of a discussion of its format and functioning. This forms the rationale on which this research is based.

2.4.2 Concept mapping as a scaffolding tool for meaningful learning

In response to the problems currently being experienced in education, Novak (2010:2) states that it is time for "new educational practices that are guided by sound theory and make better use of new technologies". Concept mapping offers a valuable solution in the pursuit of significant learning, and, as Maas and Leauby (2005:79) declare, this is a technique that deserves consideration. The following section describes concept mapping and clarifies its functionality and effectiveness.

2.4.2.1 Why concept mapping?

i.   Concept mapping visually scaffolds knowledge

The technique, as illustrated in Figure 1, takes the form of a visual aid that depicts relationships between concepts and therefore represents information in an alternative and visual way, which aligns with the human facility of pattern identification (Simon, 2007:276). Utilising concept mapping software such as CmapTools or similar software makes it possible to include a range of images, further enhancing the visual nature of concept mapping (Novak & Cañas, 2008:8).
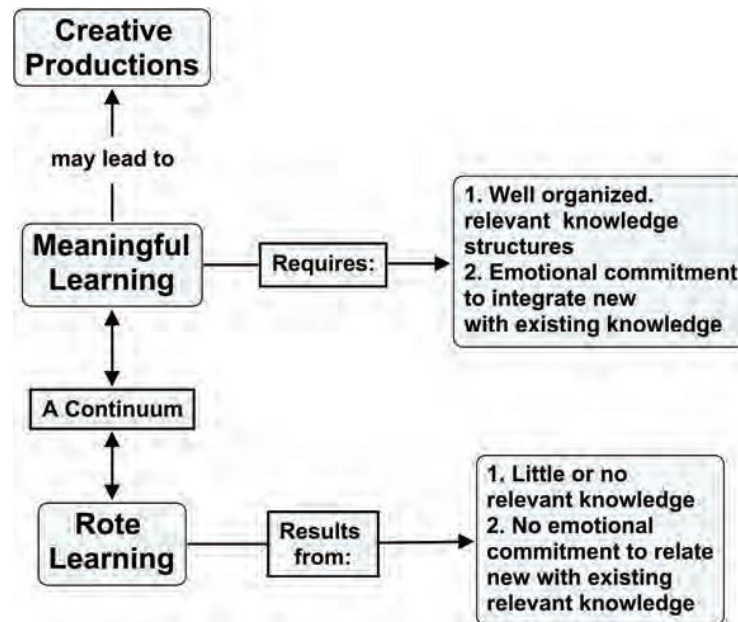
Figure 1 An elementary example of a concept map, taken from Novak and Cañas (2008)

There are other, often similar, forms of visual representation – flow charts, decision trees and mind maps, for example. The most familiar of these is possibly the mind map. The functionality of the mind map is somewhat different from that of the concept map, however. While the concept map indicates "systematic relationships among sub-concepts" pertaining to a central concept, a mind map shows only the sub-topics without emphasising the relationships (Eppler, 2006:203). A comparative overview of the alternative visual aids mentioned here is given in Appendix J. What sets concept maps apart is that no other type of visual presentation has "the theories of learning and knowledge" as its basis (Greenberg & Wilner, 2015:16-18; see also Novak & Gowin, 1984:37). Concept mapping is moreover a more considered or "reflective" process than other types of visual aids (Novak, 2010:127).

The structure of a concept map, besides its visual nature, has a further important advantage in line with our present understanding of the workings of cognitive functions that asserts that the scaffolding of knowledge is required for successful learning (Simon, 2007:274). Concept mapping was designed to simulate and make explicit the knowledge structures in the mind (Novak, 2010:112; Maas & Leauby et al., 2010:281,285; Novak & Cañas, 2008:7; Simon, 2007:274; Safayeni et al., 2005:2; Leauby, 2005:76,79; Carnot *et al.*, 2003;). Its effectiveness lies in its ability to scaffold large areas of knowledge "piece by piece with small units of interacting concept and propositional frameworks" (Novak & Cañas, 2008:7). Moreover, making knowledge explicit means that complex concepts may be clarified (Novak, 2010:112; Leauby *et al.,* 2010:285).

Additionally, in this process, the "bigger picture" is revealed. Because concepts and themes are often addressed separately in class, students might continue to see them as unrelated (Leauby *et al.*, 2010:284; Greenberg & Wilner, 2015:22). According to Leauby *et al.* (2010:284), in such cases students will "remain novices" because, without an awareness of the bigger picture, reasoning will continue to be limited. On the other hand, concept mapping encourages the identification of relationships and interrelationships, or cross-links, so that students are able to form a better understanding of the whole (Chabeli, 2010; Leauby *et al.*, 2010:28; Maas & Leauby, 2005:77). Identification of such relationships are evidence of the student developing a deeper understanding of the subject (Simon, 2007:280). The introduction of a new concept could even result in the restructuring of previously incorporated concepts and relationships as new meanings come to the fore (Simon, 2007:280; Novak & Gowin, 1984:17). Ausubel calls this process "integrative reconciliation" (Simon, 2007:280; Ausubel, 1962). To further enhance the students' awareness of the bigger picture, concept maps should be used to "build upon each other to integrate concepts" throughout a course (Greenberg & Wilner, 2015:17).

ii. Concept mapping encourages student participation

- *Individually*

From the previous paragraph, it is evident that the effective use of concept mapping depends on student participation, one of the essential factors of Ausubel's Assimilation Theory (Section 2.3.5). The need for a student to be a willing and active, emotionally involved participant if meaningful learning is to take place (Chabeli, 2010; Novak, 2010; Novak & Cañas, 2008: 11; Simon, 2007; Maas & Leauby, 2005:81;Zarotiadou & Tsaparlis, 2000) is, as we have seen, also a requirement for the achievement of meaningful learning (Carnot *et al.*, 2003:6-7). In fact, Carnot *et al.* (2003:10) insist that "mental interaction with the subject matter to be learned during the building of the concept map is key to the learner's achievement" and that, even with the use of a deep-learning activity like concept-mapping, students will only truly benefit if they have an "active, deep and questioning approach" to their subject (Carnot *et al.*, 2003:9). On the other hand, students who have chosen rote learning as their learning method will not easily be dissuaded from that path (Novak, 2002:558). The instructor's responsibility in this scenario is to provide the means by which students can effectively apply themselves (Novak, 2010:59).

There are two reasons why concept mapping is dependent on student participation. Firstly, concept mapping is useful for establishing the student's prior knowledge, which, as we have seen, is another fundamental aspect of Ausubel's Assimilation Theory (Leauby *et al.,* 2010:281;

Novak & Cañas, 2008:7;) and in line with the Constructivist theories of learning. Secondly, the quality of the various elements of the concept map that the student has constructed will provide evidence that successful learning has taken place (Simon, 2007).

However, by making knowledge explicit, a misconception held by the student may also become evident by means of this process. According to Novak and Gowin (1984:20), a misconception refers to an unacceptable, but not necessarily wrong, understanding held by a student about a concept, often evidenced by the relationship the student has indicated as the link between two concepts. The assimilation of information is reliant on an individual's learning style, emotional response and harboured expectations, and is therefore personalised (Novak, 2002:555). Misconceptions can consequently easily be formed and even become entrenched, especially as "[i]n everyday use, language tends to be weakly defined, allowing increased scope for misinterpreting what is heard" (Taber, 2000:64). This is also in line with Constructivist theory which states that students construct their own knowledge by building onto previous knowledge. Therefore, should this construction contain errors, students' knowledge will be based on misconceptions (Novak, 2002). Students who would be considered "able" (and, indeed, even such "able" students may harbour misconceptions [Simon, 2007:292]) are often capable of correcting misconceptions because of the strong cognitive structures they build, whereas "less able" students might be building onto already faulty structures, further entrenching the misconception (Novak, 2002:558). Concept mapping therefore facilitates the identification and addressing of misconceptions (Novak, 2010:80; Novak & Cañas, 2008:5; Simon, 2007:281) so that subsequent knowledge may be assimilated correctly (Leauby *et al*., 2010:285).

- *In groups*

The value of shared learning, which echoes Vygotsky's viewpoint of learning through socialisation, is now generally recognised and educational methods that encourage interaction and collaboration, such as concept mapping, are deemed valuable (Chabeli, 2010; Novak & Cañas, 2008:15). Working in teams, students are able to "come to consensus on…their collective knowledge" (Novak, 2010:118) and this helps them to tackle assignments that might have proved too complex if worked on individually (Leauby *et al*., 2010:285). Novak (2010:173) points out that there has been much talk recently on "the importance of teams in industry" and that "the central purpose of teams is to learn how to do something better". In a team setting, the Constructivist principle of building from previous knowledge takes on wider significance, as students' previous knowledge is pooled. Thus, in identifying one another's previous knowledge,

learning already takes place through the "richness and diversity of knowledge, skills, and attitudes of the various team members—and also the problems associated with each person's idiosyncratic view of the world" (Novak, 2010:173). Working in teams, though, requires the same level of commitment as working individually for meaningful learning to take place (Simon, 2007:283).

Group work is also an effective method of addressing misconceptions. Taber (2000:66) asserts that one of the most successful ways of correcting misconceptions is by means of a group concept-mapping task for a subject like Chemistry. This inevitably provokes peer discussion that could bring misconceptions to the fore, because, although concepts are created by individuals, they are "mediated socially" (Novak, 2002:551). While learning is not shared, meanings "can be shared, discussed, negotiated, and agreed upon" (Novak & Gowin, 1984:20). Novak (2010: 137) cautions that the correction of errors in understanding is not a quick process: incorrect propositions need to be deconstructed and corrected propositions assimilated into existing knowledge structures (Novak, 2010:140). However, through the negotiation that takes place in a small group, the necessary realignment can be accomplished. Quite clearly, the correction of misconceptions can never be accomplished through rote learning (Novak & Cañas, 2008: 9). Finally, Novak and Cañas (2008:23) comment that using a pre-created "expert skeleton" map will lessen the chance of misconceptions getting a foothold.

- *For struggling students*

Meaningful learning requires motivation and effort from the student. It can be challenging to an academically underprepared student but it is not unattainable by such a student. In fact, research suggests that successful learning depends to a large degree upon the will to learn (Novak, 2010:59; Novak, 2002:557), which could be an equalising factor among advantaged and disadvantaged students.

Effective students have been shown to have a structured and disciplined approach to learning (Carnot *et al.*, 2003:9), which mirrors the functionality of concept mapping. Struggling students or students from environments where rote learning dominates can therefore benefit from using concept maps by being introduced to more structured learning processes (Simon, 2007:284). Carnot *et al.* (2003:9) caution that, in these cases, struggling students, unused to such structure, might find creating an entire concept map from scratch overwhelming and suggest that a partially pre-constructed map might initially be more beneficial. The suggestion of Carnot *et al.* (2003:9) has been supported by other researchers, such as Greenberg and Wilner (2015), Novak

and Cañas (2008), Carnot *et al.* (2003) and Chang *et al.* (2002). However, the danger exists of struggling students being further encumbered by having to accommodate others' knowledge structures in the partially-constructed concept maps. It is hoped that the advantages of using concept maps will outweigh such concerns. The use of pre-constructed concept maps is discussed in more detail hereafter.

Concept mapping might also be useful in supporting another type of struggling student. Maas and Leauby (2005:80) report on a study that described the support concept mapping offered students who experience anxiety in learning. They comment that "concept mapping might be effective not only in the more familiar cognitive domain … but also in the less often discussed but equally important affective domain…" (Maas & Leauby, 2005:80), and that this further supports meaningful learning (Novak, 2010: 226; Maas & Leauby, 2005:80).

iii.   Concept mapping supports metacognitive learning

Concept mapping develops meta-cognitive skills that have an ongoing effect on the quality of a student's learning. A student is able to apply the strategies inherent in concept mapping, such as comprehension and critical thinking, to other fields and domains, even when concept mapping is not being employed (Chang, Sung & Chen, 2002:18). Moreover, concept mapping makes learning more efficient, as it helps one to make sense of the given information (Taber, 2000:65).

Concept mapping is thought to improve the comprehension required for reading and summarising, because of the process that is foundational to concept mapping as well as to the identification and organisation of key ideas (Chang et al., 2002:18). It could also be said that concept mapping enhances comprehension because it causes the structure that underlies all knowledge to be understood (Leauby *et al.*, 2010:285). Furthermore, the constructing of multiple interlinked concepts means knowledge is reinterpreted with each new construction. Comprehension thus becomes a continuing process of layered understanding (Gablasova, 2012:33).

Critical thinking refers to the "ability a person has to rationally organize, interpret, and use information – even when the information may be incomplete, or when the decision context or the environment in which the information is to be used may be new or unfamiliar" (Cunningham, 2014:403). Because concept mapping requires the creation of one's own links and crosslinks, critical thinking skills are inevitably developed (Greenberg & Wilner, 2015:18;

Leauby *et al*., 2010:285; Maas & Leauby, 2005:76; Carnot *et al.*, 2003:7;). While constructing knowledge of a particular subject, it also teaches cross-domain metacognitive skills that enhance all learning (Novak, 2002:559), because problem-solving ability is incremental and results from an accumulation of experiences and perspectives (Widmayer, 2005). Such cross-domain knowledge-transfer is the hallmark of meaningful learning and critical thinking (Widmayer, 2005). Maas and Leauby (2005:76) further consider concept mapping an "enabling" skill because it facilitates greater complexity in thinking (see also Leauby *et al*., 2010:285).

iv. Supporting a variety of learning tasks

The use of concept mapping is not limited to a particular type of task (Leauby *et al*., 2010:286). For instance, it is useful for providing the framework of an upcoming theme (Leauby *et al*., 2010:286; Novak & Gowin, 1984); when a certain theme has been taught, concept mapping can be used to summarise the information; it can be used to plan the outline of an assignment (Leauby *et al*., 2010:286; Novak & Gowin, 1984); and it lends itself well to brainstorming (Leauby *et al*., 2010:286), especially when working in teams (Novak & Gowin, 1984).

Novak and Cañas (2008:8) refer also to a subsidiary aspect of concept mapping that might further aid learning. Because of our ability to remember images, or what Novak and Cañas (2008:8) call "iconic" learning, the visual structure of concept mapping might be a further enhancement to memory. Utilising concept mapping software such as CmapTools makes it possible to include a range of images (Novak & Cañas, 2008:8).

2.4.2.2 Putting concept mapping into practice

i. The format of concept maps

The appropriate starting point for a discussion of the concept mapping format is a clarification of the term "concept", as it is fundamental to the process. Concepts are defined by Novak (2002:549) as "*perceived regularities in events or objects, or records of events or objects designated by a label* (usually a word)" [author's emphasis] (See also Novak, 2010:42; Novak & Cañas, 2008:12). It is important for students to grasp that the term "concept" refers to the understanding they have of "events or objects", and that without such understanding there can be no knowledge (Simon, 2007:275). The creation of a concept must start with a main theme (Simon, 2007:196, 275) or a question (Novak & Cañas, 2008:12). In either case, a context is provided which determines the hierarchical structure of the map (Novak, 2010; Novak & Cañas,

2008:11). For novice map builders, it is preferable that a familiar "domain of knowledge", and only a section thereof, is used to construct the map (Novak & Cañas, 2008:1).

Concepts that support the main theme must next be identified for inclusion in the concept map. An in-depth study of the theme should clarify what the key concepts are, of which there are normally a limited number (Novak, 2010; Simon, 2007:275; Novak & Gowin, 1984:15). For instance, in Figure 2, "Focus Question(s)", "Associated Feelings of Affect" and "Organised Knowledge" are examples of key concepts. For those still unaccustomed to the process, a list of familiar concepts could be provided (Novak, 2010:61).
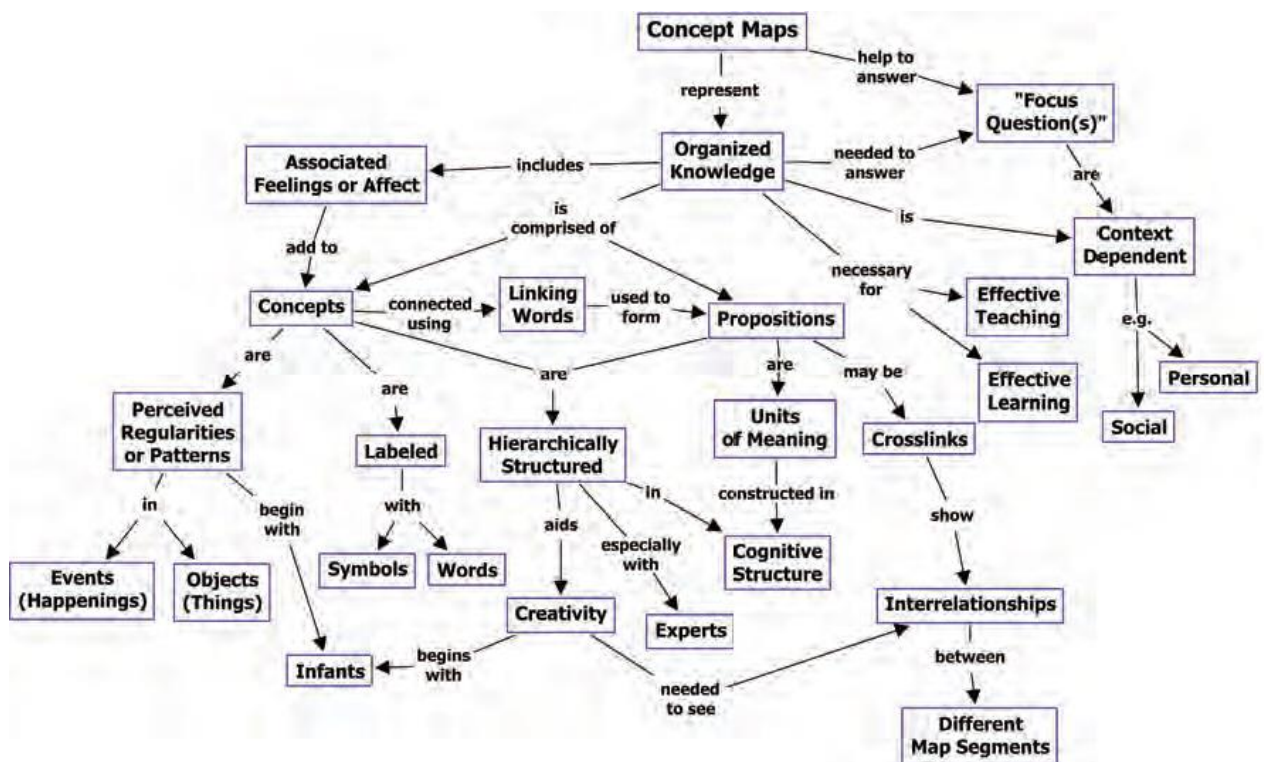
Figure 2 A concept map with "Concept Maps" as its theme, taken from Novak and Cañas (2008:2)

Concepts are placed in boxes, although some practitioners prefer to place them in ovals (Novak and Cañas, 2008:1; Simon, 2007:196). Whether a concept is represented by a word or a phrase, a noun or gerund must be present (Carnot *et al.*, 2003:13); however, a concept cannot consist of an entire sentence as this would negate the functionality of concept mapping (Novak & Cañas, 2008:12).

Concepts are linked to each other by means of lines to denote existing relationships; the lines are labelled using either symbols, words or phrases (Novak, 2010; Novak and Cañas, 2008:1;

Simon, 2007:196; Safayeni *et al.*, 2005:2; Carnot *et al.*, 2003:5;). The relationship represented by the linking line is expressed by means of a linking word or phrase (Novak & Cañas, 2008:1), which must indicate an action (Leauby *et al.*, 2010:281). In Figure 2 (above), "help to answer", "represent" and "includes" indicate the relationship between concepts. This unit of concept-relationship(s)-concept(s) is called a proposition and constitutes a meaningful statement, a semantic unit, or a basic unit of knowledge (Leauby *et al.*, 2010:281; Novak & Cañas, 2008:1; Simon, 2007:276; Maas & Leauby, 2005:77;)Carnot *et al.*, 2003:13; Novak & Gowin, 1984:15). Novak and Cañas (2008:13,20) comment that students, and sometimes even experienced mappers, may experience difficulty with labeling the linking lines, which indicates a lack of understanding of the relationship between concepts. In fact, Leauby *et al.* (2010:281) suggest that it may be more useful for novices to concentrate initially on the identification of the core concepts only. Propositions are nevertheless of great importance because this is where learning either takes place or is shown to have taken place (Simon, 2007:276). Examples of the concept under discussion may be added as a final level for further illumination (Novak & Cañas, 2008:1; Simon, 2007:196).

Once students become adept at correctly identifying relationships, they begin to perceive the interrelatedness of all concepts (Leauby *et al.*, 2010:281; Novak & Cañas, 2008:12). A crosslink is used to indicate these perceived relationships among concepts in different semantic units or domains of knowledge (Novak & Cañas, 2008:1; Simon, 2007:277) that result in a concept map thus becoming "richly interconnected" (Carnot *et al.*, 2003:14). Knowledge is constructed when new propositions are perceived and created (Novak, 2002:550). Such cross-links should therefore be sought once the basic map has been constructed (Novak & Cañas, 2008:12; Simon, 2007:277) as they show insight and understanding of the material (Carnot *et al.*, 2003:5) as well as "creative leaps" by the map creator (Novak & Cañas, 2008:12) and thus give evidence of higher-order thinking (Novak & Cañas, 2008:13).

ii. The hierarchical nature of concept mapping

Concepts are arranged in a hierarchical order, with the most inclusive and therefore most general at the top and the least inclusive and most specific at the bottom (Greenberg & Wilner, 2015:18; Novak, 2010:4; Novak & Cañas, 2008:12; Simon, 2007:276), as illustrated in Figure 2 (above), where the main, inclusive theme is at the top of the diagram, and progressively more specific concepts are ranked below it. Novak and Gowin (1984:15) give as a reason for this the fact that meaningful learning takes place more successfully when presented in this top-down order, or what Ausubel would call "subsumption" (Carnot *et al.*, 2003:15; Ausubel, 1962). Top-

down processing is also useful "to resolve ambiguities or to select between alternative possible interpretations of the incoming data" (Carrell & Eisterhold, 1983:557). The use of cross-links suggests, however, that the hierarchical nature of the concept map is not strict, but is rather what Carnot *et al.* (2003:1) call "semi-hierarchical". For this reason, the direction of the linking lines indicating the flow of the relationships is understood to be downwards unless otherwise indicated by an arrow (Simon, 2007:276), although the use of arrows throughout might at times also be useful (Novak & Gowin, 1984:35). It is this aspect of hierarchical order, along with the cross-linking of concepts, that makes concept mapping such a useful tool for enhancing critical thinking (Novak and Cañas, 2008:1).

iii. The use of pre-constructed concept maps

Creating a concept map "from scratch" might not always be possible or even desirable. The primary constraint is time, as both lecturers and students will need time to familiarise themselves with the technique for constructing concept maps. The problem is worsened because time must necessarily be taken from an already overburdened timetable to teach both the course materials and the concept mapping technique (Greenberg & Wilner, 2015:19; Maas & Leauby, 2005:93; Chang *et al.* 2002:6). Space must also be made for reflection and continued reinforcement of the process (Maas & Leauby, 2005:93; Chang *et al*, 2002:20). Novak and Cañas (2008:9), on the other hand, maintain that only students who have been caught in the rote learning trap struggle to grasp the concept mapping technique. They consequently suggest that "students also need to be taught something about brain mechanisms and knowledge organization, and [that] this instruction should accompany the use of concept maps" (Novak & Cañas, 2008:9). Nevertheless, whatever the reason for the time constraint, the time required for instruction must still be found. In addition, it can be argued that adding more information to what needs to be learnt, i.e. the workings of the brain, might very well aggravate the situation rather than ease it. Accordingly, as Greenberg and Wilner (2015:19) maintain, following the entire process from the start might only be possible when concept mapping is incorporated into the curriculum. The question is whether the full value of concept mapping can only be obtained from participating in the entire process (Greenberg & Wilner, 2015:19). Indeed, Chang *et al*., (2002:6) warns that using an alternative to a self-completed concept map (see the following paragraph) may lead to rote learning – the very issue that concept mapping was designed to counteract. On the other hand, they also report that constructing a concept map *ab initio* has been known to be so stressful to students that it has had a negative effect on learning and even

an eventual negativity towards the technique itself. An alternative solution to constructing a complete concept map consequently seems warranted.

For many who are experiencing these predicaments, the answer appears to lie in using some form of pre-constructed concept map (Greenberg & Wilner, 2015:19), such as Figure 3 below. By using alternative scaffolded ways of interacting with concept maps, it is still possible to experience many of the advantages of concept mapping (Carnot *et al.*, 2003:9), because the very act of "organizing the information into an integrated, hierarchal system" is in line with Ausubel's Assimilation Theory (Greenberg & Wilner, 2015:19). Tackling a complicated topic might be a further reason for using a pre-constructed map, as an "expert skeleton" map, produced by someone who is an expert on that particular theme, may serve as a useful scaffold for both teachers and students (Novak & Cañas, 2008:20). This has the added benefit of providing a "macrostructure" of the theme that serves as an outline of what is to be learnt (Chang *et al.*, 2002:6). If concept mapping is to be used for assessment (see below for a further discussion on assessment), a pre-constructed map has the advantage of allowing for quantifiable measurement, which the wholly constructed concept map does not, being individual expressions of knowledge (Maas & Leauby, 2005:93).
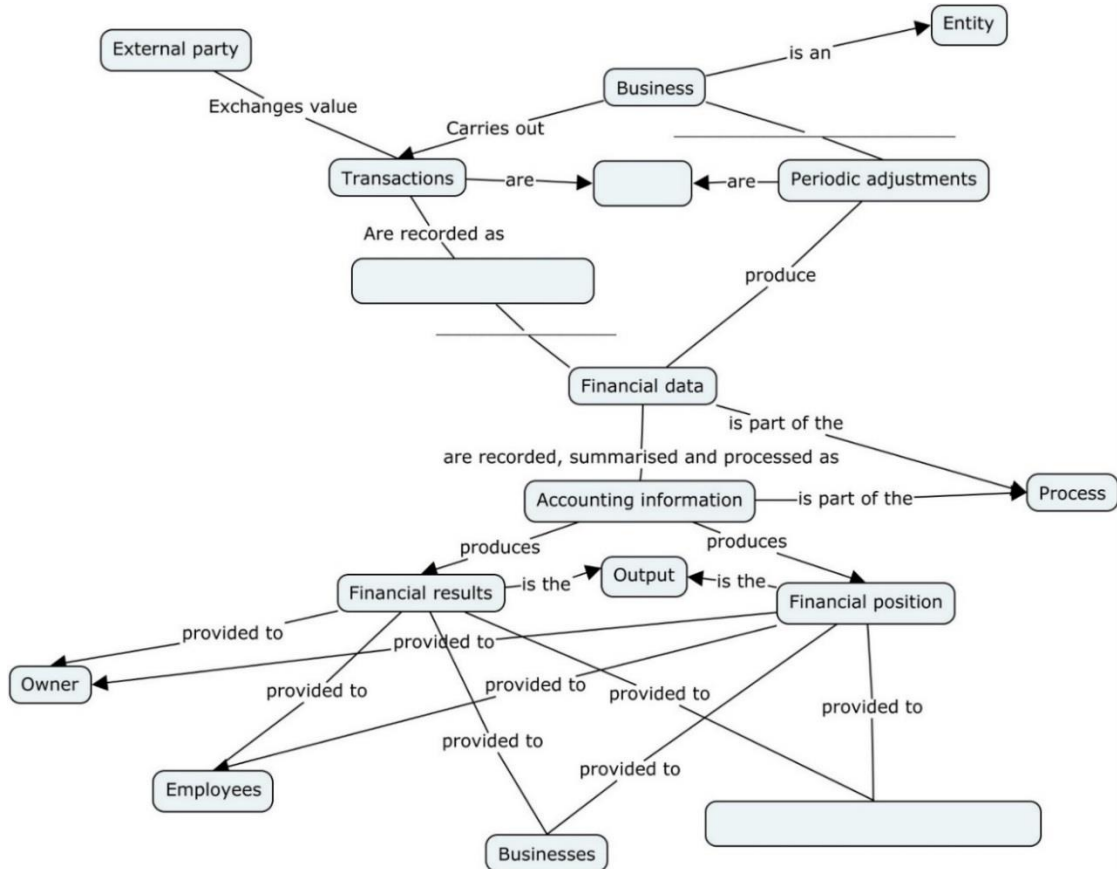

Figure 3 An example of a pre-constructed or partially constructed concept map

A number of different methods has been suggested for using a pre-constructed concept map. This might consist of filling in the blank content nodes of a concept map already containing the labelled relationships of a completed concept map (Greenberg & Wilner, 2015:19), or vice versa. However, a concept map that is too skeletal might create as much cognitive overload as creating an entire concept map (Chang *et al.*, 2002:19). Chang *et al.* (2002:7) suggests two ways in which pre-constructed maps may effectively be used for meaningful learning. One proposed method is to use scaffolding principles by progressively lessening the degree of help given per map as a student's understanding and proficiency improves, a method Chang *et al.* (2002:7) call "scaffold-fading". This suggests that the initial maps will be uniform, becoming gradually more personalised as students' proficiency increases. This process is in keeping with Constructivist principles (Chang *et al.*, 2002:7). A second method proposed by Chang *et al.* (2002:8) is "map correction", where about 40% of the pre-constructed map contains incorrect concepts or relationships. The advantage of this method is that it avoids rote learning because the student, instead of simply regurgitating learnt definitions, is forced to think critically about the propositions expressed in the concept map. Of the two methods proposed by Chang *et al.* (2000), "map correction" appears to have had the most favourable outcome. This result is ascribed to the relative ease with which students were able to adapt to the method, compared to the instruction time required for the "scaffold-fading" method. Chang *et al.* (2002:20) found that it took as long as fourteen weeks before a pre-constructed concept map method showed results, and that, in fact, an entire year might be required to internalise the process fully. This observation yet again highlights the time-consuming nature of implementing concept mapping, even in assisted form.

iv.   The use of concept maps in assessment

The use of concept maps in assessment is encouraged by Novak (2010:231). Indeed, he considers concept mapping as "the most powerful evaluation tool available to educators". Standard tests, especially those that require short answers, do not always sufficiently indicate whether a student has understood the material being tested, as only a small section of knowledge can be covered this way (Novak, 2010:231). When concept maps are used as assessment instruments, a much better insight is gained of a student's understanding (Novak, 2010:232; Novak & Gowin, 1984:94). Nonetheless, not all researchers consider concept mapping a reliable assessment tool because of the idiosyncratic expressions of knowledge it engenders. Novak (2010:232), on the other hand, sees this as a strong point in favour of using concept maps for assessment, as it precludes rote-learned responses. He further argues that

concept mapping as assessment tool complies with both issues of validity and reliability because it aligns with Constructivist theories (Greenberg & Wilner, 2015:16-18; Novak & Gowin, 1984). There are provisions, however. Firstly, students will need to be familiar with concept mapping (Novak, 2010:231). Secondly, objectivity of the marking will have to be ensured. This restraint will only be an issue where the students are required to construct the complete map, because of the resultant variation in the individual map solutions. Novak (2010:232) is of the opinion that such subjectivity in marking will be minimal and easily negated by the advantage that concept mapping assessment offers over assessment that requires rote-learning (Novak, 2010:232). Nevertheless, for large classes this would become a time-consuming matter, apart from the difficulty of remaining objective. A solution might yet again be offered by the use of partially completed concept maps.

v.   The use of technology in creating concept maps

The use of technology might greatly facilitate the concept mapping technique. Novak and Cañas (2008:12) favour the use of CmapTools (Cañas *et al.*, 2004; available at http://cmap.ihmc.us), created by the Florida Institute for Human and Machine Cognition (Novak, 2010:122), although other concept mapping software also exists and is available online. Figure 4 shows an example of the use of CmapTools. A software program eases the process of initially setting up a map and rearranging the positions of concepts and links, and offers the added benefit of the inclusion of images and online links (Novak & Cañas 2008:12-14). A concept map will need several revisions to improve its clarity and structure before it can be considered complete (Novak, 2010; Novak & Cañas, 2008:12; Simon, 2007:277), a necessity which is also greatly facilitated by using software (Novak, 2010). Finally, it enables team participation and collaboration, even across distances (Novak & Cañas, 2008:12). A word of caution is necessary here, however. When considering using computer generated concept maps, it is important to take students' computer literacy into consideration so as to avoid an additional cognitive load.
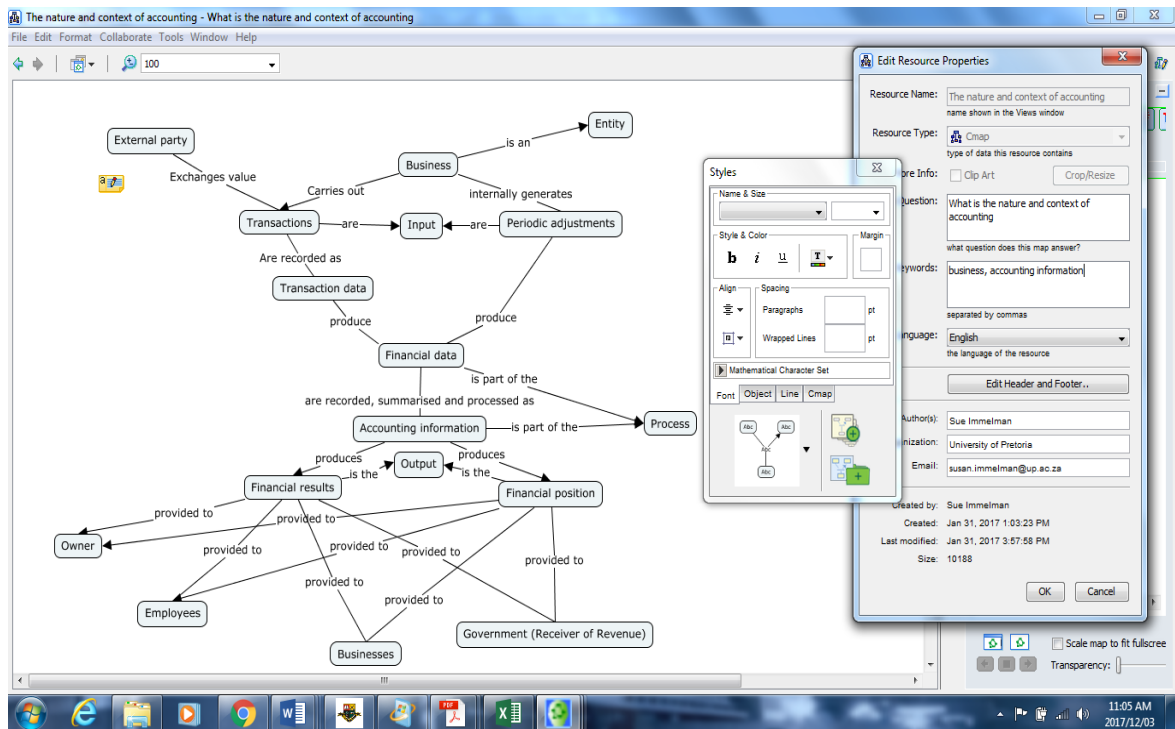
Figure 4 An example of a concept map being created using CmapTools

2.4.2.3 Limitations of concept mapping

Concept mapping is not without restrictions. For instance, while the purpose of concept maps is to represent knowledge, Safayeni *et al.* (2005:2) contend that concept maps cannot represent complicated or "higher" forms of knowledge, such as the mathematical equations needed for Physics. They further maintain that concept maps are only suitable for "static" concept relationships. Indeed, Novak (2002:553) declares that concept mapping is principally useful for declarative knowledge, in accordance with Assimilation Theory principles. Nevertheless, concept maps can be used to clarify confusing or complex concepts and have been used successfully in many subjects, including Mathematics, Bioengineering, Biology (Kinchin, 2000; Novak, 2010), Accounting (Simon, 2007; Maas & Leauby, 2005), Health Sciences (Brennan *et al*., 2012), Nursing (Clarke, 2015) and Religion (Pui-lan, 2010).

There are other constraints, however, that are arguably more problematic. The concern of the time required for both lecturers and students to master concept mapping has been discussed in detail (see Section 2.4.2.2). Some researchers further question students' ability to identify all the intricate relationships that exist between concepts (Simon, 2007:284).

2.5 Conclusion

In this chapter, an overview was given of different approaches to Constructivism – the learning theory in which the pedagogy of the present research is embedded. One of the important concepts within constructivist approaches to teaching and learning is scaffolding. The chapter provided an in-depth exposition of a particular technique for scaffolding content and language learning, namely concept mapping. Concept mapping, based on Ausubel's Assimilation Theory, was shown to function as a scaffolding tool on many levels, as it visually scaffolds knowledge, encourages student participation and supports metacognitive learning in a variety of learning tasks. It can thus be expected to support the acquisition of concept literacy. In a discussion of the formatting of the concept mapping technique, the visual and hierarchical nature of concept mapping was demonstrated, and the use of partially completed concept maps supported. Finally, the possibility of its use in assessment was discussed.

Chapter 3: Methodology

3.1 Introduction

This chapter describes the methodology that will drive the research for this study. Postpositivism was chosen as the research paradigm as it was regarded to be the most suited to answer the main research question, namely "Is concept mapping an effective technique for scaffolding concept literacy among first-year Accounting students in an extended curriculum programme?" Both qualitative and quantitative research will be used to measure the effectiveness of concept mapping. While a mixed-methods approach is not normally used with Postpositivism, it was deemed the most useful strategy here. For various reasons that will be explained in more detail hereafter, it was convenient to conduct the research with the Accounting students of an extended programme at a South African university. Of the approximately 700 students that make up the entire population of students who attend the extended programme, about 180 take Accounting as a subject. These students are divided into two groups according to their choice of degree, the BCom group forming the test group and the BSc Mathematical Sciences group forming the control group. The materials used for the intervention as well as the methods of data gathering and data analysis will be discussed in detail.

3.2 Research paradigm

Karl Popper (2002:18) was the first to declare that theories can never be verified empirically, which was in contrast to the inductive reasoning practised by Positivism. At present, many researchers therefore take the position that it is not possible to claim an absolute truth about the knowledge acquired through research (Floden, 2009:488; Trochim, 2001:20), especially when doing research in which humans are participants (Creswell, 2014:7; Somekh & Lewin, 2011:327). Popper proposed that research should thus not aim at verifying a theory or hypothesis, but at attempting to falsify it (Crook & Garratt, 2011:213; Popper, 2002:18; Mouton, 1996:15). With every failed attempt to prove a theory false, the theory emerges stronger and finally becomes part of the body of knowledge. Yet even this endorsement is tenuous, as the theory might still be proved false at some future date (Crook & Garratt, 2011:213; Mouton, 1996:15). However, this does not prevent a researcher from "making credible claims based on rigorous inquiry" (Floden, 2009:488).

This outlook describes the Postpositivist worldview, embedded in a Realist ontology (Willis, 2012a:9), which will inform the methodology used in this study. Some expressions of Postpositivism hold extreme views of "falsification", and insist that no amount of research will prove a theory right. This position has been attenuated somewhat so that, currently, knowledge claims may be made after many studies have been conducted on the same theme (Willis, 2012b:8). In fact, in working "publicly within the context of a broader contentious community of truth-seekers (including other scientists) who criticize each other's work", true objectivity may be approached (Trochim, 2001:20). Underlying the Postpositivist worldview, then, is the desire to look for truth (Willis, 2012b:8), although this remains a goal that is not easily attainable.

The Postpositivist paradigm is deterministic in nature, which means that outcomes are presumed to have causes, and that these causes may be identified and investigated (Creswell, 2014:7). For example, extenuating circumstances may be sought to explain the failure of a theory (Willis, 2012b:7). This worldview is also reductionist, as it is the basic elements that make up the proposed theory that are tested in the research (Creswell, 2014:7). The key features of Postpositivism may be expressed as follows (extracted from Creswell, 2014:7 and Willis, 2012b):

- At the start of the research, a theory must be put forward on which the research will be conducted. The theory (or hypothesis) must be clearly and unambiguously stated (see Sections 1.5 and 1.6).

- Data are then collected by means of appropriate instruments and the process strictly controlled (see Section 3.6).

- After analysis of the data, an attempt is made to explain the causes of the observed outcomes (see Chapter 4).

- Objectivity and validity of the conclusions must be assured. Willis (2012b:12) cautions that, to avoid bias, "[y]ou must step out of the professional practitioner role in order to take on the role of researcher" (see Section 3.4).

3.3 Research design and strategy

The most appropriate research methodology for the Postpositivist worldview is a quantitative strategy. However, the sequential mixed-methods strategy was selected for this study, as the aim was to obtain a wide range of data, and using both quantitative and qualitative data

collection methods have the desired outcome of obtaining knowledge through investigation, with the aim of understanding the world around us (Sale, Lohfeld & Brazil, 2002:46).

With the sequential mixed-methods strategy, one type of data collection is used to expand on the other (Creswell, 2014:14). In this case, the qualitative data made up a small part of the collected data, as they were drawn from four open-ended survey questions and the observations of the research intervention; nevertheless, the fact that both qualitative and quantitative methods were used had an impact on the research design. Therefore, despite the research design for Postpositivism normally being a quantitative approach, a mixed-method approach was followed here.

Using a mixed-methods design has advantages as it prevents the possible biases that may arise from a single-focus lens, and the different foci are useful in providing additional triangulation of results (Creswell, 2014:15; Lewin, 2011:220). Yet, mixed-methods approaches can move beyond these initial advantages to merged strategies that forge new paths of research, so that, according to Creswell (2014:10), "the overall strength of a study is greater than either qualitative or quantitative research".

3.4 Population and sampling

There are approximately 700 extended programme students per year at the Mamelodi campus of the University of Pretoria. These students are grouped according to the course they wish to pursue, being either BSc (Biological, Mathematical and Physical Sciences) or BCom. The annual intake of the BCom Extended Programme is approximately 150 students, and that of the BSc Extended Programme approximately 550 students. Concept mapping aims at improving concept literacy and is therefore best housed in a content subject rather than a non-content subject, such as Academic Literacy. Selecting a content subject depended largely on the willing cooperation of the content subject lecturer. The Accounting lecturer showed an interest in concept mapping and Accounting was consequently chosen for the research. To house the research in Accounting was merited since research shows that the use of concept mapping is suited to this content subject (Leauby *et al*., 2010:284). A further positive aspect of using the Accounting course as the content subject is that students were conveniently grouped into two groups, which facilitated the formation of a test and control group.

According to Faculty regulations, students may apply to do the BCom (Extended Programme) if they have achieved an Admission Point Score (APS)[1] of at least 26, an NSC Mathematics level of at least 3 (40-49%) and an NSC English level of at least 4 (50-59%, either at English Home Language level or First Additional Language level) (Faculty of Economic and Management Sciences, 2017). The BCom Extended Programme has a fixed structure and content, except for certain variations in the Mathematics and Statistics offerings, which are determined by whether the students will be pursuing a numerical or non-numerical BCom degree. Students wanting to pursue a numerical BCom degree must obtain an NSC Mathematics level of at least 4 (50-59%) (University of Pretoria Yearbook, 2017). For the non-numerical degree, only one semester of Mathematics is included in the curriculum. All the BCom students have Accounting as a subject in the extended programme.

Students may apply to the BSc Mathematical Sciences (Extended Programme) if they achieved an APS of at least 26 and an NSC English rating of at least 4, as with the BCom (Extended Programme). However, for BSc Mathematical Sciences (Extended Programme) students, an NSC Mathematics rating of at least 5 (60-69%) is required. Students may select Accounting as elective and students choosing this elective are then grouped together (Faculty of Natural and Agricultural Sciences, 2017).

Accounting as a school subject is not a pre-requisite for either programme; in other words, some of the students may be doing Accounting for the first time. As both the BCom (Extended Programme) and the BSc Mathematical Sciences (Extended Programme) require English at level 4 (50% – 59%, either as Home Language or First Additional Language), a certain level of proficiency in English may be presumed.

The Accounting students have four hours of lectures per week, during which new Accounting concepts are introduced by the lecturer. This is followed by four hours of tutorials, facilitated by tutors, during which the concepts are embedded through practice. For the tutorials, the large lecture groups are broken up into smaller groups that can be accommodated in the laboratories. It was deemed appropriate that the concept maps be introduced by the Accounting lecturer in the lecture periods. It would not have been suitable to use the tutors (senior students), for whom concept mapping was unfamiliar, whereas the Accounting lecturer had been instrumental in the construction of the concept maps and he was therefore

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[1] The Admission Point Score (APS) is calculated using the NSC seven-point rating scale of achievement for six of a student's recognised NSC 20-credit subjects.

conversant with their function. This is a suitable environment for the effective use of concept mapping as the Postpositivism paradigm requires the researcher to be distanced from his or her normal role as practitioner, for the sake of validity (Willis, 2012b:12).

The BCom group was chosen as the test group and the BSc Mathematical Sciences group with Accounting as elective as the control group. The BCom group was chosen as the test group because it was the larger of the two groups and it was felt that the concept mapping intervention would therefore be more thoroughly tested. Because these two groups were chosen for their accessibility, convenience sampling, a type of non-probability sampling often used when there is a time constraint, was used (Lewin, 2011:224). The sampling could also have been called "purposive", as the participants were specially selected to test something new. As the participants of the two groups are not randomly selected, the study can be called quasi-experimental (Lewin, 2011:221). This raises concerns about validity because the groups might differ in significant ways, based on the criteria used to divide the students into these groups. Validity of data is of primary concern in the Postpositivist paradigm (Creswell, 2014:7). Consequently, the two groups were tested for equality of ability (see Section 4.2.2). For the same reason, confounding variables, such as previous exposure to visual aids, high school attended, Maths and English marks in Grade 12, and previous experience of Accounting, needed to be carefully accounted for (see Leauby *et al.*, 2010:288, for a review of issues that invalidated concept mapping research results).

3.5 Setting

The setting was the first semester Accounting module (FRK 133). The syllabus comprises the following main themes: The nature and function of Accounting; the development of Accounting; financial position; financial performance; flow of documents; the recording process; processing of Accounting data; treatment of VAT; elementary statement of comprehensive income (income statement) and statement of financial position (balance sheet) (University of Pretoria, 2017).

The intervention, which revised previously addressed material, was integrated into the standard curriculum. Because of the pedagogic importance of authenticity and validity in assessment, the additional research and assessment instruments were aligned to the outcomes of the curriculum and the purpose of the task at hand (Herrington & Herrington, 2006:149; see also Cumming & Maxwell, 1999:179).

3.6 Methods of data gathering

With the Postpositivist research paradigm, it is important that suitable instruments be used to collect the necessary data. The following research instruments were deemed most appropriate for this research study:

- A pre-intervention questionnaire survey of students' experience in using visualisation techniques for learning and memorisation

- Pre- and post-intervention expository paragraphs

- Observation of concept mapping class discussion

- A post-intervention opinion survey (questionnaire)

Below, each of these instruments will be discussed in terms of how they were constructed, how they were used to gather data and how the data were analysed.

3.6.1 Pre-intervention questionnaire survey of students' experience in using visualisation techniques for learning and memorisation

To obtain a holistic view of the factors that influence student performance (Koh, 2014:456) and to prevent a skewed result, it was considered necessary to identify confounding variables, such as students' educational history, learning styles and other relevant background factors. A pre-intervention questionnaire, designed to elicit this information, was therefore completed in class by the test and control groups (See Appendix A). As it was expected that a large number of students were to be surveyed, questionnaires were deemed more useful than other survey methods, such as interviews and focus groups (Lewin, 2011:224; Novak, 2010:116). Novak (2010:116) also makes the point that questionnaires have an advantage over focus groups and interviews in that quantitative data can be extracted from questionnaires. However, he also warns of misinterpretation of student responses in a questionnaire, in contrast to an interview where a response can be investigated by means of further questions. Furthermore, questionnaires have a notoriously poor response rate (Michaelidou & Dibb, 2006). It was therefore thought advisable that the questionnaires be done in class time. Descriptive and inferential statistics were used to analyse the data, and contributed to answering the main research question: "Is concept mapping an effective technique for scaffolding concept literacy among first-year Accounting students in an extended curriculum programme?"

The first four questions of the pre-intervention questionnaire were aimed at establishing the learning styles of the students: verbal ("I learn through reading a printed or written text"), aural ("I learn through listening, e.g. to a lecture"), physical ("I learn when I am active, e.g. when I highlight, underline, summarise") or visual ("I learn by using visual elements, e.g. maps, graphs, pictures"). This was done to determine whether a visual learner would be advantaged in the use of concept mapping, which is a highly visual technique. A Likert scale of one to four was used, ranging from "strongly agree", "agree" and "disagree" to "strongly disagree". Students were therefore forced to give an opinion, as the traditional neutral point in a Likert scale was removed.

The next three questions probed students' experience of visual aids, such as mind maps. The first question attempted to establish whether students had used such learning aids previously, with a straightforward "yes" or "no" response to the question "I have used visual aids, such as the one shown here, before". In retrospect, an additional question could have been added to determine the degree of such exposure as a brief introduction to visual aids would have had a very different result from an immersion in the use of such aids. Students were then prompted to assess the extent to which visual aids had been useful for memorisation ("The visual aid that I used helped me to memorise the work") and for understanding ("The visual aid I used helped me to understand the work"), again with a "yes" or "no" response. Here, however, students were given the option of providing a third, "not applicable" response if they had no previous experience of visual aids for learning.

One qualitative question was included to allow for further information regarding visual aids that students might wish to add. The question read as follows, "Is there any further comment you would like to make about the advantages and disadvantages of using visual elements in academic work?"

The next twelve questions were used to gather demographic information about students, in particular to determine the factors that might have had an impact on the students' pre- and post-intervention paragraph results (Koh, 2014:453). Such demographic information, if placed at the beginning of a questionnaire, may seem intrusive to students and prevent their further participation (Lewin, 2011:224). For this reason, these questions were asked at the end of the questionnaire. Even though the anonymity of each student was guaranteed, it was necessary to obtain their names and student numbers to be able to match the pre- and post-intervention paragraphs results. According to Lewin (2011:224), the questionnaire could therefore not truly be called anonymous. Students were then asked whether they belonged to the BCom (test) or

BSc (control) group, and, even though the two groups operated separately and their identity was known beforehand, this was added confirmation that students were in the correct group. Students' gender was established, as it was originally thought that this might be a factor that could have an impact on results.

Students were asked to provide the name of the school they had attended, as well as where the school was situated, as it was thought that the level at which the school operated might have an impact on results. Currently, the South African government funds basic education according to a "pro-poor funding model", where schools are categorised according to the level of poverty in the surrounding area. There are five categories or "quintiles", with quintiles 1 to 3 receiving most funding and charging no schools fees; schools falling within quintiles 4 and 5 receive the least funding and are consequently allowed to charge school fees (Dass & Rinquest, 2017:143). There is also a further category of schools, namely independent or private schools. These schools do not fall within the quintile system and are commonly funded entirely by parents. Since students were not expected to know in which quintile the schools fell that they had attended, the school names and locations were used to find information on the schools and then to categorise them as non fee-paying schools (quintiles 1 to 3 = 1), fee-paying schools (quintiles 4 and 5 = 2), or private schools (= 3). Categorisation facilitated better statistical analysis and provided information that was more useful. However, a few problems were encountered during this process. Some schools could not be traced, possibly because of respondents' spelling mistakes, and the information in such cases unfortunately needed to be discarded. Furthermore, it became clear that there are private schools run by charitable organisations attempting to uplift a community. The category of "private school" is therefore somewhat blurred and may affect the drawing of conclusions about the effect the level of a school has on results.

Four questions in the questionnaire dealt with students' matric results. They were asked what their final symbol for English had been ("Symbol received for English in final exams"), and whether the level of the paper had been English Home Language or English First Additional Language ("Level of English in Grade 12"). For the first of these two questions, a range of symbols (A [7] to F [2]) was provided for selection, to ensure that all reasonable possibilities were catered for. Even though students needed a level 4 to gain entry to either the BCom or BSc Mathematical Sciences extended programme, a level 2 response was made available in case students who had only achieved this level had slipped through the system. The question on the level of English in Grade 12 required a choice between "English Home Language" and "English

First Additional Language". These two questions were linked to the question on home language ("Home Language") which offered the following range of responses: English, Afrikaans, Sepedi, Other South African, Other African and Other. The current interest in the impact that not being taught in one's home language has on student success (Carstens, 2015; Gablasova, 2012; Mckenna, 2012; Nkomo & Madiba, 2011) elicited these questions. Nevertheless, the data on home language were discarded because of the sparse distribution of cases, which meant that the model was not estimable. As a result, the impact that language might have had on student results rested upon the level of English they took in Grade 12 and their matric results for English.

The symbol students received for Maths was also obtained ("Symbol received for Maths in final exams"), as well as the APS with which they applied to the University ("Final AP score gained"). It was thought that this information could affect the student results. As far as the question regarding symbols was concerned, a range of symbols (A [7] to F [2]) was provided for selection, to ensure that all reasonable possibilities were catered for. Even though students needed a level 3 (BCom) or 5 (BSc Mathematical Sciences) in Maths to gain entry to the extended programme, a level 2 response was made available in case students who had only achieved this level had slipped through the system. The APS required a number to be filled in (for more information on the APS, see Section 3.5). A further school-related question dealt with whether the students had previous experience of Accounting ("Had Accounting as a school subject"), which required a "yes" or "no" answer.

3.6.2 Pre- and post-intervention expository paragraph

Prior to the concept mapping intervention, both the test and control groups were asked to write a paragraph based on a previously introduced Accounting theme that required the understanding of specific Accounting terms. A similar task was conducted after the concept mapping intervention, based on the theme that had been addressed during the concept mapping intervention. To assist students in the formulation of their answers, a list of Accounting terms was provided, which needed to be incorporated into their answers. Lined paper accompanied the questions on which the solutions were to be written.

The pre- and post-intervention paragraph questions (see Sections 3.6.2.1 and 3.6.2.2 below) were drawn up by the Accounting lecturer during whose lectures the concept mapping intervention would take place. This was necessary, as it was essential that the assessment represented an environment that was familiar to the Accounting students. The questions were

moderated by a senior lecturer in Accounting to ensure their validity, as well as by me, to ensure that the results would be measurable according to the requirements of the present research.

For both paragraphs, two real-life scenarios were sketched to which students had to apply relevant Accounting principles. The use of real-life scenarios in assessment is familiar to Accounting students, and complies with the third level of Bloom's Taxonomy in that the cognitive skill, application of knowledge, is required (Needles, 2014:38). However, whereas answers are typically required in numerical or bookkeeping form in assessments, students were in this case required to respond by writing the answers in a paragraph form. In other words, they needed to verbalise their responses.

There is justification for this departure from the normal Accounting assessment format. Pearson, Hiebert and Kamil (2012:2) state that a true test for effective terminology acquisition would be the spontaneous use of terminology in students' speaking and writing. However, they also point out that tracing such use would entail both time- and effort-intensive moderation that would be unmanageable on a large scale. It is for these same reasons, they contend, that terminology assessment has most often been directed towards receptive (listening and reading) rather than productive (speaking and writing) methods.

Nevertheless, it was considered of importance that the "spontaneous use of vocabulary words" was evaluated for this study, as this would provide valuable feedback on the effectiveness of the intervention that had conceptual understanding as its focus. It is worthwhile here to refer again to the statement made by Gablasova (2012:13) that "part of mastering the subject-matter is the learning of the appropriate way of communicating it". Many researchers see conceptual learning as taking place through the medium of language (Vygotsky, 1986:108; Novak, 2010:80; Novak & Cañas, 2008:15). A further motivating factor for requiring students to write paragraphs was the possibility that the typical numerical solutions might have been memorised, a situation that would be revealed by means of the setting of unfamiliar problems (Novak & Gowin, 1984:94; see also Vygotsky, 1986:150). Furthermore, in her study, Jonker (2016) reports that students' written assignments showed a lack of conceptual understanding of the concepts that an improved pass rate had suggested.

Cloze tests and vocabulary levels tests were not used, as these tests focus on English language proficiency rather than on concept knowledge attainment. It is my belief that conceptual understanding is better tested through productive terminology usage than through receptive

terminology usage. The idea of spontaneous use of terminology was therefore adapted to be of value for this assessment, as students needed to be informed of the assessment criteria for the exercise beforehand. "Spontaneous" must in this case therefore be interpreted as "unprompted".

The use of subject-specific terms in the pre- and post-intervention paragraphs were assessed for occurrence (unprompted use) and correct usage (conceptual understanding). These tasks comply with two of the "levels of complexity" that Alcina (2009:5) uses to measure the degree of cognitive development that has occurred, in that students had to recall the meaning of the words from memory (first level of complexity) and apply them to a new situation (second level of complexity). The verbalisation of their responses also creates the "professional context" that Maas and Leauby (2005:78) advocate, in which "Accounting graduates must be capable of applying conceptual and technical business knowledge and skills to structured, unstructured, or ill-defined business scenarios". Needles (2014:39) names communication skills, which include writing skills, as one of the five basic skills areas essential to the Accounting profession. He further maintains that such skills need to be "developed through particular tasks and assignments".

In the writing of the post-intervention paragraph, the most comparable environment needed to be created for both the test and control group. For this reason, the topic covered in the concept mapping intervention for the test group ("The Accrual Concept") was also revised for the control group by means of PowerPoint notes, a revision format with which they were well acquainted. Furthermore, the same timespan of three days was allowed to elapse between the revision and the writing of the post-intervention paragraph for both groups. There was no prescribed reason for deciding on that particular interval; it was solely determined by timetable constraints. However, once the interval became necessary for the test group, it was similarly required for the control group.

The pre- and post-intervention paragraphs were evaluated for conceptual understanding using the extensive guidelines provided by the Accounting Department (see Sections 3.6.2.1 and 3.6.2.2 below). Marks were thus awarded for the correct application of the terms provided. The grammar, spelling and punctuation usage was also assessed and the impact on the marks of infringements captured separately. The marks that included the grammar infringements were eventually not used, as such infringements in some cases had too great an impact on the Accounting marks, and took the focus away from what the research was actually testing. The marking was done by me and moderated by the subject specialist.

The pre- and post-intervention paragraph scores of the students from the test and control groups were compared to see if there had been any improvement, and to establish whether such improvement had been greater for the test group than for the control group. The results of the statistical tests based on this data contributed to answering the sub-question: "How does concept mapping affect students' comprehension of subject-specific concepts and their associated terms?"

3.6.2.1 The pre-intervention paragraphs

The following scenarios were given for the pre-intervention paragraphs.

Mrs Mohamed owns a fast food business (At-Your-Service). The following transactions occurred during the financial year ending 28 February 2016:

27 February 2016   At-Your-Service received a water and electricity bill of R 5 000 from its municipality relating to the month of February 2016. Mrs Mohamed indicated that the bill will be settled in March 2016.

28 February 2016   At-Your-Service made a 3 year loan of R100 000 to Bisho enterprises on 01 March 2014. The interest on the loan amounts to R 7 000 per annum. Bisho has not yet paid the interest due for the year ended 28 February 2016.

Required:

Discuss, with reasons, how you will account for both of the above transactions in:
- The Statement of Profit or Loss and Other Comprehensive Income of At-Your-Service for the year ended 28 February 2016 AND
- The Statement of Financial Position of At-Your-Service as at 28 February 2016.

Note:
- You are required to use the format provided
- The following terms should be included in your discussion:
  - Interest income or income
  - liability
  - expense
  - accrued expense
  - accrued income
  - asset
  - current financial year
  - following financial year
  - earned
  - incurred

Students were expected to apply these terms to the correct scenario and in the correct way. Thus, seven correct statements could be made for each scenario, as illustrated in the suggested

solution below. The final mark was out of fourteen, a mark being awarded for the correct application of each of the terms provided.

Transaction on 27 February 2016:

The water and electricity bill of R5 000 represents an **expense incurred** but not yet paid (**accrued expense)**. The water and electricity **expense** account will be debited while an **accrued expense** account will be credited. The water and electricity **expense** of R5 000 will be recognised in the **Statement of profit or loss and other comprehensive income** as it was **incurred** in the **current financial year** ending 28 February 2016. An **accrued expense** will be recognised in the **Statement of Financial Position** as a current **liability** as it was not yet paid as at 28 February 2016 (or is payable in the **following financial year**).

Transaction on 28 February 2016:

The interest receivable from Bisho of R7 000 represents **interest income earned** but not yet received (**accrued income)**. The **interest income** account will be credited while an **accrued income** account will be debited. The **interest income** of R5 000 will be recognised in the **Statement of profit or loss and other comprehensive income** as it was **earned** in the **current financial year** ending 28 February 2016. An **accrued income** will be recognised in the **Statement of Financial Position** as a current **asset** as it was not yet received as at 28 February 2016 (or is receivable in the **following financial year)**.

3.6.2.2 The post-intervention paragraphs

The following scenarios were provided for the post-intervention paragraphs.

Mrs Lee owns a soft drink making business (**Softie Beverages**). The following transactions occurred during the financial year ending 28 February **2016**:

| 1 January 2016 | Softie Beverages paid R20 000 for business insurance cover. The policy commences on 1 January 2016 and costs R2 000 per month. |
| 1 February 2016 | After tasting Softie Beverage's soft drink, Mr Moloko placed two orders, the first worth R5 000 which was delivered to him on the same day and the second worth R7 000 which will be delivered to him on 3 March 2016. Mr Moloko paid the full R12 000 on 1 February 2016. |

Required:
Discuss, with reasons, how you will account for both of the above transactions in:
- The Statement of Profit or Loss and Other Comprehensive Income of Softie Beverages for the year ended 28 February 2016 **AND**
- The Statement of Financial Position of Softie Beverages as at 28 February 2016.

Note:
- You are required to use the format provided
- The following terms should be included in your discussion:

- Sales (or income)
- Income received in advance
- liability
- expense
- prepaid expense
- asset
- current financial year
- following financial year
- earned
- incurred

Students were again expected to apply these terms to the correct scenario and in the correct way. In this case, eight correct statements could be made for each scenario, as illustrated in the suggested solution below. The final mark was out of sixteen, a mark being awarded for the correct application of each of the terms provided. The difference in the marks was catered for in the statistical analysis.

Transaction on 1 January 2016:

The total amount paid to the insurer of R20 000 will be credited to the business bank account. However, only R4 000 (R2 000 x 2 months) will be recognised as an **expense** in the **Statement of profit or loss and other comprehensive income** for the year ended 28 February 2016, as it was an **expense incurred** in the **current financial year**. The R16 000 (R20 000 - R4 000) represents **prepaid expenses** as it relates to the **following financial year**. The **prepaid expense** of R16 000 is a current **asset** which will be recognised in the **Statement of financial position at 28 February 2016**. Softie Beverages has not yet **incurred** the R16 000 insurance **expense** even though the cash was paid.

Transaction on 1 February 2016:

The total amount received from Mr Moloko of R12 000 will be debited to the business bank account. However, only the R5 000 amount will be recognised as **sales (or income)** in the **Statement of profit or loss and other comprehensive income** for the year ended 28 February 2016, as the soft drinks were delivered in the **current financial year**, therefore the **income** was **earned**. The R7 000 represents **income received in advance** as the soft drinks will only be delivered in the **following year**. The income received in advance represents a current **liability** which will be recognised in the **Statement of financial position as at 28 February 2016.** Softie Beverages has not yet **earned** the R7 000 **income** even though the cash was received.

3.6.3 The concept maps

It was decided to familiarise the students in the test group with concept mapping prior to the intervention, by presenting them with two concept maps on work that they had already covered. This was felt to be an essential course of action because, on the one hand, the concept mapping strategy was most likely entirely new to students. On the other hand, the time available to acquaint students with concept mapping was limited, and, as discussed before, a substantial period is needed to become familiar with the technique. Moreover, since the intensive participation required from students in the concept mapping exercises might have created anxiety in participants or might even have precluded their participation, partially completed concept maps were created (Carnot *et al.*, 2003:9). As Novak (2010:13) maintains, students need "explicit guidance in the use of tools and strategies". The novelty of the strategy of concept mapping necessitated guidance by the lecturer and the support of peers, and consequently the concept map tasks were done in teams of two or three where possible, which had the added benefit of facilitating peer scaffolding (Herrington, Oliver & Reeves, 2002).

The concept maps were drawn up by the Accounting Department and then created online by me, using CmapTools software (Novak & Cañas, 2008:14). The concept maps were therefore conceived by experts in the field of Accounting, who understand the relationships between concepts, as advised by Novak and Cañas (2008:14). The pre-intervention concept maps covered "Revenue (Sales)" and the "Accounting Cycle", both themes that had already been addressed during the semester. The maps were only presented once the pre-intervention paragraphs had been written, to prevent the paragraph marks from being influenced. Firstly, a completed concept map on "Revenue (Sales)" (Figure 5), depicting the relationship between revenue and cash flows, was presented to the test group in class.
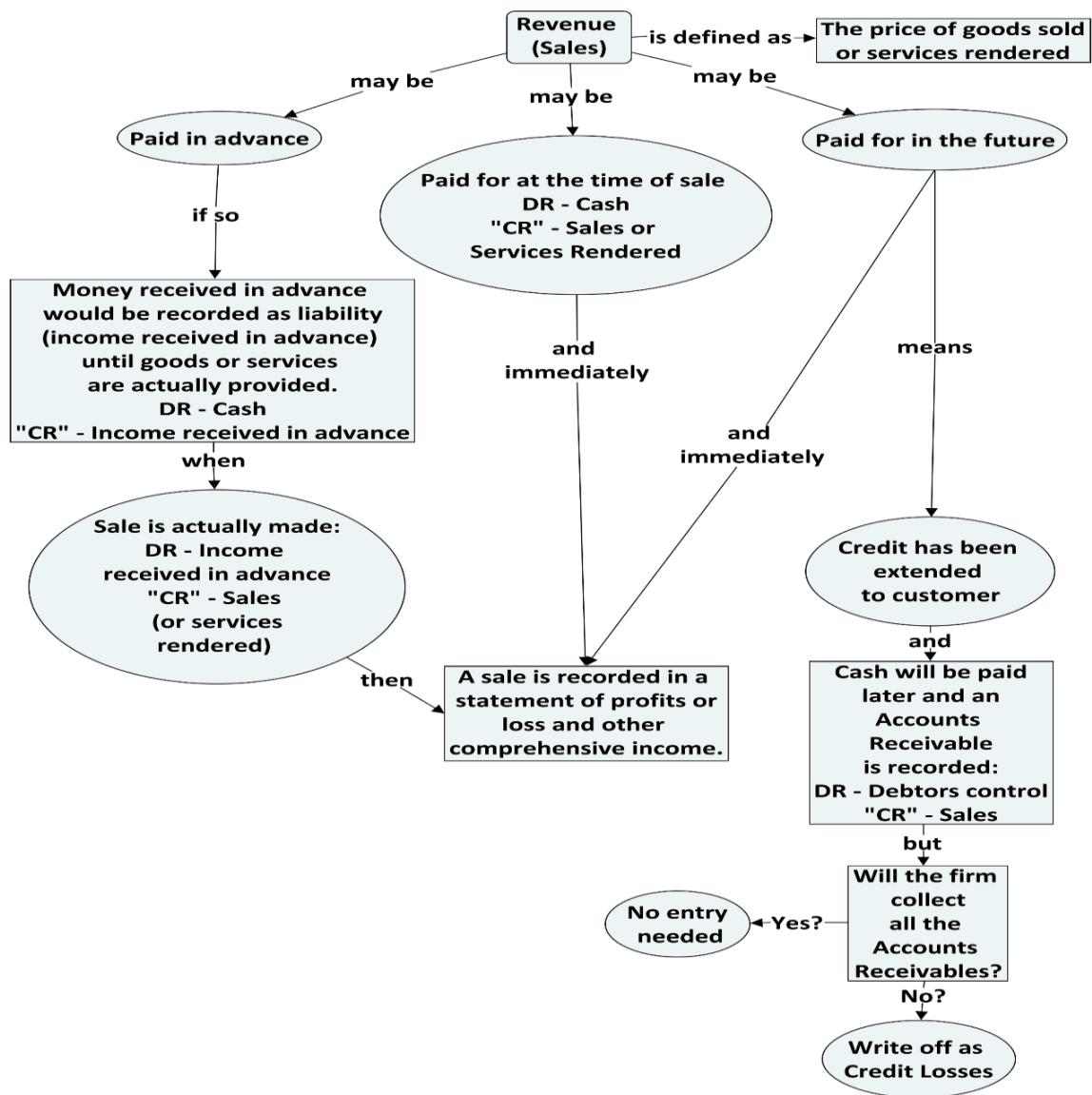
Figure 5 The Revenue (Sales) concept map

Thereafter, the students were given a concept map representing the Accounting Cycle (Figure 6). In this instance, the map was only partially completed. As mentioned previously, requiring students to complete the map was considered a further step in illuminating the idea of concept mapping. The completed map was then presented by the Accounting lecturer, and the Accounting cycle discussed.
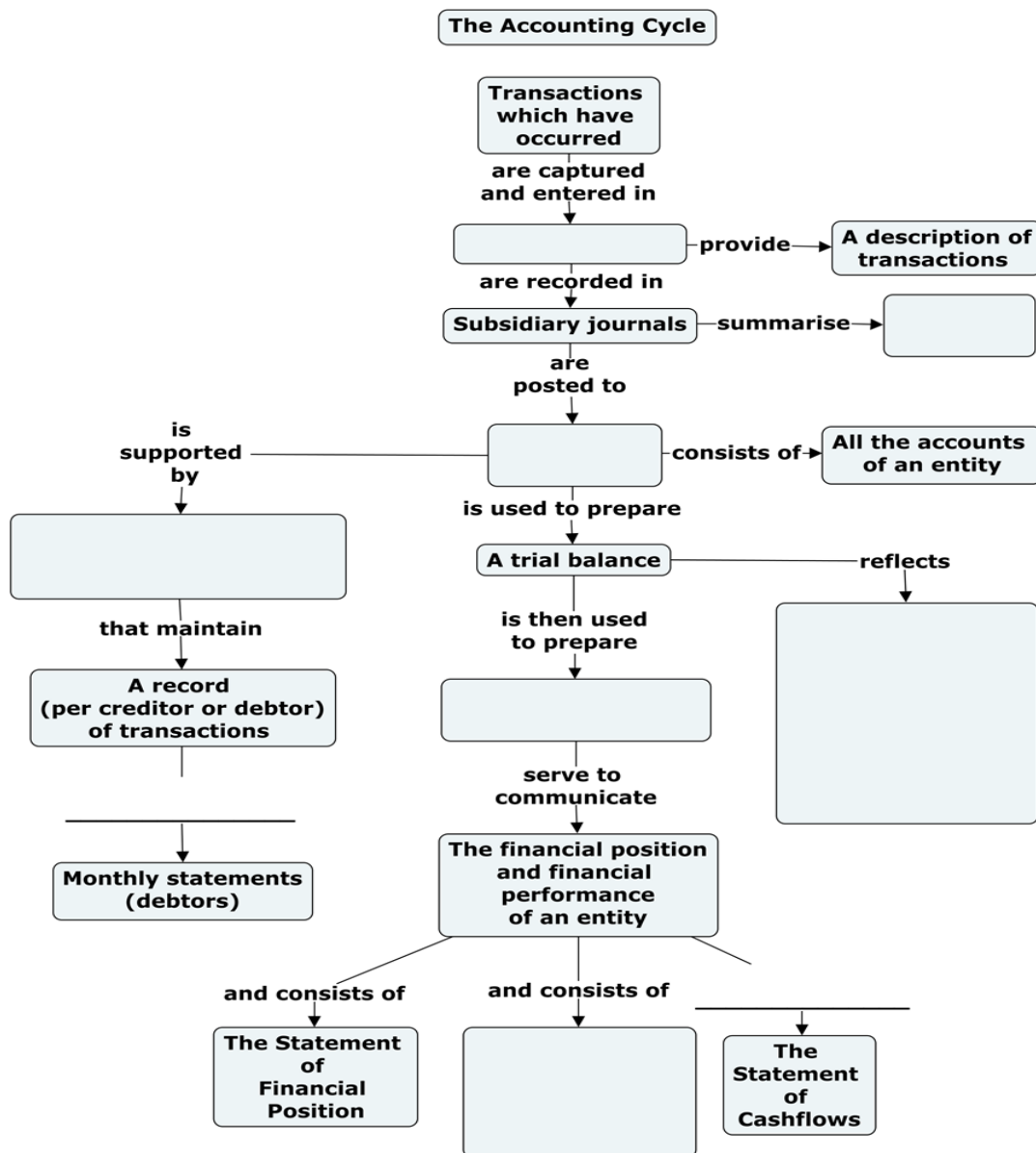
Figure 6 The Accounting Cycle concept map

After this preparatory work, the main intervention took place, for which the topic was the "Accrual Concept" (Figure 7). Once again, a partially completed concept map was supplied to students that they had to complete. Once again, they were asked to work in teams, although each student was expected to complete a map. They were allowed to refer to their textbooks. After a time period that was considered adequate for the completion of the concept map had elapsed, the Accounting lecturer discussed the correct version of the map by filling in the gaps and talking students through the process. Students were allowed to correct their maps and ask questions.
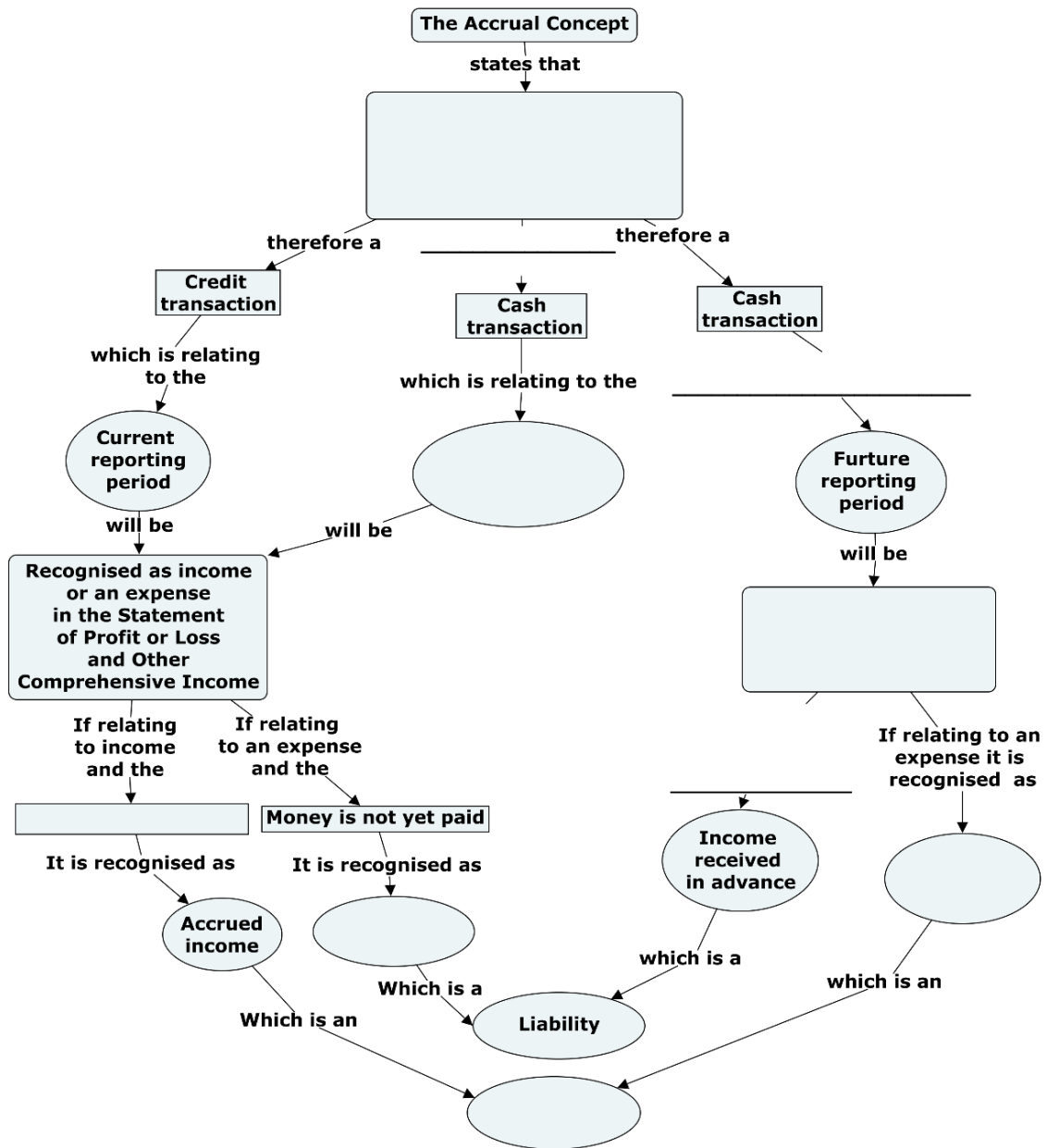
Figure 7 The Accrual Concept concept map

Each student's completed map was then collected so that a record could be kept of participants, as only the data of students who had participated in the entire process, from pre-intervention questionnaire, pre- and post-intervention paragraph and concept mapping intervention, to post-intervention questionnaire, would be useable for research purposes. There was also a secondary reason for collecting the maps: if the maps were allowed to circulate amongst students (as the sharing of knowledge is a common, and encouraged, practice amongst students), the non-intervention status of the control group could have been compromised.

3.6.4 Observation of concept mapping intervention

Three lecturers took part in the observation of the concept mapping intervention: the Accounting lecturer, an academic literacy colleague and I. While the Accounting lecturer and I were involved in the research and therefore had particular, though unspoken, aspects in mind while observing the students, the third observer was not guided beforehand as to the aspects worthy of comment. The reason for this was to obtain an entirely objective view, with, possibly, fresh insights. The observers moved amongst the students while they, individually or in groups of two or three, completed the partially-constructed concept map on the Accrual Concept (see Figure 7). After the completion of the concept map, the correct version was presented to the class so that the teams could correct their maps and become aware of their misconceptions. The further discussions were again observed, and recorded. These observations were useful in determining the level and type of interaction that concept mapping stimulates. This form of observation was decided on as the most efficacious, as an audio-visual specialist attached to the university where the research was conducted advised that recording the student conversations would not have been possible in the venue in which the intervention took place. The observation notes of the lecturers were analysed and the results informed the findings of the quantitative research.

3.6.5 Post-intervention opinion survey (questionnaire)

Finally, the students in the test group were requested to complete a post-intervention questionnaire so that an attitudinal measurement of their concept mapping experience might be obtained (See Appendix B). Both quantitative and qualitative methodologies may be used to investigate the experiences of the research subjects, but the methods should be in keeping with their respective theoretical paradigms. For example, questionnaires with controlled responses, such as those using a Likert scale, are in keeping with a quantitative perspective (Sale *et al.*, 2002:45), while open-ended questions follow a qualitative perspective.

In the questionnaire, Likert-scale questions pertinently solicited students' experiences of the concept mapping intervention. The Likert scale does not test answers for correctness but rather tries to obtain the opinion of students (Novak, 2010:226). In order to obtain a broader, unconstrained view of the students' experiences of, and attitudes to, concept mapping, a number of open-ended questions were added to the questionnaire (Sale *et al.*, 2002:45). The questionnaire was largely an operationalisation of the benefits of concept maps mentioned in

the literature, as well as issues that may have arisen during the intervention and the relevant assessments.

The post-intervention questionnaire primarily focused on the experiences of concept mapping of the test group students. As with the pre-intervention questionnaire, a Likert scale of one to four was used for the quantitative questions, ranging from "strongly agree", "agree" and "disagree", to "strongly disagree", forcing students to provide a definite response.

The quantitative questions probed the students' experiences of concept mapping from several angles to ensure that responses were not misinterpreted. For instance, a positive response to the question "I find concept mapping easy to use" does not necessarily mean that students are positively disposed to using the strategy. On the other hand, if students did not find concept mapping easy to use, they might display a negative attitude towards every other aspect of concept mapping. Furthermore, if students liked concept mapping ("I liked using concept mapping"), it would be useful to establish whether particular aspects of concept mapping influenced this opinion. Therefore, the questions "Concept mapping helped me to better understand the Accounting concepts", "Concept mapping made it easier to remember information" and "Concept mapping helped to identify misconceptions I had about a topic" were included to measure which of the acknowledged strengths of concept mapping students had experienced as useful. The question "I would be able to use concept mapping in my other subjects" was asked because it was necessary to see whether students would recognise the cross-domain applicability of concept mapping. Two of the nine quantitative questions in this questionnaire seem unrelated to concept mapping, yet had a particular purpose. The first of these, "I like Accounting", was deemed necessary as a negative association with Accounting could likewise negatively affect a student's experience of concept mapping. For example, Lucas and Mladenovic (2014:132) report that Australian "students' performance is negatively affected by the negative perceptions of Accounting that students bring to the subject". The second question, "I like being at the Mamelodi campus", was similarly intended to account for the influence of negativity towards an extrinsic factor.

Three qualitative questions were also asked, to elicit responses that were not covered by the quantitative questions. Two of the questions with qualitative responses were specific ("Which two aspects did you like most about concept mapping?" and "Which two aspects did you like least about concept mapping?"). The third question was an "open" question ("Is there anything further you would like to add about concept mapping?") to allow students an opportunity to express an opinion or describe an experience not catered for in the rest of the questionnaire.

Finally, students needed to supply their identification details (names, surnames and student numbers) so that pre- and post-intervention experiences could be matched. As with the pre-intervention questionnaire, anonymity was assured.

3.7 Ethical considerations

Several conditions are required in the practice of ethical research. Connelly (2014) lists the following:

- Permission must be given by the participants.
- No coercion may take place, through either undue pressure or bribery.
- Participants must be clearly informed of the implications and extent of the research.
- Participants must be competent to consent.
- Participants must be allowed to remove themselves from the research should they so wish.

For the present research, the test and control groups were informed of the proposed investigation and they were asked to sign a consent form indicating their willingness to participate (Appendix C). It was also made clear that should students choose to abstain from signing, they would nevertheless need to participate in all research activities, as the research was integrated into the normal curriculum. However, the task results of non-participating students would not be included in the investigation. Students were also informed that they were allowed to withdraw from the research at any stage. By the very fact of their being enrolled at a tertiary institution, it was presumed that all participating students were competent to make their own decisions. In the event, all students chose to participate in the research and no students requested that their responses be withdrawn from the research.

Regarding the qualitative dimensions of the research, Clarke (2009) warns of the possibility that the social scientists' "embedded position" might lead them to "*shape* the social environment" [author's emphasis]. Though there is distance between the interviewer and the respondent in the case of a questionnaire, the answers to open questions may be misinterpreted for the sake of a previously held conviction on the part of the interviewer (Nielsen, 1980). The qualitative analyses were consequently checked by an independent third party to ensure inter-rater reliability.

Finally, formal approval to conduct the research with students from the Mamelodi campus was obtained from the Director of the Four-year Programme. After the completion of the research, the concept mapping intervention was repeated for the control group.

3.8 Conclusion

In this chapter, the methodology that was employed in the research was described. The reasons for conducting the research with Accounting students were given, as well as the procedure for the concept mapping intervention. The methods of data gathering, namely the pre- and post-intervention questionnaires and paragraphs, along with the observations of the intervention, were explained in detail.

Chapter 4: Research findings and discussion

4.1 Introduction

In this chapter, the descriptive statistics emanating from the research are reported and analysed using applicable statistical procedures. The qualitative data collected from the pre- and post-intervention questionnaires are also analysed to establish whether and in what way they support the quantitative data. In keeping with the Postpositivist research paradigm, causes of the observed outcomes will be sought and discussed as far as possible (Creswell, 2014:7). The research questions will be addressed in the light of these findings. Finally, based on the data, the research hypotheses will be accepted or rejected.

4.2 Findings

4.2.1 Comparison of pre-intervention questionnaire responses of test and control groups

As discussed in the methodology chapter, it is necessary to ensure the objectivity and validity of any conclusions that might be drawn. Therefore, in order to establish similarities and differences between the two groups before conducting the experiment, students' responses to the pre-intervention questionnaire were analysed. A comparison was made of the ordinal (see Table 1 below) and of the tabulating variables (see Table 2 below) of the pre-intervention questionnaire responses of test and control groups. The results are discussed hereafter.

Table 1 Table of comparison of ordinal pre-intervention questionnaire responses of test and control groups

No	Question (Scaling = strongly agree=1, agree=2, disagree=3, strongly disagree)	Test group (BCom) n=70			Control group (BSc) n=35			p-value
		M	Med	SD	M	Med	SD	
Q1	I learn through reading a printed or written text	1.61	2.00	.708	1.66	2.00	.639	0.590
Q2	I learn through listening (e.g. to a lecture).	2.13	2.00	.779	1.97	2.00	.133	0.326
Q3	I learn when I am active (e.g. when I highlight, underline, summarise.	1.57	1.00	.693	1.77	2.00	.154	0.386
Q4	I learn by using visual elements (e.g. maps, graphs, pictures).	2.19	2.00	.937	2.34	2.00	.998	0.480

The responses to the first four questions of the questionnaire were based on a Likert scale, which means they are ordinal variables. Moreover, the two groups are independent, and there is independence of observations, as the participants in each group are unique. It was consequently suitable to conduct the non-parametric Mann-Whitney *U*-test in order to determine whether the test and control groups had the same distribution as far as the responses to the Likert-scale questions were concerned. The results are shown in Table 1 above. The medians of the different variables for the two groups are closely grouped, which suggests that there is no significant difference between the responses of the groups. This is confirmed, as the p-values are all greater than 0.05, which indicates that there is no significant difference in the way that students from the two groups responded to these particular questions. This observation suggests that the students from both groups share a similar environment in terms of learning styles.

Table 2 Table of comparison of tabulating variables of pre-intervention questionnaire responses of test and control groups

No	Question	Test group (BCom)		Control group (BSc)		p-value
		n	%	n	%	
Q5	I have used visual aids, such as the one shown here, before (yes=1, no=2).	Y=46 N=24	Y=65.7 N=34.3	Y=15 N=20	Y=42.9 N=57.1	.025*
Q6	The visual aid that I used helped me to MEMORISE the work (yes=1, no=2, not applicable=3).	Y=40 N=10 NA=20	Y=57.1 N=14.3 NA=28.6	Y=9 N=7 NA=19	Y=25.7 N=20.0 NA=54.3	.008**
Q7	The visual aid that I used helped me to UNDERSTAND the work (yes=1, no=2, not applicable=3).	Y=37 N=13 NA=20	Y=52.9 N=18.6 NA=28.6	Y=14 N=2 NA=19	Y=40.0 N=5.7 NA=54.3	.022*
Q13 + 14	Name of high school attended/ Town/city where school is situated (No fee school=1, Fee-paying school=2, Private school=3)	1=17 2=35 3=17	1=24.6 2=50.7 3=24.6	1=21 2=9 3=5	1=60 2=25.7 3=14.3	.002**
Q15	Had Accounting as a school subject (yes=1, no=2)	Y=49 N=20	Y=71.0 N=29.0	Y=8 N=27	Y=22.9 N=77.1	.000**
Q17	Level of English in Grade 12 (English Home Language=1, English First Additional Language=2)	HL=41 Al=29	HL=58.6 AL=41.4	HL=10 AL=25	HL=28.6 AL=71.4	.004**
Q18	Symbol received for English in final exams (A=7, B=6, C=5, D=4, E=3, F=2)	AB=24 C=33 DEF=12	AB=34.8 C=47.8 DEF=17.4	AB=11 C=10 DEF=14	AB=31.4 C=28.6 DEF=40.0	.031*
Q19	Symbol received for Maths in final exams (A=7, B=6, C=5, D=4, E=3, F=2)	AB=8 C=8 D=26 F=27	AB=11.6 C=11.6 D=37.7 F=39.1	AB=19 C=14 D=2 F=0	AB=54.3 C=40.0 D=5.7 F=0	.000*
Q20	Final AP Score gained (Mean scores provided)	n=70	Mean= 28.20	n=35	Mean= 27.09	.555

**Significant at 1% level
*Significant at 5% level

The remaining variables of the pre-intervention questionnaire have categorical type values and cross-tabulation was therefore used to plot the distribution of the responses between the two categorised variables. Pearson's Chi-square tests, designed to determine the likelihood that the observed distribution in categorical data is attributable to chance, were then run to measure the association between the categories and p-values were obtained. From the results shown in

Table 2 above, we can observe that the p-values are all significant, except for the APS: the test group students were more likely to have used visual aids in the past, and therefore to have a positive experience of visual aids helping them to memorise and understand their work. Only 25% of the test group students came from no fee government schools, compared to 60% of the control group students who came from these schools. Accounting was taken as a school subject by 71% of test group students and only 23% of the control group students. The test group students were more likely to have taken English as a home language at school, which ties into the fact that they also tended to come from more advantaged schools. The Grade 12 English results of the test group students were also higher than those of the control group students. However, the control group students had far higher Grade 12 Maths results than the test group students did. There was no significant difference between the APS of the two groups. From the association between the covariates of the test and control groups, it is therefore clear that the students come from different backgrounds.

4.2.2 Pre- and post-intervention paragraph marks

The crux of the research were the results of the pre- and post-intervention paragraphs that were written by the test and control groups. These marks were therefore analysed in several ways. Firstly, the pre-intervention paragraph marks of the two groups were compared for similarity of ability. Secondly, the pre- and post-intervention paragraph marks for each group were assessed for improvement. Finally, the difference between the pre- and post-intervention paragraph marks of the two groups were compared to see whether the difference was significant. The results are shown in Table 3 (below), and are analysed in the following paragraphs.

Table 3   Results of comparison of pre- and post-intervention paragraph marks for test and control group

	Pre-intervention paragraph marks (compared between groups)				Post-intervention paragraph marks (compared to pre-intervention marks)				Comparison of difference between pre- and post-intervention marks of groups			
	M	SD	n	p-value	M	SD	n	p-value	M	SD	n	p-value
Test group	52.09%	25.87%	70	0.013*	46.88%	22.81%	70	0.960	-5.22%	25.90%	70	0.989
Control group	38.78%	24.79%	35		33.48%	25.66%	35	0.277	-5.29%	28.36%	35	

*Significant at 5% level

4.2.2.1 Comparison of pre-intervention paragraph marks between groups

The pre-intervention paragraph marks for the test group and the control group were compared by means of a two-sample *t*-test to establish similarity of ability. Testing for similarity of ability is necessary to ensure the validity of the research, and neglecting to conduct this test could undermine the rigour of a study, as pointed out by Leauby *et al*. (2010:288). The two-sample *t*-test is a parametric test that is used when a variable (the pre-intervention paragraph marks) is compared for two independent samples (the test and control groups). In this case, the Comparison of Means *t*-test was used because it was necessary to compare the means of two groups of unequal size and equal variances. The results, given in Table 3 (above), show that the mean score for the test group was 52.09%, which was considerably higher than the mean score for the control group, which was 38.78%. The comparison between the two groups delivered a p-value of 0.013, which indicates a statistically significant difference. The conclusion we must draw from this result is that the two groups were not, as presupposed at the start of the research, comparable in Accounting ability.

4.2.2.2 Comparison of pre- and post-intervention paragraph marks for each group

Leauby *et al*. (2010:288), in their summation of research into concept mapping, question the conclusions drawn from a study in which student marks were not assessed for improvement. Therefore, in line with the rigour required in a Postpositivist research paradigm, the pre- and post-intervention paragraph marks for each group were compared by means of paired *t*-tests. Paired *t*-tests are used when the samples are dependent and normal distribution is assumed, such as in this case, where pre- and post-intervention marks are compared. It was necessary to see whether the concept mapping intervention had resulted in an improvement in the marks of the test group, as this was the basis of the research. On the other hand, even if there had been an improvement in the marks of the test group, a similar positive result for the control group would negate the supposed influence of the intervention. It was therefore likewise necessary to check for possible improvement in the marks of the control group.

Table 3 shows the results of the test, and indicates a lower mean post-intervention paragraph mark for the test group (46.88%) as well as a lower mean post-intervention paragraph mark for the control group (33.48%). However, with p-values > 0.05, the drop in the marks of both the test and control groups was not statistically significant. While the drop in marks might not be significant, the result for the test group is disappointing, given the aim of this research. In their

comprehensive study on the effectiveness of concept mapping, Leauby *et al*. (2010:289) recorded a similar result: the quantitative data did not support that study's hypothesis that concept mapping enhances learning.

4.2.2.3 *Comparison of difference between pre- and post-intervention paragraph marks of groups*

In order to determine whether the difference between the pre- and post-intervention paragraph marks for the test and control groups was significant, a paired *t*-test was used, and Levene's test was run to check for equality of variances. Levene's test is used when a variable has been calculated for two or more groups, in this case the difference in the pre- and post-intervention paragraph marks of the test and control groups, and the equality of variances for the variable needs to be assessed. The results are also given in Table 3 (above). With a p-value > 0.05, we can conclude that there is no significant difference in the decrease between the test results of the two groups.

4.2.3 Comparisons between the quantitative pre-intervention questionnaire results and the results of the two groups

It was furthermore deemed necessary to test for collinearity between the different pre-intervention questionnaire co-variates and the pre- and post-intervention paragraph results using the Spearman-rho correlation test[2]. Table 4 (below) shows the following significant relationships between the pre- and post-intervention paragraph marks and the variables per group:

- The pre-intervention questionnaire factors that had a significant impact on the pre-intervention paragraph marks for the test group

- The pre-intervention questionnaire factors that had a significant impact on the pre-intervention paragraph marks for the control group

- Pre-intervention questionnaire factors that had a significant impact on the post-intervention paragraph marks of the test group

- Pre-intervention questionnaire factors that had a significant impact on the post-intervention paragraph marks of the control group

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[2] The Spearman-rho correlation test is a non-parametric test used for ordinal and ranked variables.

Table 4 Table showing significant relationships between pre- and post-intervention paragraph marks and pre-intervention questionnaire variables per group

No	Question	Test group (BCom) (GLM procedure)						Control group (BSc) (Kruskal-Wallis test/ Wilcoxon rank-sum scores)					
		Pre-intervention marks			Post-intervention marks			Pre-intervention marks			Post-intervention marks		
		n	Mean score	p-value	n	Mean score	p-value	n	Mean score	p-value	n	Mean score	p-value
Q4	I learn by using visual elements (e.g. maps, graphs, pictures) (strongly agree=1, agree=2, disagree=3, strongly disagree=4). Tendency	1+2=41 3+4=24	6.634 8.083	0.088									
Q5	I have used visual aids, such as the one shown here, before (yes=1, no=2). Tendency	Y=44 N=21	7.659 6.143	0.074				Y=15 N=20	22.067 14.950	0.041			
Q13 +14	Name of high school attended/ Town/city where school is situated (No fee school=1, Fee-paying school=2, Private school=3).							1=9 2=7 3=19	21.167 27.214 13.105	0.004			
Q15	Had Accounting as a school subject (yes=1, no=2).	Y=45 N=20	7.878 5.575	0.010	Y=45 N=20	8.200 5.725	0.010	Y=8 N=27	25.750 15.704	0.015	Y=8 N=27	25.500 15.778	0.018
Q17	Level of English in Grade 12 (Home Language=1, First Additional Language=2).	1=40 2=25	8.050 5.760	0.005				1=10 2=25	23.800 15.680	0.034			
Q20	Final AP Score gained	65	28.2	0.008									

4.2.3.1 Pre-intervention questionnaire factors that had a significant impact on the pre-intervention paragraph marks for the test group

It was of importance to see which of the factors referred to in the pre-intervention questionnaire had an impact on, and could therefore explain the results of, the pre-intervention paragraph mark. To obtain this information, a General Linear Model (GLM) procedure was run, with the pre-intervention paragraph marks as the dependent variable. The GLM procedure is a type of multiple regression analysis where one dependent variable is involved. The procedure was initially run to establish whether the model could be reported. Table 5 (below) indicates that, as the p-value < 0.05, the model is significant and can be reported. Sixty-four observations were found to be valid and useable.

Table 5   Table showing result of GLM procedure that tests validity of model

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	284.2921955	56.8584391	6.16	0.0001
Error	59	544.8462660	9.2346825		
Corrected Total	64	829.1384615			

A box and whisker plot, or boxplot, is a graph that displays quantitative data patterns and shows the distribution of the data, by providing the range of all the data (from whisker to whisker), or the interquartile range (IQR), which refers to the range of the "box" part of the graph. The boxplot also indicates the median by means of the line running through the box. Boxplots will be used to illustrate the distribution of data.

Two of the pre-intervention questions, while not statistically significant, showed tendencies that were worth reporting (See Table 4 above). The first of these was whether the student saw him- or herself as a visual learner (Q4). This information was self-reported. With a p-value of 0.088, being > 0.05 (significance level), the result is not statistically significant but indicates a tendency for non-visual learners to perform better in the pre-intervention paragraph. The boxplot below (see Figure 8) illustrates that the distributions for the responses are not the same ("agree" = answers 1 and 2, and "disagree" = answers 3 and 4).
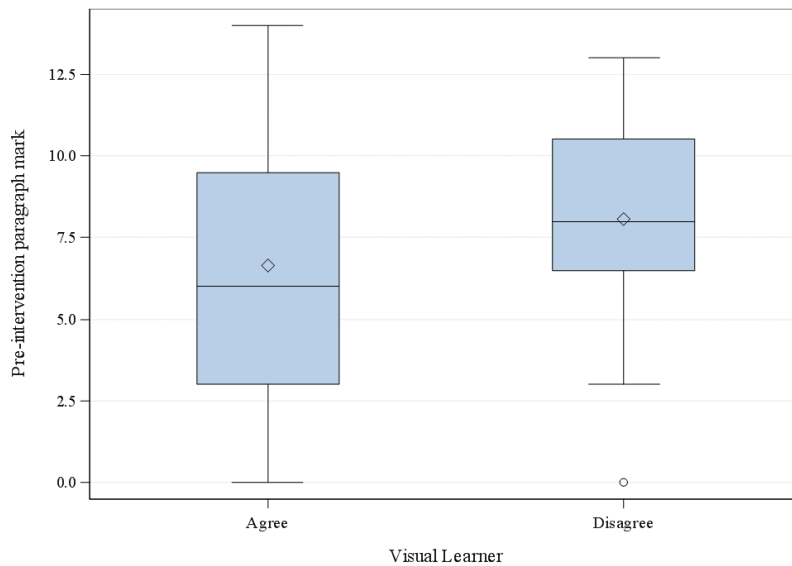
Figure 8 Box and whisker plot showing the distribution of scores of the link between the paragraph mark and students' identification with visual learning

The second reportable factor refers to whether the students had any previous experience in the use of visual elements, such as mind mapping (Q5). Again, this information was not verifiable, as it was self-reported. As with the previous element, the distributions of the "agree" and "disagree" responses are not the same (See Figure 9 below). With the p-value being 0.074, the result is not statistically significant, yet indicates a tendency towards students with previous experience of visual elements performing better in the pre-intervention paragraph.

Figure 9 Box and whisker plot showing the distribution of scores for the link between the paragraph mark and previous experience of visuals aids

This result casts doubt on the previous observation regarding visual learners. The way in which the question was framed might have led to confusion. In the questionnaire, visual learning is

associated with maps, graphs and pictures, which might not be the terms with which students associate visual learning.

Three of the factors probed in the pre-intervention questions proved to be significant. The first of the significant factors, with a p-value of 0.010 (See Table 4 above), was whether the student had had Accounting as a school subject (Q15), which was verifiable information. It is to be expected that previous knowledge of Accounting should have advantaged students. The box and whisker plot confirms the result (See Figure 10 below). The marks for the students with previous experience of Accounting appear to be skewed upwards, which shows that most of these students performed well.
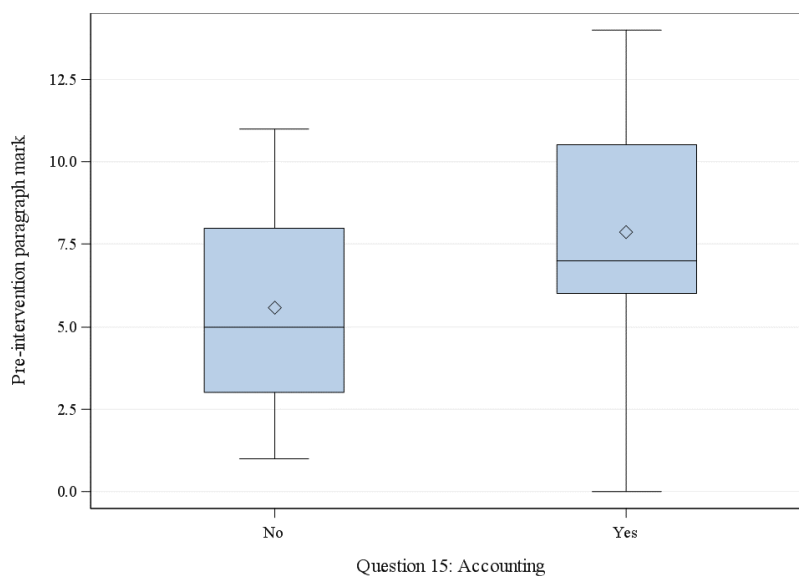
Figure 10 Box and whisker plot showing the distribution of scores for the link between the paragraph mark and previous student experience of Accounting

The second factor that showed significance was whether the student had followed the English Home Language stream in Grade 12, or the English First Additional Language stream (Q17). This was also verifiable information, although it was self-reported. The p-value in this case is 0.005, indicating that this variable had a significant effect on students' pre-intervention paragraph results. Figure 11 below indicates that having taken English as a home language led to higher marks. This is in keeping with current research regarding the influence of language on learning (Carstens, 2015; Mckenna, 2012; Nkomo & Madiba, 2011).
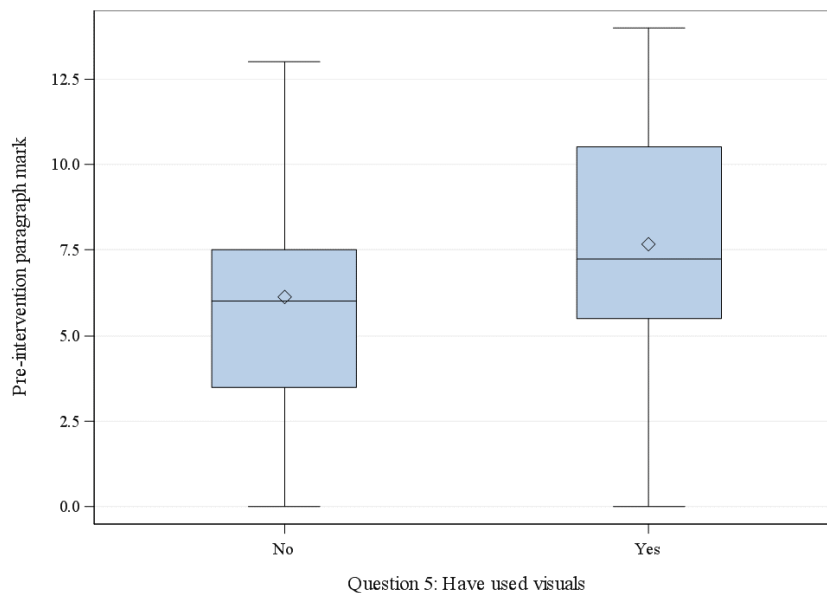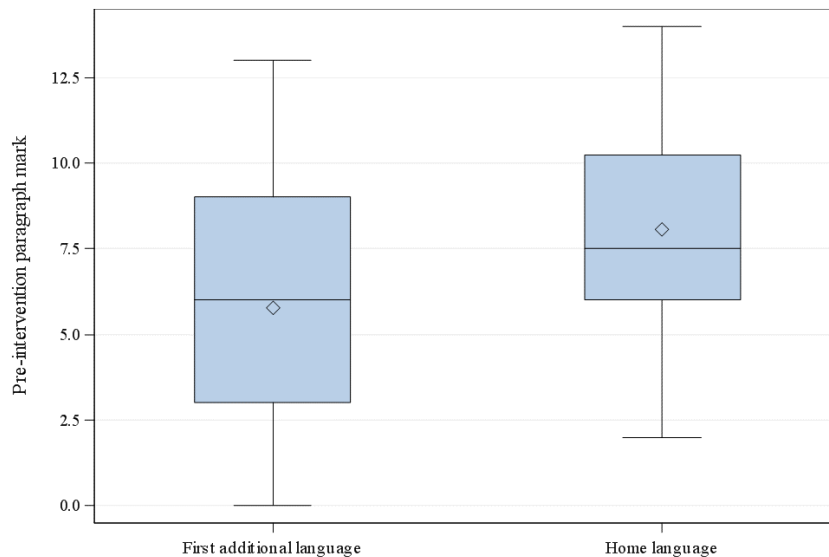
Question 17: Grade 12 English

Figure 11 Box and whisker plot showing the distribution of scores for the link between the paragraph mark and the level of English in Grade 12

Finally, a student's APS (Q20) shows statistical significance, with a p-value of 0.008. It is possible to deduce from this that the higher performing school students will likewise perform well at university. However, the data collected for the APS are not considered reliable, as it was apparent from the questionnaire responses that many students could not clearly remember their APS, and either guessed the score or gave no response. In retrospect, the validity of the data should have been assured by referring to the University database. This constraint is acknowledged and will be discussed further under the section addressing the limitations of the study.

The factors that showed no significance were:

- whether students were verbal learners

- whether students were aural learners

- whether students were physical learners

- the types of school students attended

- the Grade 12 marks for Maths

- their Grade 12 mark for English

The data on students' home language was not included in the GLM procedure because of the sparse distribution of cases, resulting in the model not being estimable. The home language distribution is therefore given here: English = 10, Afrikaans = 3, Sepedi = 17, other South African languages = 38 and other African languages = 3. The question about students' home language

was posed as an adjunct to the question about the level of English in Grade 12, both relating to the issue of the effect of language in learning (see Section 1.3.2).

4.2.3.2 Pre-intervention questionnaire factors that had a significant impact on the pre-intervention paragraph mark for the control group

It was similarly necessary to see which of the factors referred to in the pre-intervention questionnaire might have had an impact on the pre-intervention paragraph mark for the control group. Because of the small number of respondents (35), the GLM model was not used, but rather the NPAR1WAY procedure that consists of the Wilcoxon rank-sum test (equivalent to the Mann-Whitney U-test), which is preferred to the independent *t*-test when normal distribution is not expected, and the Kruskal-Wallis test, which is a non-parametric test that is suitable when the independent variables consist of three or more categories, but normal distribution of data is not expected. The Wilcoxon rank-sum test, used here, is applicable when the two groups of data are independent.

The first factor that showed significance was students' previous experience of visual aids (Q5), with a p-value < 0.05. This suggests that, as with the test group, students with previous experience of using visual aids performed better in the pre-intervention paragraph than those who had not. Figure 12 (below) shows the distribution of the Wilcoxon scores in a boxplot and confirms that the distribution is not the same. The results, however, are not borne out by the outcome of the post-intervention paragraph, as there is no statistical significance between the post-intervention paragraph marks and previous experience of visual aids for the control group.

Figure 12 Box and whisker plot showing the distribution of the Wilcoxon scores of the link between the pre-intervention paragraph results and previous experience of visual aids for the control group

A second factor that showed statistical significance, with a p-value < 0.01, dealt with the type of school students had attended (derived from Q13). As previously discussed, schools were categorised as "no fee school", "fee-paying school" and "private school". The Wilcoxon scores show that the students from fee-paying schools fared the best in their pre-intervention paragraph, compared to the other groups. Of the other two groups, students from no fee schools achieved better results than students from private schools did. Previous comments about the different types of private schools might cast some light on this unexpected result. The boxplot (Figure 13) shows the distribution of the results for each category.

Figure 13   Box and whisker plot showing the distribution of the Wilcoxon scores of the link between the pre-intervention paragraph mark and type of school for the control group

The link between the pre-intervention paragraph mark and students with experience of Accounting at school had a significant p-value of 0.015. The result coincides with the result for the test group. This suggests that those students - whether in the test or control group - who took Accounting at school were at an advantage when writing the pre-intervention paragraph. The boxplot illustrates the uneven distribution of the results (see Figure 14 below).

Figure 14   Box and whisker plot showing the distribution of the Wilcoxon scores of the link between the pre-intervention paragraph results and Accounting experience for the control group

The third and last variable that showed significance was the level of English in Grade 12, with students in the Home Language stream scoring better than those in the English First Additional Language stream. The p-value is < 0.05. The boxplot shows the distribution of the scores (see Figure 15 below) and the uneven distribution of the data. This result likewise echoes the result of the test group and, as mentioned before, supports the importance of language in learning. Nevertheless, no similar link is found with the post-intervention paragraph marks, which indicates that the impact of students' school language level disappeared by the time the students wrote the post-intervention paragraph.

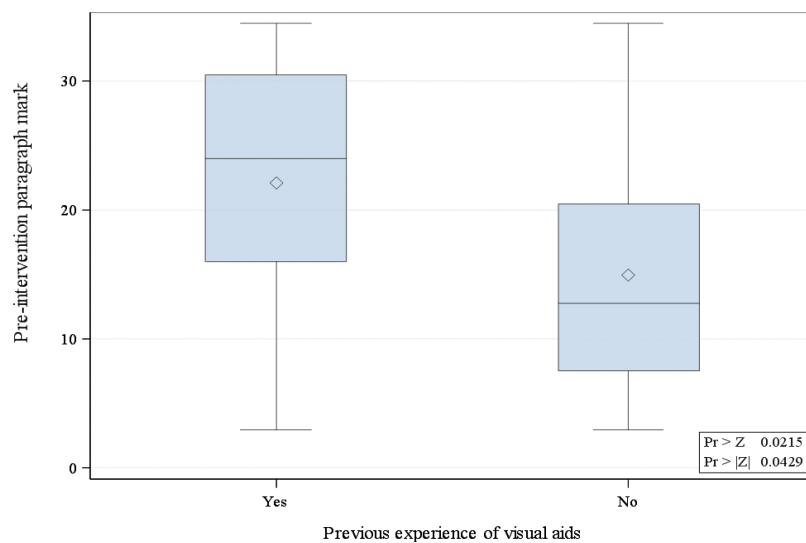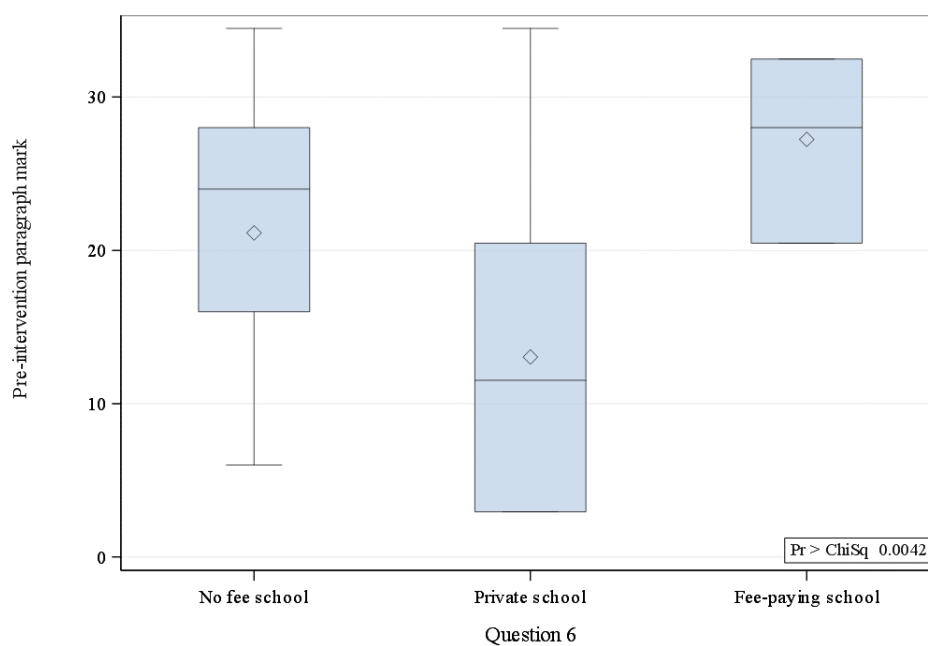*Figure 15   Box and whisker plot showing the distribution of the Wilcoxon scores of the link between the pre-intervention paragraph results and Grade 12 English for the control group*

The factors that showed no significance were:

- whether students were visual learners
- whether students were verbal learners
- whether students were aural learners
- whether students were physical learners
- their Grade 12 marks for Maths
- their Grade 12 mark for English
- their Grade 12 APS

As with the test group, the data on students' home language was not included in the tests, because the sparse distribution of cases caused the model to be inestimable. The home language distribution, in this case, was as follows: English = 1, Afrikaans = 1, Sepedi = 11, other South African languages = 20, other African languages = 1 and any other languages = 1. The question is related to the previous question about the level of English in Grade 12. A tabular comparison of the language distribution between the two groups is provided in Appendix I.

4.2.3.3 Pre-intervention questionnaire factors that had a significant impact on the post-intervention paragraph marks of the test group

The factors referred to in the pre-intervention questionnaire could also have had an impact on the post-intervention paragraph mark, and therefore needed to be investigated. Of the 66 observations read, 65 were used.

Only one of the post-intervention aspects, namely students' previous experience of Accounting (Q15), showed up as significant, with a p-value of 0.010 (see Table 4 above). This was verifiable information. This result is in line with the effect previous Accounting experience had on the pre-intervention paragraph mark. One can therefore deduce that previous Accounting experience is an advantage. The distribution of the data is shown in Figure 16 below.

Figure 16 Box and whisker plot showing the distribution of the GLM procedure scores of the link between the post-intervention paragraph marks and previous experience of Accounting for the test group.

4.2.3.4 Pre-intervention questionnaire factors that had a significant impact on the result of the post-intervention paragraph marks of the control group

As with the test group, it was important to see which of the pre-intervention questionnaire factors had an impact on, and could therefore explain the results of the post-intervention paragraph mark for the control group (see Table 4 above). Thirty-five observations were read and used. Similar to the test group, only students' previous experience of Accounting (Q15) proved to be statistically significant, with a p-value of 0.018. This reinforces the significance of previous Accounting experience in the pre-intervention paragraph mark. One can therefore deduce that previous Accounting experience is an advantage. The distribution of the data is shown in Figure 17 below.

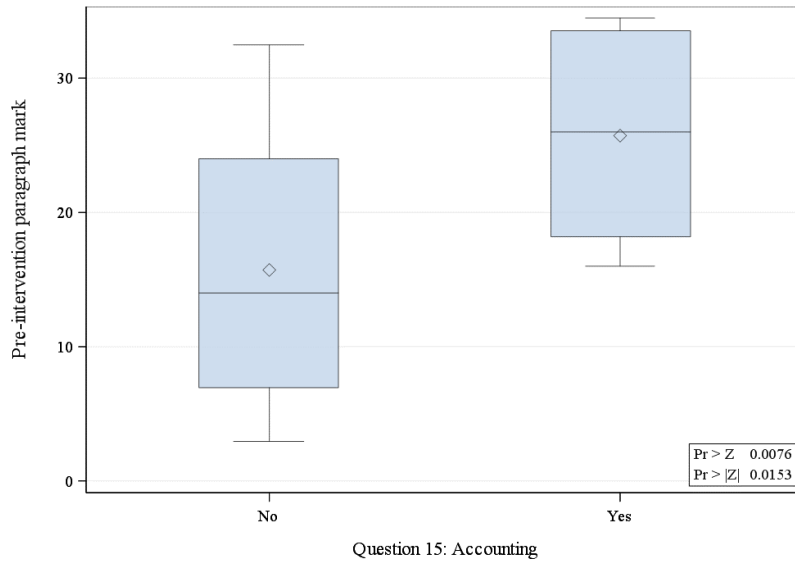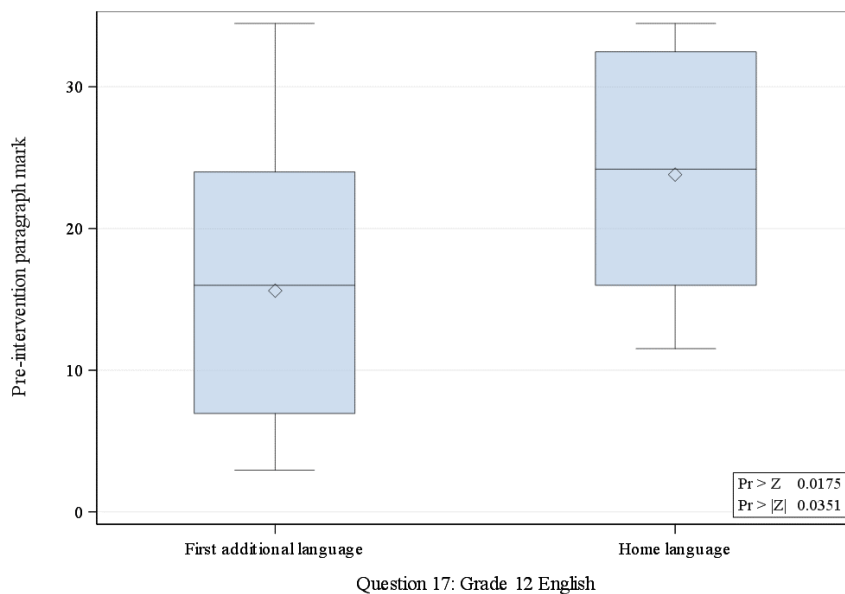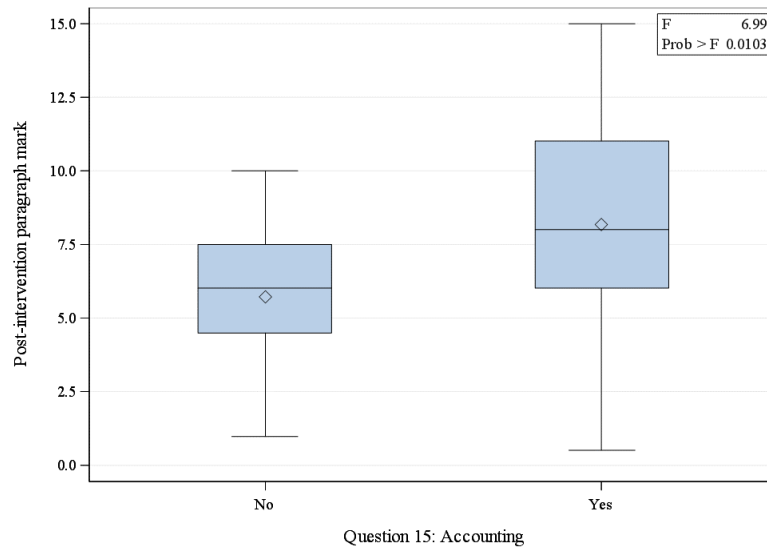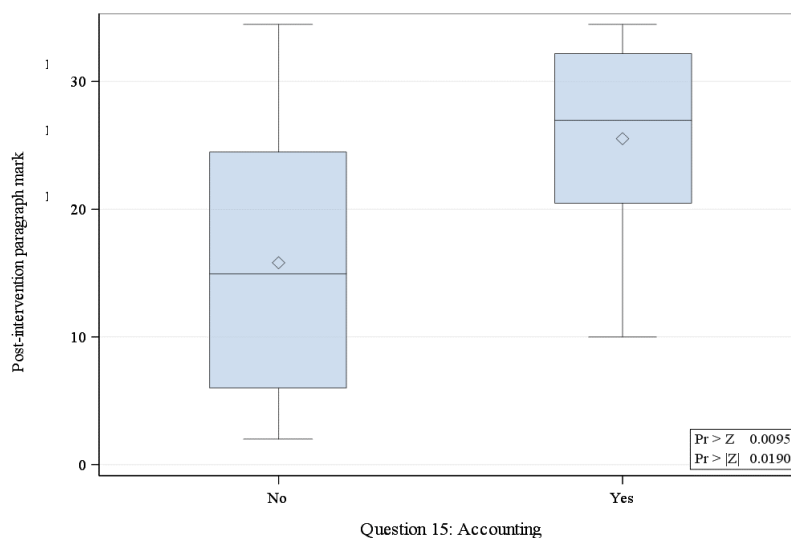*Figure 17   Box and whisker plot showing the distribution of the Wilcoxon scores of the link between the post-intervention paragraph marks and previous experience of Accounting for the control group*

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4.2.4 The quantitative results of the post-intervention questionnaire

The post-intervention questionnaire was designed to capture students' experiences of the concept mapping intervention. A simple one-way frequency table was required here, for which the FREQ (frequency) procedure was run. The results are summarised in Table 6 below, and will be discussed individually. The responses to Q3 and Q4 in the post-intervention questionnaire will be discussed separately in Section 4.2.5.

Table 6 Table showing frequency of post-intervention questionnaire responses for test group

Nbr	Question (Scaling = strongly agree=1, agree=2, disagree=3, strongly disagree)	n	%
Q1	I like Accounting.	Agree (1+2)=59 Disagree(3+4)=10	Agree=85.51% Disagree=14.49%
Q2	I find concept mapping easy to use.	Agree(1+2)=51 Disagree(3+4)=18	Agree=73.91% Disagree=26.09%
Q3	Concept mapping helped me to better UNDERSTAND the Accounting concepts.	Agree(1+2)=52 Disagree(3+4)=17	Agree=75.36% Disagree=24.64%
Q4	Concept mapping made it easier to REMEMBER information.	Agree(1+2)=52 Disagree(3+4)=17	Agree=75.36% Disagree=24.64%
Q5	Concept mapping helped to identify MISCONCEPTIONS I had about a topic.	Agree(1+2)=49 Disagree(3+4)=20	Agree=71.01% Disagree=28.99%
Q6	I will use concept mapping again.	Agree(1+2)=47 Disagree(3+4)=22	Agree=68.12% Disagree=31.88%
Q7	I liked using concept mapping.	Agree(1+2)=45 Disagree(3+4)=24	Agree=65.22% Disagree=34.78%
Q8	I would be able to use concept mapping in my other subjects.	Agree(1+2)=48 Disagree(3+4)=21	Agree=69.57% Disagree=30.43%
Q9	I like being at the Mamelodi campus.	Agree(1+2)=51 Disagree(3+4)=18	Agree=73.91% Disagree=26.09%

Five of the seven remaining questions addressed experiential aspects of concept mapping (Q2, Q5, Q6, Q7 and Q8). With these responses, the following patterns were observed: the majority of the students reported that they had found concept mapping easy to use (73.91%), that concept mapping helped them to identify misconceptions they held about the topic covered in the intervention (71.01%), that they would use concept mapping again (68.12%), that they liked using concept mapping (65.22%) and that they would use concept mapping in other subjects (69.57%).

The following parameters should be considered when these responses are reflected upon. Firstly, they are based on the perceptions of the students and are therefore not verifiable. Some students' positive attitude towards the subject and/or the participating lecturers could also have disposed them towards a favourable but biased response. This is referred to as the "halo" effect. Furthermore, the responses were measured after a relatively short exposure to concept

mapping. Even when considering these parameters, it is nevertheless interesting to note that students were positive overall about the concept mapping experience. In addition, it seems significant that such a high percentage of students felt that concept mapping had helped to point out misconceptions, a very important function of this strategy. Considering these parameters, it is surprising that a relatively high percentage of students said that they would use concept mapping again (68.12%) and would apply the strategy to other subjects (69.57%), indicating that, even in a short period, they had realised the cross-domain application of the strategy.

The two questions in this questionnaire that did not refer to concept mapping were aimed at garnering the general attitude of students (see Table 6 above). Students were questioned on their attitude to Accounting, to measure whether this attitude could have been an underlying factor in the concept mapping responses. Certainly, the high percentage of students who responded positively to this question (85.51%) seems to relate to the generally positive response towards concept mapping. However, far more students were positive about Accounting than about, for example, liking concept mapping, the difference being 20.29%. This suggests that the two responses were not necessarily linked.

The second general question probed students' attitude towards being at the Mamelodi campus. This was deemed necessary, as anecdotal evidence suggests that students have been known to harbour resentment about being placed on the Extended Programme, especially as they are accommodated at a campus that separates them from their friends and the activities that they associate with student life. Such a negative attitude could sub-consciously have had a similarly negative effect on their attitudes towards concept mapping. Nonetheless, the vast majority of students responded positively about being on the Mamelodi campus (73.91%). Interestingly, this is exactly the same response for the question about finding concept mapping easy. Although the two questions are unrelated, a positive attitude about being on the Mamelodi campus might have translated into a generally positive approach to learning.

The positive responses of the post-intervention questionnaire suggest that students found the concept mapping intervention useful, and would consider implementing this strategy. These responses, however, must be aligned with the qualitative data before the deduction can be confirmed.

4.2.5 Possible link between pre- and post-intervention questionnaire responses for memorisation and understanding

The post-intervention questionnaire was filled in by only the test group, as the information referred to the concept mapping intervention. Two of the questions in the pre- and post-intervention questionnaires were designed to link to each other. These questions referred to the use of visual aids to support memorisation and understanding, the pre-intervention questionnaire referring to visual elements generally and the post-intervention questionnaire referring to concept mapping in particular. The pre-intervention questionnaire question on memorisation (Q6) read: "The visual aid that I used helped me to MEMORISE the work" and the matching post-intervention questionnaire question (Q4) read: "Concept mapping made it easier to REMEMBER information". The pre-intervention questionnaire question on understanding (Q7) read: "The visual aid that I used helped me to UNDERSTAND the work" and the matching post-intervention questionnaire question (Q3) read: "Concept mapping helped me to better UNDERSTAND the Accounting concepts". The words "memorise", "remember" and "understand" were capitalised to indicate the focus of the question for the students.

We are thus dealing here with two variables relating to visual aids in general and concept mapping in particular (Pre-intervention questionnaire Q7 and post-intervention questionnaire Q3 in the first instance, and pre-intervention questionnaire Q6 and post-intervention questionnaire Q4 in the second instance), each with two categories (the questionnaire response options of "strongly agree" and "agree" were grouped as "agree", while "disagree" and "strongly disagree" were grouped as "disagree" for ease of statistical analysis). The Frequency procedure, which is able to produce the required cross-tabulation table, was therefore appropriate, along with McNemar's test, which is able to analyse the matched pairs of categorical data under discussion here.

Forty-nine students responded positively to Q7 in the pre-intervention paragraph, compared to the 52 who responded positively to Q3 in the post-intervention questionnaire (see Table 7 below). This indicates that more students found concept mapping useful for understanding than those who found visual aids in general useful for understanding. The difference, however, is not noteworthy. Students' total responses were the same for the question about memorisation (Q6 in the pre-intervention paragraph and Q4 in the post-intervention paragraph) (see Table 9 below). Initially, these responses suggest that students had a predominantly favourable experience of concept mapping regarding the aspects of understanding and memorisation.

However, Table 7 shows that, as far as improving understanding is concerned, only 16 (23.19%) students found concept mapping more useful than other visual aids, and that 13 students (18.84%) who found other visual aids useful, did not find concept mapping useful at all. Similarly, Table 9 shows that, as far as memorisation is concerned, only 13 (18.84%) students found concept mapping more useful than other visual aids, and that ten students (14.49%) did not find concept mapping useful, while they had found other visual aids to be so. In summary, concept mapping does not appear to have been experienced as being significantly more helpful for understanding and memorisation than visual aids in general.

When the Frequency procedure was run to look for a link between these two aspects, McNemar's test delivered a p-value of 0.578 for the questions on memorisation (see Table 8 below), and a p-value of 0.532 for the questions on understanding (see Table 10 below), neither showed significance. This suggests that students were not necessarily influenced by their experience of visual aids in general when responding to the questions on concept mapping.

Table 7   Table showing the result of the Frequency procedure run to establish a link between the pre-intervention paragraph (Q7) and post-intervention paragraph (Q3), which refers to "understanding"

Table of Q7 by Q3				
Q7 (Question 7: Helped understand)		**Q3 (Question 3: Understand)**		
		Agree	**Disagree**	**Total**
Agree	**Frequency**	36	13	49
	Percent	52.17	18.84	71.01
	Row Pct	73.47	26.53	
	Col Pct	69.23	76.47	
Disagree	**Frequency**	16	4	20
	Percent	23.19	5.80	28.99
	Row Pct	80.00	20.00	
	Col Pct	30.77	23.53	
Total		52	17	69
		75.36	24.64	100.00
Frequency Missing = 1				

Table 8   Table showing statistical result of Frequency procedure checking link with "understanding"

McNemar's Test	
Statistic (S)	0.3103
DF	1
Pr > S	0.5775

Table 9   Table showing the result of the Frequency procedure run to establish a link between the pre-intervention paragraph (Q6) and post-intervention paragraph (Q4), which refers to "memorisation"

Table of Q6 by Q4				
Q6 (Question 6: Helped memorise)		**Q4 (Question 4: Remember)**		
		Agree	**Disagree**	**Total**
Agree	**Frequency**	39	10	49
	Percent	56.52	14.49	71.01
	Row Pct	79.59	20.41	
	Col Pct	75.00	58.82	
Disagree	**Frequency**	13	7	20
	Percent	18.84	10.14	28.99
	Row Pct	65.00	35.00	
	Col Pct	25.00	41.18	
Total		52	17	69
		75.36	24.64	100.00
Frequency Missing = 1				

Table 10   Table showing statistical result of Frequency procedure checking link with "memorisation"

McNemar's Test	
Statistic (S)	0.391
DF	1
Pr > S	0.532

4.3 Research findings and analysis of the qualitative data

The qualitative data were gathered from both the pre- and post-intervention questionnaires in the case of the test group, and from the pre-intervention questionnaire in the case of the control group. The pre-intervention questionnaire included a general question regarding the use of visual aids, whereas the post-intervention questionnaire included general questions that focused on the concept mapping intervention to which students had been exposed for a short period of time. In contrast to the rest of the questionnaire, students were not required to answer the open questions, and the number of responses is therefore limited. They are, nevertheless, important because of what they highlight about students' perspectives.

For the analysis of the qualitative data, content analysis was used. According to Krippendorff (2013:89):

> Content analysts support their interpretations by weaving quotes from the analysed texts and literature about the context of these texts into their conclusions, by constructing parallelisms, by engaging in triangulations, and by elaborating on any metaphors they can identify.

Content analysis is based on the Naturalistic paradigm (Hsieh & Shannon, 2005), which attempts to access meaning from the point of view of the respondent. In this paradigm, in contrast to the paradigm used for the analysis of quantitative data, confounding variables are not accounted for, but are described, as they form part of the context in which the results are reported (de Valenzuela, 2017).

The categories used for sorting responses were not pre-determined. The flexible nature of content analysis allows for the identification of categories to be both concept-driven (the literature on the research questions guides identification) and data-driven (categories emerge from the data) (Schreier, 2014:3). The emerging keywords were counted and comparisons were made between them, in line with the summative content analysis procedure (Hsieh & Shannon, 2005). Qualitative content analysis restricts data in that the researcher searches only for aspects that refer to the research in question (Schreier, 2014:2). Where the point made by a response was unclear, the response was not tallied, to prevent invalid inferences being made. If a certain advantage or disadvantage was recorded by only one student and appeared random in nature, it was recorded but not included in the analysis. On the other hand, a single response might address several useful aspects, and each of the aspects was then categorised. This procedure is confirmed by Schreier (2014:2), who further states that "ultimately the number of aspects is limited by the number of categories a researcher can handle". Content analysis also allows for some abstraction in identifying aspects if an overarching keyword is found to be more effective in conveying meaning than specific keywords (Schreier, 2014:2). The systematic nature of content analysis requires that the data be searched in detail for the presence of relevant aspects, which should prevent researcher's bias.

The qualitative data for the two groups garnered from the pre-intervention questionnaire will be compared first, and thereafter the qualitative data from the post-intervention questionnaire will be discussed. Summaries of the results are given in table format below, and the responses are given in full in Appendices E, F and G.

4.3.1 The qualitative data from the pre-intervention questionnaire

The pre-intervention questionnaire had only one open question: "Is there any further comment you would like to make about the advantages and disadvantages of using visual elements in academic work?" For the test group, 39 students responded, and, using the system explained in the previous section, 30 of the points made were found to be useful (see Table 11 below). The salient advantages identified by the test group, as shown in Table 11, were that visual elements

helped them to remember information (seven entries, or 17.5% of the total responses), helped them to understand the work (four entries, or 10% of the total responses), usefully summarised work (four entries, or 10% of the total responses), and helped them to study and/or prepare for tests (two entries, or 5% of the total responses). At least one student understood the usefulness of a visual technique to "provide a framework that [one] can later apply to different problems in the subject" (see "Interesting further comment" under "Advantages", Table 11). The most significant disadvantages identified were that visuals were not seen as useful for subjects such as Accounting (seven entries, or 17.9% of the total responses); important information was sometimes left out when using visual elements (six entries, or 15.3% of the total responses); the concentrated format of most visual elements were experienced as confusing (three entries, or 7.6% of the total responses); the technique was "not for everyone" (four entries, or 10.2% of the total responses); and it was simply not useful (four entries, or 10.2% of the total responses).

It would appear that the majority of respondents question whether the use of visual elements is suitable to all subjects. Furthermore, while the identification and summarisation of key points are seen as advantages, they are at the same time recognised as major disadvantages, as information considered vital by the students is often left out. The additional comment, "I feel that when I use [such] study methods, I am only memorising some key points and not actually understanding the work" (See "Interesting further comment" under "Disadvantages", Table 11), is noteworthy. Another student also commented that "[t]hey help with memorisation but not understanding the work". This point of view is reinforced to an extent by the fact that more students (seven) found visual elements useful for memorisation, than those who found them useful for understanding (four). A full list of the responses is given in Appendix E.

Table 11   Salient responses to the pre-intervention questionnaire for the test group

Question: Is there any further comment you would like to make about the advantages and disadvantages of using visual elements in academic work?	
Advantage	**Representative entry**
Help remember Entries = 7	Visual elements make it easy for one to remember the concepts during examinations or tests.
Help understand Entries = 4	They help you to understand the subject better.
Summarise work Entries = 4	Advantage is probably that it summarises the work quickly.

Help study/ prepare for tests Entries = 2	If used effectively it is a great way to study and prepare for tests.
Interesting further comment	Visual aids provide a framework that I can later apply to different problems in the subject.
Disadvantage	**Typical entry**
Not for Accounting/ number subjects Entries = 7	Visual aids can only be used to a certain extent. With respect to FRK visual aids are applicable in some learning areas, but others cannot be learned using visual aids, such as learning fundamental concepts
Not all information captured Entries = 6	Sometimes not all the work that is required to study is in the visual aid.
Too busy/ confusing Entries = 3	It can be confusing to other students because there will be a lot going on in the visual aid.
Not for everyone Entries = 4	I think using visual elements should be someone's own choice since we all have a different way of learning and understanding things.
Not helpful Entries = 4	I don't find visual aids helpful.
Interesting further comment	I feel that when I use study methods, I am only memorising some key points and not actually understanding the work.

The same procedure was used for the analysis of the responses of the control group, except that the categories identified for the test group were also used as input for the analysis of the control group data. However, where a further point, not identified by the test group, appeared to be of significance, it was added as a category. Twenty-six students responded and 34 useful points made were made (see Table 12 below). The advantages the students identified were that visual elements helped memorisation (seven entries, or 20.5% of the total responses) and understanding (four entries, or 11.4% of the total responses), usefully summarised the work (seven entries, or 20.5% of the total responses) and helped in preparing and/or studying for tests (four entries, or 11.4% of the total responses) (See Table 12). Three students (or 8.8% of the total responses) identified the visual nature of the technique as important, which was additional to the aspects identified by the test group. The other aspects identified were similar for both groups except that more students from the control group saw the summarising and test preparation functions of visual elements as important. An interesting additional comment read as follows: "I find visual elements to be quite useful. They help me in understanding abstract academic ideas and understanding work means you have to memorise less" (See

"Interesting further comment" under "Advantages", Table 12). The importance of this comment was the student's grasp of the fact that to understand is to remember, and that to remember does not necessarily equate to understanding. Only three salient disadvantages were reported by the control group: firstly, using a visual technique sometimes led to important information being left out (three entries, or 8.8% of the total responses); secondly, the concentrated nature of the visual element could lead to confusion (three entries, or 8.8% of the total responses); and, thirdly, some students felt that the technique did not suit everyone (three entries, or 8.8% of the total responses). Interestingly, no students from the control group saw the visual technique as of only limited use, compared to 17.9% of respondents from the test group. The other responses are comparable. One student commented that visual elements "are sometimes unclear, then we answer according to what we think the visual element might be presenting. They make one's life difficult." This response will be discussed further below. A full list of the responses is given in Appendix D.

Table 12   Salient responses to the pre-intervention questionnaire for the control group

Question: Is there any further comment you would like to make about the advantages and disadvantages of using elements in academic work?	
Advantage	**Representative entry**
Help remember Entries = 7	Visual elements help your brain to be able to remember information.
Help understand Entries = 4	They help you understand key concepts of a particular module.
Summarise work Entries = 7	The usage of usual elements is crucial for highlighting and giving a clear summary of all the important work you need to know, it is very efficient.
Help study/ prepare for tests Entries = 4	Visual aids have helped me study better as I have a photographic memory so it is easier for me to remember stuff by trying to locate where it is in my book and what colour I used to highlight it.
Help visualise Entries = 3	I use visual elements, because it helps me to link difficult concepts to pictures. These pictures is a representation of the difficult term/concept and it makes it easier for me to memorise it (study it).
Interesting further comment	I find visual elements to be quite useful. They help me in understanding abstract academic ideas and understanding work means you have to memorise less, which is good news to me because I have a short memory.
Disadvantage	**Representative entry**
Not for Accounting/ number subjects Entries = 0	(No entries)

Not all information captured Entries = 3	The downside to it is that they tend to leave out valuable information.
Too busy/ confusing Entries = 3	Visual aids can be confusing.
Not for everyone Entries = 3	It all depends on the type of person. But I personally failed to use them correctly or did not know how to use it correctly.
Interesting further comment	They are sometimes unclear, then we answer according to what we think the visual element might be presenting. They make one's life difficult.

What emerges from student responses in both groups is that visual elements are used primarily to memorise information, with a far lower number experiencing them as useful for understanding. The fact that some students also pointedly referred to the discrepancy between memorisation and understanding in the use of visual elements further underlines this aspect. As mentioned earlier, the ability of visual elements to summarise information is regarded by students in either group as both a strength and a weakness. It is regarded by some as a strength because it creates a good overview and summary; on the other hand, it is regarded by some as a weakness because it appears cluttered, not all information is included, and the flow of information is unclear. These negative experiences could be related to the type of visual technique the students had been exposed to previously, or to insufficient instruction in the use of the technique. However, the very nature of a familiar visual technique, such as a mind map, could very well have resulted in these negative responses. The image below (see Figure 18) serves to illustrate that a mind map may be perceived as "cluttered" at times, and that, furthermore, the lack of linking words indicating the connection between concepts could account for the comment about visual aids being "sometimes unclear" so that students "answer according to what [they] think the visual element might be presenting" (see "Interesting further comment" under "Disadvantages", Table 12).

Figure 18 Example of a mind map on the topic of mind mapping

4.3.2 The qualitative data from the post-intervention questionnaire

The post-intervention questionnaire had three open questions, namely "Which two aspects did you like most about concept mapping?", "Which two aspects did you like least about concept mapping?" and "Is there anything further you would like to add about concept mapping?" The responses to each question are discussed individually below. A full list of the responses is given in Appendix F.

4.3.2.1 Which two aspects did you like most about concept mapping?

The post-intervention questionnaire had three open questions that focused on students' recent experience of concept mapping. The first open question (Q10) was "Which two aspects did you like most about concept mapping?" Seventy-nine students responded to the question, and as the question asked for two positive aspects, this potentially equated to 158 entries. However, some respondents named only one positive aspect; furthermore, not all responses were useful. The result was a total of 100 useful comments.

Students liked six aspects in particular about concept mapping (see Table 13 below). The aspect most identified by students (27 entries, or 27% of respondents) was that concept mapping clearly outlined the structure and flow of the information. This is a very encouraging result as the hierarchical structure of concept mapping as well as the clear indication of the flow of information, by means of linking words, are two of its strongest points. This result also contrasts

significantly with the pre-intervention questionnaire result where both groups were of the opinion that visual aids were busy and confusing (see previous section). The second aspect of importance referred to the conciseness of the represented information, and therefore the way in which information had been summarised (25 entries, or 25% of respondents). This feature is generic to visual aids and also featured strongly in the pre-intervention questionnaire. Extrapolation of key points is clearly important to students, and this need seems to have been met to some extent by concept mapping. The third significant aspect identified by respondents is that concept mapping facilitates the understanding of Accounting concepts (22 entries, or 22% of respondents). This is another key feature of concept mapping and its unsolicited recognition by respondents must be welcomed. Two other aspects were identified to a lesser extent, namely that concept mapping helps with memorisation (11 entries, or 11 % of respondents), and with clarification of information (8 entries, or 8% of respondents). All these aspects can be said to aid understanding and/or memorisation. Finally, seven entries (7% of respondents) indicated an outright rejection of the use of concept mapping. This suggests a strong dislike as a separate question (Q11) was, in fact, available for negative comments. Interestingly, some of the respondents who displayed a negative attitude towards concept mapping appeared to have a generally negative association with visual aids (see Table 14 below). A further comment was included in the table that did not necessarily relate to the other aspects that had been identified but of which it was nevertheless worth taking note. In this response, mention is made of the help provided by "a good Accounting partner who helped me understand". The comment is a good illustration of peer scaffolding.

Table 13 Salient responses to the first open question of the post-intervention questionnaire

Question: Which two aspects did you like most about concept mapping?	
Aspect	**Representative entry**
Structures the information and shows how things connect Entries = 27	I liked how c/m outlines important/key points of topic. It made it clearer to understand and see how different sections connect with each other.
A lot of information captured in few words/ summarises well Entries = 25	It helps in the summarisation of information. It makes studying any theory-based module much easier to understand.
Makes understanding Accounting concepts easier Entries = 22	It has helped me with understanding different concepts in FRK. It simplifies FRK.

Helps memorise information Entries =11	It allowed me to identify and correct all the concepts I had problems remembering.
Clarifies information Entries =8	The flow diagrams as it clarified the Accounting process more for me.
Does not like concept mapping Entries = 7	I don't like any.
Interesting further comment	Made me understand the work better and I have a good Accounting partner who helped me understand.

Table 14   Examples of a general negative association with visual elements

Is there any further comment you would like to make about the advantages and disadvantages of using elements in academic work?	Which two aspects did you like most about concept mapping?	Which two aspects did you like least about concept mapping?	Is there anything further you would like to add about concept mapping?
No	I don't like any.	I can't remember.	
I feel that when I use study methods, I'm only memorising some key points and not actually understanding the work.	None	Certain key points are left out. It creates additional study and because one has to remember the maps itself along with concepts.	Should not study concepts like a parrot, only to memorise, cram and regurgitate info. Students should rather have a fundamental understanding.

4.3.2.2 Which two aspects did you like least about concept mapping?

The open question from the second post-intervention questionnaire (Q11) was "Which two aspects did you like least about concept mapping?" (see Table 15 below). There were 69 responses, and as the question asked for two negative aspects, this potentially equated to 138 entries. However, as some respondents pointed out only one negative aspect, and some responses were not useable, there were eventually only 70 useful entries. Nine aspects were pointed out by respondents as being particularly problematic.

Sixteen respondents (22.8%) reported having problems with the structure of the concept map, because the flow of information was unclear, or finding the right linking words or filling in the conceptual nodes was difficult. This is a most informative response as it points to a problem of understanding on the part of the respondents of how Accounting concepts are linked, a lack that would not be evident if the concepts are always dealt with in isolation. The 27% positive

responses for the concept mapping structure in the first question ("Which two aspects did you like most about concept mapping?") form an interesting comparison with the 22.8% here. This suggests that understanding was improved for some students because of the clarification of the structure of the topic, while for others a failure to grasp the approach prevented effective use of the structure that the concept map provided.

A high proportion of the replies also indicated that respondents found concept mapping confusing (14 entries, or 20% of respondents). In these cases, the actual words "confusing" or "complicated" were used. The high percentage here also compares unfavourably to the low percentage of respondents who identified visual aids in general as confusing (7.5%). Six respondents (8.5%) found that there was "too much going on" in concept mapping. This echoes the previous aspect that saw concept mapping as confusing. In fact, the three aspects mentioned so far (problems with the structuring of the maps, finding the technique confusing or too busy) could be grouped as they refer to the concept mapping format. This issue may point to problems with understanding the information, as discussed in the previous paragraph. It may also be argued that the collectively high proportion of negative responses here is the result of students' short exposure to the concept mapping technique, which did not allow students enough time to practice and become familiar with its use. A further comment was included in the table (see Table 15 below), though not grouped with specific problematic aspects, as this respondent seems to capture the problem discussed here so precisely: concept mapping is "[n]ot easy to use when the concept is not understood entirely".

The following aspects were of lesser significance but still worth noting. The first of these is that students found the technique time consuming (six entries, or 8.5% of respondents). Only one respondent mentioned the problem of the time involved in creating visual aids (this was not reported because of the low number of entries). This is a legitimate concern, especially until students are familiar with the technique; it is somewhat surprising that this aspect had such a relatively low occurrence, under the circumstances. A further aspect that was of equal concern (six entries, or 8.5% of the respondents) was that some respondents had wanted to add more information than there was space for. This reflects one of the disadvantages of visual aids identified by three respondents (7.5%), namely that important information was usually left out, as far as they were concerned. This suggests that some students need more clarification regarding the concepts under discussion, perhaps because of a lack of understanding. Five respondents (7%) were negative about concept mapping without giving particular reasons. Three respondents (4%) stated that they had problems with the drawing of the concept map,

which is odd as they were given a pre-created map and no drawing was required. Perhaps these comments reflect a general concern. The same number of students (three respondents or 4%) seemed to have experienced the concept mapping intervention as threatening. From their responses, it appears that they might have thought that they were being tested on the work.

Nine respondents (12.8%) chose to make a positive statement about concept mapping, even though they had had a previous opportunity to do so. This indicates a distinctly positive experience of concept mapping. A final aspect that is worth mentioning is that some respondents expressed disappointment at not being allowed to keep the completed maps. This is important, not because of the number of entries (only two, or 2.8%), but because it indicates further that some respondents had seen the value of the technique.

Table 15 Salient responses to the second open question of the post-intervention questionnaire

Question: Which two aspects did you like least about concept mapping?	
Aspect	**Representative entry**
Having to structure information Entries =16	Natural flow of map can be difficult to comprehend if concept wasn't initially understood fully.
Confusing Entries = 14	If you do not know your work, it can get very confusing. Some concepts are not explained in detail. A lot of information (irrelevant information).
Wanted to add more info Entries =6	Not every information can be covered in c/m.
Too much going on Entries = 6	Don't think I learn best this way (too much going on).
Time consuming Entries = 6	It takes my time and effort.
Generally negative Entries = 5	I have tried this and it did not work.
Drawing the map Entries = 3	Drawing the actual map.
Felt threatened Entries = 3	They are given to us unexpectedly. Made me feel stupid.
Could not keep maps Entries = 2	We can't keep the maps. I feel it doesn't help because I can't go over it.
Found nothing negative Entries = 9	There was nothing I didn't like. The concept of mapping assists me in studying so I find it effective.

Interesting further comment	Not easy for use when the concept is not understood entirely.

4.3.2.3 Is there anything further you would like to add about concept mapping?

The third open question from the post-intervention questionnaire (Q11) was "Is there anything further you would like to add about concept mapping?" (see Table 16 below). The 14 responses were diverse, which made categorisation difficult. However, the six positive responses (42 % of respondents) are similar in nature and can therefore be grouped together. Nevertheless, the separate negative comments, taken together, add up to seven (50%) and are therefore also worth reporting. Respondents' individual concerns were that the technique would need getting used to, that one would not be able to do it oneself, that concept mapping cannot be applied to Accounting and that the technique was not understood. These concerns are all connected to the need for greater familiarity with concept mapping, which can be addressed. One respondent's comment was that it encourages rote learning. This respondent made a similar comment when naming an advantage of visual aids ("I feel that when I use study methods, I am only memorising some key points and not actually understanding the work") and this might thus indicate a general attitude rather than a reaction to concept mapping itself.

Table 16   Salient responses to the third open question of the post-intervention questionnaire

Question: Is there anything further you would like to add about concept mapping?	
Aspect	**Representative entry**
Covers everything Entries = 1	For me everything is perfect the way it is because it covers everything I've learned so far.
Positive Entries = 6	C/m is really good for understanding of the relationship of concepts and how different concepts are connected in graphical sense, because people learn and remember fast with imaging.
Wrong application Entries = 2	I feel the concept maps only work for memorising modules or theory-based modules. They are difficult to implement for "understanding" modules.
Will take getting used to Entries = 1	It's very good and will take some getting used to.
Must make what is expected clear Entries = 1	Make the questions clear so I know what is expected of me.
Would not be able to do oneself Entries = 1	I do not think I would work with concept mapping because I would find it hard to start it from scratch myself.

Don't understand Entries = 1	I don't understand it.
Encourages rote learning Entries = 1	Should not study concepts like a parrot, only to memorise, cram and regurgitate info. Students should rather have a fundamental understanding.
Interesting further comment	How can it be applied to number or amounts, whether it will be recorded in this journal and be posted under which account on general journal.

4.3.3 Observations of the concept mapping intervention

As discussed in Section 3.6.4, three lecturers observed the concept mapping intervention. Their observations were subsequently recorded and are described here. The Accounting lecturer, Mr Amogelang Nawa, observed the following:

> The incomplete concept maps engaged all the students, I saw students discussing concepts, some asked questions (such as why income received in advance is regarded as a liability) which means they have never made that connection before. Students were also referring to their textbooks. Some students completed the map very quickly while for others it took a while. Some students immediately started discussing the map while the others firstly took some time (individually) to read their textbook. One of the students wanted me to tell them the answer (which I didn't) while the others were just confirming their answers.

Ms Nandi Weder (academic literacy) gave the following feedback of the observations:

> The BCom students seemed quite capable of completing the accrual concept map, worked on it individually and in pairs, and made the necessary corrections afterwards, while marking with their lecturer. The students appeared to be comfortable with the format of the task and did not seem particularly intimidated or confused by what they were expected to do, as they were able to carry on without much assistance. Most students managed to complete the task, often well before the time was up. I think it is likely that many of them will be able to construct their own concept map after having completed this task. Although some students completed the task individually, most paired up. Since the lecture hall only had long rows of seats, and since the class was quite noisy, discussing the task with more than one person at a time was not tenable. Typically, the students would start by filling in those gaps they could complete easily

and then discussing the sections they were uncertain of with a friend, often consulting a textbook together. They generally worked quite diligently on the task, despite the fact that it was a late class and many seemed quite eager to get home, although knowing that they were being observed might have had something to do with this. Once they were done with the task, many students added notes and corrections during the marking session, which also suggests that the task was not so easy that no mistakes were made.

As the researcher, I made the following observations:

Whereas students seemed uninterested when the normal lecture was in progress, they responded with alacrity to the task of completing the concept maps. Some worked individually but most seemed to work in pairs or groups. However, everyone participated. Many referred to different sections in their textbooks. Students pointed out certain aspects on the concept maps to each other in support of their proposed answers. There was some lively discussion. One pair of students was so delighted with having successfully completed the concept map that they high-fived each other. Even those who seemingly worked on their own checked certain answers with their peers. I also noticed some of the groups of students asking questions of the Accounting lecturer, Mr Amogelang Nawa.

Once the students had completed their maps, Mr Nawa discussed the solution. They were interested in seeing the solution and in correcting their own maps where necessary. When asked to return the maps, several seemed disappointed and one student asked to keep the map for studying purposes.

The three observers had the following similar comments:

- Students participated in the concept mapping exercise. A comment was also made that some had not shown much interest in the lecture before the concept map was introduced, so student participation could be linked to the concept mapping activity itself.

- Students used several scaffolding strategies in completing the concept map, such as teaming up with another student or asking other students for help, consulting their textbooks, and correcting misunderstandings when the Accounting lecturer discussed

the solution afterwards. Vygotsky's theory that learning takes place through socially mediated activity may be observed to be in action here (Vygotsky, 1986).

- Students appeared capable of doing the concept maps, as nobody seemed at a loss during the activity, although some needed more time than others did.

- The Accounting lecturer remarked that some of the students saw links between concepts that they had not been aware of before.

In summary, the observations of the lecturers indicate that students eagerly participated in the concept mapping intervention overall, and that they found the activity of value.

4.4 Relating the data to the first research sub-question

The first research sub-question was:

How does concept mapping affect students' comprehension of subject-specific concepts and their associated terms?

The aim of the research was to find out whether concept mapping could be used to improve students' subject-specific concept literacy. For the purposes of this research, the discipline that was used was Accounting. To investigate the effect concept mapping could have on students' comprehension of subject-specific concepts and their associated terms, Accounting terms were presented to the test group in the form of a concept map, and thereafter they were tested on their understanding of the terms. In the test, students were required to produce a paragraph in which they applied the terms to a real-life Accounting scenario. The post-intervention paragraph marks did not show an improvement on the pre-intervention paragraph marks. Similarly, the marks of the control group showed a decline. The decline in the marks of both the test group and the control group was not statistically insignificant, which means that no categorical conclusion, either positive or negative, can be drawn regarding the results of the intervention. Concept mapping can therefore not be said to have had a measurable effect on students' comprehension of subject-specific concepts and their associated terms.

Several questions in the pre-intervention questionnaire were aimed at investigating the influence of outside factors on results. Firstly, factors that might have influenced the pre-intervention paragraph marks were identified. For the test group, these aspects were as follows: whether or not a student had had English at Home Language level in Grade 12, the final matric marks and previous experience of Accounting. For the control group, the aspects were as

follows: previous use of visual aids, the type of school attended, whether or not a student had had English at Home Language level in Grade 12 and previous experience of Accounting. Secondly, factors that might have influenced the post-intervention paragraph marks were identified. The only aspect that appeared to be influential here was previous experience of Accounting. As none of the other previously identified aspects appeared to have any influence on the post-intervention marks, they may be dismissed. In conclusion, for both the test and control groups, students who had had Accounting at school were more likely to perform well in the pre- and post-intervention paragraphs.

4.5 Relating the data to the second research sub-question

Having analysed the qualitative data in the questionnaires, we are in a position to address the second research sub-question. The question reads:

> What are the opinions of students about concept mapping as a technique for scaffolding comprehension and memory of subject-specific concepts and their associated terms?

From the discussion in Section 4.2.5, it is clear that concept mapping was not experienced as significantly superior to other visual aids for understanding and memorisation. On the other hand, the 75% (52 out of 69) positive response rate for both understanding and memorisation indicates that students nevertheless found these aspects helpful. The qualitative data drawn from the post-intervention questionnaire support this observation (see Section 4.3.2), in that the positive aspects all identify concept mapping as useful for understanding, and, to a lesser extent, memorisation. This overwhelmingly positive response is significant, given the short exposure the students had to the technique. The same observation was made when the quantitative data from the post-intervention questionnaire were analysed (see Section 4.2.4), showing that the majority of students found the concept mapping intervention useful and were positively inclined towards implementing the strategy. Finally, lecturer observations of the concept mapping intervention appear to confirm that students found value in the activity. It can therefore be stated that students are predominantly in favour of concept mapping as a technique for scaffolding comprehension and memory of subject-specific concepts and their associated terms.

4.6 Relating the results to the research question

Having considered the data and interpreted its significance, the main research question may be addressed:

> Is concept mapping an effective technique for scaffolding concept literacy among first-year Accounting students in an extended curriculum programme?

The analysis of the quantitative data does not conclusively establish that concept mapping advances students' concept literacy, given the statistically insignificant result of the comparison between the pre- and post-intervention paragraph marks of the test and control groups. The analysis of the qualitative data more positively substantiated the value of concept mapping as a useful technique for improving concept literacy.

4.7 Accepting or rejecting the hypothesis

Three hypotheses were put forward at the start of the research. The first hypothesis was:

> The performance of students in the test group will improve from the pre-intervention test to the post-intervention test, based on their individual test scores.

As there was no improvement in scores from the pre-intervention test to the post-intervention test for the test group, this hypothesis is rejected.

The second hypothesis was:

> There will be very little improvement in the performance of students in the control group from the pre-intervention test to the post-intervention test, based on their individual test scores.

As there was a decline in the performance of students in the control group from the pre-intervention test to the post-intervention test, this hypothesis cannot be rejected directly.

The third hypothesis was:

> The performance of students in the test group will improve more than the students in the control group did, based on the difference between their pre- and post-intervention test scores.

The performance of students in the test group did not improve more than the performance of students in the control group did, based on the difference between their pre- and post-intervention test scores. Therefore, this hypothesis is rejected.

4.8 Factors influencing the results

Postpositivism allows for extenuating circumstances to have an influence on the failure of a theory (Willis, 2012b). It is also deterministic in nature, and it is thus appropriate to look for the possible causes of reported results (Creswell, 2014:7). Therefore, now that the research has been concluded, I would like to reflect on my observations and experience of the process, as this might provide a perspective on the results presented above. These do not include the recognised limitations of the study, which will be discussed in the next chapter, but rather refer to unforeseen issues that only became apparent during the course of the research. The factor causing most concern was student participation and the impact this had had on the research.

In the discussion on Ausubel's Theory of Assimilation (see Section 2.3.5), the importance of student participation in the process of meaningful learning is given as one of the three essential factors of the theory (Novak, 2010:59; Novak & Cañas, 2008:3-4; Carnot et al., 2003:6-7). For example, if a student is unwilling to cooperate in the assimilation of new knowledge (Novak, 2010: 60) and refuses to forego the habit of rote learning, there is little that the instructor can do to force the issue (Novak & Gowin, 2010:159; Novak & Cañas, 2008:3). This is of course true for any learning strategy or any curriculum that might be proposed, as well as students' general attitude towards their studies. Furthermore, while assisting in the Accounting lecture, I observed that many students paid no attention to the lecturer, but rather occupied their time in personal pursuits. Indeed, it seems that the issue of accountability is now being recognised in many quarters. Recently, the FLY@UP campaign was launched at the University of Pretoria to encourage students to "*take responsibility* for their own finish lines and to [graduate on time]" [author's emphasis] (Byles, 2017). A practical implication of some students' poor attitude towards their learning is discussed in the next paragraph.

A major factor that influenced the current research was the number of students in the test and control groups. The test group consisted of 127 students and yet, as a result of poor class attendance, the information of only 65 students, on average, was usable. Similarly, the control group consisted of 53 students, and yet the information of only 35 students could be used. Class attendance is not compulsory for the relevant extended programme, although it is encouraged, as it has been shown to be influential in good academic performance (Koh, 2014:457). Thus,

while it is surely not an unreasonable assumption that students who have been granted this "grace" year would approach it with a greater sense of purpose, the reality proved that many did not.

4.9 Conclusion

In this chapter, the quantitative data gathered by means of the pre- and post-intervention questionnaires and the pre- and post-intervention paragraph marks were analysed and discussed, to assess the validity of the three hypotheses put forward at the start of this study. The qualitative data collected by means of the pre- and post-intervention questionnaires, as well as from the observations that had been made of the intervention, were analysed to see whether they supported the results of the quantitative data. The research questions were then addressed, and two of the research hypotheses rejected. Finally, unforeseen factors that might have influenced the results were reflected upon.

Chapter 5: Conclusion

5.1 Introduction

In this concluding chapter, an overview will be given of the motivation for this study, the methodology used for the research, and the collection and analysis of the data. Thereafter, I shall reflect on the relevance of the results, and conclude by stating the limitations of the study and mentioning possibilities for future research.

5.2 Overview of the study

Since 1994, the aim in higher education in South Africa has been accessibility and excellence, not only to correct injustices of the past, but also to boost the economy of the country by providing effective graduates (Volbrecht & Boughey, 2004:58). While great strides have been made as far as accessibility is concerned (CHE, 2013; Paxton, 2009; Badsha & Harper, 2000), we still experience problematic throughput that is indicative of an education system that is wanting, despite the establishment of various policies in this regard (Department of Higher Education and Training, 2011; Department of Higher Education and Training, 2010; Ministry of Education, 2001; Department of Education, 1997). In response, various academic development programmes were established (Mckenna, 2012; Boughey, 2010; Volbrecht & Boughey, 2004) but as yet these programmes have not been able to address the problem of throughput adequately (CHE, 2015), which forces us to look more widely for solutions. Underdeveloped cognitive skills and insufficient concept literacy, which are typical outcomes of rote learning, have been identified as problematic areas at the heart of underpreparedness (Wilson *et al*., 2014; Maas & Leauby, 2005; Joseph & Ramani, 2004; Norris & Phillips, 2003; Novak, 2002). Concept literacy refers to a deep understanding of the terms that make up the vocabulary of a certain discipline, without which the subject remains inaccessible (Gablasova, 2012) and ways and means must therefore be found to improve students' understanding of the concepts integral to their chosen subjects in order to grant access to the epistemologies of those subjects. The present study set out to find an answer to the particular issues facing the South African educational environment.

A Postpositivist paradigm was followed, as this study was meant to produce "credible claims based on rigorous enquiry" (Floden, 2009:488). Even though this research paradigm claims that the conclusions drawn from a research study are never decisive (Creswell, 2014), a conclusion

may be reached from the collective results of various studies on the same theme (Willis, 2007b:8). A research claim can therefore only be verified after a lengthy process. This illustrates an important aspect of Postpositivism, namely the desire for truth. While a Postpositivist paradigm is generally synonymous with a quantitative methodology, this study used mixed methods to ensure a balanced interpretation of results (Creswell, 2014:15) and to enhance the overall strength of the research (Creswell, 2014:10).

The research leans upon educational theories that may be subsumed under the denominator of cognitive Constructivism, which maintains that the construction of meaning is an individual process and that newly acquired knowledge is merged with previously assembled knowledge structures (Byrne & Willis, 2014; Lucas & Mladenovic, 2014; Taber, 2000). In Constructivism, the construction of meaning is more important than simply a regurgitation of information (Lutz & Huitt, 2004), and the process of aiding the construction of new knowledge is called scaffolding (Fennema-Bloom, 2009:33; see also Walqui, 2006:170). Constructivism further emphasises the need for student engagement in learning, as individual construction of meaning cannot take place without such engagement (Lutz & Huitt, 2004).

Ausubel's Assimilation Theory (1962) is a variation of Constructivism and in particular seeks to promote meaningful learning that emphasises relevant and valuable prior knowledge (Greenberg & Wilner, 2015; Novak, 2010; Simon, 2007:278; Safayeni *et al*., 2005:2). Knowledge must be clearly expressed (Novak & Cañas, 2008:3) and, furthermore, the student must cooperate in the learning process (Novak, 2010:59; Novak & Cañas, 2008:3-4; Carnot *et al*., 2003:6-7). This is also emphasised in Constructivism, as mentioned in the previous paragraph. Assimilation Theory is of particular use to the current research as it is specifically aimed at the educational environment.

Novak used the ideas advocated in Asubel's theory to design and develop concept mapping. Concept mapping is a hierarchical representation of knowledge (Greenberg & Wilner, 2015:18; Novak, 2010:4; Novak & Cañas, 2008:12; Simon, 2007:276) and as such functions as a useful scaffolding tool (Novak & Cañas, 2008; Chang *et al*., 2002). Concepts and the relationships between them are depicted, and it is in the identification of such relationships that meaningful learning takes place (Novak & Cañas, 2008; Carnot *et al.*, 2003; Novak, 2002). Many researchers have commented on the useful application of concept mapping in a variety of subjects, among which Accounting features strongly, but the reports have for the most part been anecdotal rather than backed by results from rigurous studies (Leauby *et al*., 2010: 287:289).

This study was aimed at investigating whether concept mapping could conclusively be proved to enhance meaningful learning, and, in particular, conceptual understanding. The setting was an extended programme for BSc and BCom students at a South African university. The research was accommodated in the Accounting course, as previous studies had shown Accounting to be well suited to the strategy (Leauby *et al.*, 2010; Simon, 2007; Maas & Leauby, 2005), and the Accounting lecturer was also interested in using concept mapping. The Accounting students fall into two groups, the BCom group and the BSc Mathematical Sciences group, and as initial information suggested that these groups were similar in ability, it seemed feasible to use the one group as the test (BCom) and the other as the control (BSc Mathematical Sciences) group in a quasi-experimental design. The groups were not equal in size; nevertheless, the initial numbers – 127 students in the test group and 53 students in the control group – were sufficient for statistical purposes. The research was merged with the normal extended programme Accounting curriculum to replicate the standard teaching environment as much as possible. The Accounting curriculum is very full; consequently, a limited amount of time was available to conduct the research.

The Postpositivist paradigm requires strict control of the data collection process, as described hereafter (Creswell, 2014). Both the test and control groups completed a pre-intervention questionnaire to identify factors that might influence the outcome of the research. Both groups then wrote a pre-intervention paragraph based on a previously covered Accounting topic. Examples of the pre-intervention paragraph are available in Appendix G. While it is not standard for Accounting assessment to take the form of a written paragraph, the rationale for its use was well supported (see Section 3.6.2). One of the primary reasons for this format being deemed a more appropriate test for conceptual understanding was that current research indicates how important language is in expressing content knowledge (Madiba, 2014:68; Gablasova, 2012:13). The pre-intervention paragraph marks were not only compared to the results of the post-intervention paragraph marks, but were also used to establish comparability between the test and control groups. At this stage, the concept mapping intervention took place for the test group. Students were firstly familiarised with concept mapping and were then given a partially completed concept map to complete. This concept map covered a previously discussed Accounting topic, which served as a form of revision. The same topic was also revised for the control group, but using conventional means. Both groups then wrote the post-intervention paragraph, based on the revised topic, and, finally, the test group was given a post-intervention questionnaire to complete to determine their experience of the concept mapping intervention. Examples of the post-intervention paragraph are available in Appendix H.

It is necessary that the objectivity and validity of the conclusions be assured (Creswell, 2014; Willis, 2012). For instance, if students' marks are not tested for improvement after the use of concept mapping, one cannot make any claims about the effectiveness of concept mapping (Leauby *et al.*, 2010:288). Hence, a comparison of the post-intervention paragraph marks to the pre-intervention marks was conducted, which delivered the following results: the marks of the test group showed a slight decline, as did those of the control group, although the decline was marginal in both cases. Furthermore, the initial assumption regarding the equality of the two groups proved to be invalid when the pre-intervention paragraph marks of the two groups were compared; the test group scored lower than the control group. This test was required to ensure the validity of one's data, which is essential with Postpositivism (Creswell, 2014). For the same reason, all extraneous variables need to be accounted for in the results. The data drawn from the pre-intervention questionnaire indicated only one extraneous variable that might have had an influence on results, namely previous experience of Accounting. Indeed, prior experience of Accounting is also the likely explanation for the discrepancy in ability between the two groups, as substantially fewer BSc Mathematical Sciences students had had Accounting at school. When seen within the Constructivist framework, one could contribute the poorer results of those who did not have a background in the Accounting discipline to a lack of the prior knowledge that is essential for the interpretation of new knowledge (Byrne & Willis, 2014:146; Lucas & Mladenovic, 2014; Taber, 2000:64). Alternatively, Schema Theory would say that students without prior experience of Accounting do not have the appropriate schemata upon which to build newly acquired knowledge (Brewer & Nakamura, 1984; Carrell & Eisterhold, 1983). We are also reminded of a further requirement posited by Constructivists, Dewey in particular, that students need to have the necessary expertise to complete a task (Lutz & Huitt, 2004:8). Based on the results of the quantitative data discussed above, no definite conclusion can thus be drawn regarding the value of concept mapping as an effective technique for scaffolding concept literacy. This conclusion corroborates the result of the research undertaken by Leauby *et al.* (2010), which was the most comprehensive of the studies referred to in Section 1.4.2.

A consideration of the qualitative data, on the other hand, indicates general enthusiasm for the concept mapping technique. This again reflects the outcome of the Leauby *et al.* (2010) study referred to previously, where, while there was no conclusive proof of concept mapping having an impact on conceptual understanding, the general response to the technique was positive. The aspects of concept mapping that most impressed participants in this study was that it clearly outlines the structure and flow of information, as well as the key points, all of which assisted in the understanding of Accounting concepts. That students should have spontaneously

identified so many of the particular strengths of concept mapping is encouraging. Negative responses were fewer and in almost direct contrast to the positive comments: the structure of the concept maps was found to be unclear, confusing, complicated and busy, all of which might be ascribed to a lack of familiarity with the technique. A small number of respondents also found the technique time-consuming and too concise.

5.3 Limitations of the study

There were factors that limited the study, and these must be acknowledged and discussed. The first factor is the time required to gain familiarity with concept mapping. The time-consuming nature of concept mapping has been discussed previously (see Section 2.4.2.2), and only the main issues will be summarised here. Time must be found in an already busy schedule for both lecturers and students to acquaint themselves with the technique – this might include overcoming students' negative attitudes (Novak & Gowin, 1984:159) – and also to reinforce it through continued practice (Leauby *et al*., 2010:296; Maas & Leauby, 2005; Chang *et al.* 2002). Maas and Leauby (2005:80), for example, report on a study in which "statistically significant increases in perceived accuracy of introductory statistical concepts" were found "by *continually* using mapping techniques" [author's emphasis]. In fact, Chang *et al*. (2002:20) report that it took fourteen weeks for even a pre-constructed map to deliver results, and that it is unlikely that the technique of concept mapping will be mastered properly in under a year. Novak (2010:9) furthermore informs us that the implementation of concept mapping at a particular school brought about a drop in marks in the first year, and that positive results were only reported in the following year. Indeed, a drop in marks might be generally expected, according to Novak and Gowin (1984:159), as students transition from rote learning to meaningful learning. While the period allowed for this study was all that could be spared in the Accounting timetable, the reality of the time required to master concept mapping suggests that more time is needed to investigate adequately the effectiveness of concept mapping.

Another aspect that needs to be mentioned, although it has been discussed in some detail previously (see Section 3.6.2), is the effect the unfamiliar assessment format might have had on student performance. In summary, while Accounting students were normally exposed to assessment that took a numerical form, for this study, they were expected to explain their solution to the given Accounting problems in paragraph form. There is substantial evidence from the literature to support the use of language in assessing whether conceptual understanding has been achieved (Jonker, 2016; Pearson *et al.*, 2012:2; Gablasova, 2012:13;

Novak, 2010:80; Novak & Cañas, 2008:15; Vygotsky, 1986:108). Furthermore, although this serves as anecdotal evidence only, during the marking of the pre- and post-intervention paragraphs, it was apparent that students with previous experience of Accounting were able to explain the use of Accounting terms more clearly than those who did not have such experience. Despite the ample justification for the written format, however, its possible effect on student performance must be acknowledged. It should be noted that the same format was used for both the pre- and post-intervention paragraphs, and that the format therefore could not have been a vital factor in the drop in marks for the post-intervention paragraph.

Finally, an issue that became apparent to me during the research process was the impact a lack of a pilot study had on the overall investigation into the effectiveness of concept mapping. However well the data collection might be planned during the design phase of a research study, potential weaknesses often only show up once the plan is executed. In retrospect, ways may have been found to counteract the poor class attendance if it could have been anticipated. It is also possible that the rewording of some of the questions in the pre-intervention paragraph could have resulted in a different response. For example, it is possible that the description of the different learning styles, which were added to clarify the question, could have led to a misconception. For the question on visual learning ("I learn by using visual elements"), the explanation was given as "e.g. maps, graphs, pictures", which might have confused students. Furthermore, it only became clear during the transcribing of the questionnaire responses that students were not reliable sources of personal information, such as their matric marks for English and Maths, and their APS. A pilot study would have made it clear that such information should rather have been collected from the University database. There are thus many ways in which a pilot study would have been an advantage; a few instances have been given here.

5.4 Suggestions for further research

In their study of the feasibility of concept mapping, Leauby *et al*. (2010:287-289) urge rigorous empirical research, to which body of knowledge I hope this study has added. Even though it has not produced the desired result, it nevertheless should further our understanding, not only of concept mapping applicability, but also of the role of conceptual understanding in student success.

Research into concept mapping has by no means been exhausted. Even though this study has endeavoured to produce rigorous research, it might have provided more substantial results if it had been preceded by a pilot study and the participant numbers had been higher. Many smaller

studies have been conducted on the use of concept mapping. What is required now is a substantial study that will address the limitations discussed previously. Such a study will require a time commitment of several years, as indicated by the comments in the previous section.

Higher education in South Africa is in dire need of practical and effective solutions to the problem of inadequate throughput, which is merely an outward manifestation of the far greater issue of superficial learning. Education is, as Novak (2010:19) declares, an "enormously complex human endeavour" and proposed changes must be carefully considered so that they help rather than harm. While this study does not offer conclusive proof of the advantages offered by concept mapping in aiding meaningful learning, I nevertheless continue to believe in its value. As Leauby *et al*. (2010:296) declare, "While not statistically supported, the benefits of concept mapping seem evident to us, but do not come without cost or constraints to consider."

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Appendices

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Extended Programme

Pre-intervention questionnaire: Previous experience of visual support of learning

Dear student

Thank you for your willingness to contribute data that will help us to find new ways to improve conceptual understanding.

When filling in the questionnaire, please note that there are no right or wrong answers since you are giving a personal opinion. Your responses will remain anonymous, and there are no disadvantages involved in completing the questionnaire.

Respondent number

| | Q0 | |

Please tick (using an X) the number that reflects your opinion most accurately.
All questions should be answered.

To answer questions 1 to 4, think about the way you normally learn.		strongly agree	agree	disagree	strongly disagree			
1. I learn through reading a printed or written text.		1	2	3	4		Q1	
2. I learn through listening (e.g. to a lecture).		1	2	3	4		Q2	
3. I learn when I am active (e.g. when I highlight, underline, summarise).		1	2	3	4		Q3	
4. I learn by using visual elements (e.g. maps, graphs, pictures**).**		1	2	3	4		Q4	

5. I have used visual aids, such as the one shown here, before.		yes 1		no 2	Q5	
6. The visual aid that I used helped me to MEMORISE the work.		yes (if you used visual aids and they helped you to memorise work) 1	no (if you used visual aids but they did NOT help you to memorise work) 2	not applicable (if you have never used visual aids) 3	Q6	
7. The visual aid I used helped me to UNDERSTAND the work.		yes (if you used visual aids and they helped you to understand the work) 1	no (if you used visual aids but they did NOT help you to understand the work) 2	not applicable (if you have never used visual aids) 3	Q7	

8. Is there any further comment you would like to make about the advantages and disadvantages of using visual elements in academic work?

_____
_____
_____
_____

Personal information

9. Name and surname						Q9	
10. Student number						Q10	
11. Group	BCom 1			BSc 2		Q11	
12. Gender	male 1			female 2		Q12	
13. Name of the high school attended						Q13	
14. Town/ city where school is situated						Q14	
15. Had Accounting as a school subject	Yes 1			No 2		Q15	
16. Home Language	1 English	2 Afrikaans	3 Sepedi	4 Other South African	5 Other African	6 Other	Q16	
17. Level of English in Grade 12	English Home Language 1			English First Additional Language 2		Q17	
18. Symbol received for English in final exams	A (7)	B (6)	C (5)	D (4)	E (3)	F (2)	Q18	
19. Symbol received for Maths in final exams	A (7)	B (6)	C (5)	D (4)	E (3)	F (2)	Q19	
20. Final AP score gained						Q20	

Thank you for filling in the questionnaire.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Extended Programme

Post-intervention questionnaire: Experience of concept mapping

Dear student

Thank you for your willingness to contribute data that will help us to find new ways to improve conceptual understanding.

When filling in the questionnaire, please note that there are no right or wrong answers since you are giving a personal opinion. Your responses will remain anonymous, and there are no disadvantages involved in completing the questionnaire.

Respondent number

Q0	

Please tick (using an X) the number that reflects your opinion most accurately.
All questions must be answered.

		strongly agree	agree	disagree	strongly disagree		
1. I like Accounting.		1	2	3	4	Q1	
2. I find concept mapping easy to use.		1	2	3	4	Q2	
3. Concept mapping helped me to better UNDERSTAND the Accounting concepts.		1	2	3	4	Q3	
4. Concept mapping made it easier to REMEMBER information.		1	2	3	4	Q4	
5. Concept mapping helped to identify MISCONCEPTIONS I had about a topic.		1	2	3	4	Q5	
6. I will use concept mapping again.		1	2	3	4	Q6	

		1	2	3	4			
7. I liked using concept mapping.		1	2	3	4		Q7	
8. I would be able to use concept mapping in my other subjects.		1	2	3	4		Q8	
9. I like being at the Mamelodi campus.		1	2	3	4		Q9	

10. Which two aspects did you like most about concept mapping?

_____

_____

_____

_____

11. Which two aspects did you like least about concept mapping?

_____

_____

_____

_____

12. Is there anything further you would like to add about concept mapping?

_____

_____

_____

_____

Personal information

13. Name and surname			Q13	
14. Student number			Q14	
15. Group	BCom	BSc	Q15	

Thank you for filling in the questionnaire.

Dear student participant

INFORMATION AND CONSENT

The University of Pretoria is constantly endeavouring to find innovative ways of enhancing the learning experience for students and of improving student success. In this regard, research indicates that concept literacy, which refers to the meaning of words used in specific subjects, is of vital importance in obtaining success in a subject. A solution to the problem of concept literacy attainment might be the use of a technique, known as concept mapping, which was specifically designed to address this issue.

The purpose of the research in which we would like you to participate is to investigate whether concept mapping does indeed support concept literacy. The research will consist of two paragraphs written in class. Furthermore, the test group will complete concept maps in class.

You will not be disadvantaged in any way by participating in this research. The data will be reported anonymously in a Master's degree, and possible in academic articles and papers at academic conferences. The data gathered will be kept confidential and only the researchers involved in this project will have access to it.

You may decline to participate in or withdraw at any time from this study, without any consequences.

By signing this form, you declare that you are fully informed of the purpose of the research and give permission that:

1.	data obtained from this study may be reported in a Master's thesis, academic articles and papers at academic conferences **without identifying you as an individual;** and
2.	your academic record (including your performance at school), as well as any other relevant data, may be made available for this study.

Please show your willingness to participate by signing and dating this consent form.

I agree to participate in the study on condition that my name is not used.
My responses may be used anonymously in academic publications, provided that ethical clearance is obtained from the Ethics Committee of the Faculty of Humanities.

Participant

_____ _____
(name) (signature)

Date

_____

Appendix D

Maths students' pre-intervention questionnaire qualitative responses
Question 8: Is there any further comment you would like to make about the advantages and disadvantages of using visual elements in academic work?
The visual aid helps us to grab information much quicker.
No, because I have never used visual aids.
I do not have an idea, because I have never used it before.
The usage of usual elements is crucial for highlighting and giving a clear summary of all the important work you need to know, it is very efficient.
I find visual elements to be quite useful. They help me in understanding abstract academic ideas and understanding work means you have to memorise less, which is good news to me cause I have a short memory.
They help you understand key concepts of a particular module.
I will start using visual aids and see whether it can help me to memorise.
Visual aids help to summarise and visualise the work which is good for anyone.
No comment.
One of the advantages of using elements is that they are efficient and less time consuming when studying since notes are summarised and makes it easier to grasp. (Though I have not yet used them). No Disadvantage.
Visual aids are very important for summarising and easy to read; however, the downside to it is that they tend to leave out valuable information.
The advantages for me is the fact that I get a clear picture of what am learning about in a way that it makes sense. I mostly prefer learning through videos because sometimes lecturers don't cover all the work. For me I don't see any disadvantage in learning with visual elements.
It all depends on the type of person. But I personally failed to use them correctly or did not know how to use it correctly.
I think visual elements should be mostly used as well, since some of us learn better with visuals. Actual visual element should be used in same way as lecturing since communicates in different ways.
They help very much.
The advantage is that the diagram has the summarised information about the certain chapter or theory. Disadvantage is that the diagram or visual aid has not enough information, this means one must refer back to notes for theory.
Visual elements help me grasp work faster since I am a visual learner.
Disadvantage. They are sometimes unclear, then we answer according to what we think the visual element might be presenting. They make one's life difficult.
Visual elements help your brain to be able to remember information and summarises information. They help you understand how different information relate with each other. You might have a problem when writing an essay in constructing sentences or paragraph, this will take time to do since you are used to writing keywords/phrases instead of complete sentences.
Visual aids have helped me study better as I have a photographic memory so it is easier for me to remember stuff by trying to locate where it is in my book and what colour I used to highlight it.
Never used visual aids.
People are different hence have different study methods. For me visual elements does not benefit me much in memorising the work; however, it does help me to understand the work better.

I use visual elements, because it helps me to link difficult concepts to pictures. These pictures is a representation of the difficult term/concept and it makes it easier for me to memorise it (study it).
The advantage is that it makes it easier to learn and study it hence making it more memorable.
I think visual elements help us to learn things/work easier as it attracts interests our minds.
No.
No comment.
No.
Not sure, since I have not tried it before.
I would like to find visual aids that help me to understand things in subjects like business studies rather than just helping me memorise.
The advantage of using a visual element in academic work is that it helps you know more about what you are learning and gives you more information and in some instances it helps you to remember valuable info.
Advantage: It is much simpler to construct a visual aid. Disadvantage: Visual aids can be confusing.
I don't use visual aids because they disadvantage me when it comes knowing recalling the words I come across in the book.
Sometimes they are complicated and you have less information available.
Visual elements also give you a guideline on how to approach the work.

Appendix E

BCom students' pre-intervention questionnaire qualitative responses
Question 8: Is there any further comment you would like to make about the advantages and disadvantages of using visual elements in academic work?
No
I feel that visual elements cannot sometimes be used for other modules like FRK. I haven't used it because I do not think I need to summarise numbers in order to understand but would love to try it might help.
I don't find visual aids helpful.
Sometimes not all the work that is required to study is in the visual aid,   Visual aids can be confusing sometimes. It does not always include all the important points.
No.
When I write everything down I learn much more than just reading the work.
Using colour and visual aids helps me remember and understand my work thoroughly.
No comment.
Visual aids tend to be a cluster of information.
I think using visual elements should be someone's own choice since we all have a different way of learning and understanding things.
If used effectively it is a great way to study and prepare for tests.
Advantages is probably that it summarises the work quickly. But, the disadvantage is that it leaves out some facts and some subjects like maths, you cannot apply it.
If the visual aid is too summarised, then you end up not understanding. The keywords used are sometimes irrelevant.
I find learning on paper and listening to a lecturer more effective and helpful.
The advantage is that you take information visual, therefore you will remember. The disadvantage is that you may mix up elements.
No
No
No.
They are not useful to me.
The advantages of visual aids are that they are easy to interpret but hard to understand. Visual aids only display important elements. Disadvantages are that it doesn't show all important information.
As a student, I prefer to make ……….…study methods, that don't contain visual aids.
Advantages: you can put everything under one paragraph. I use v/a for images and sub-headings of images which is effective. However, I prefer bullets which is more detailed than v/e.
When using v/a sometimes if you're photographic memory person it works very well as you remember the picture of the v/a when writing a test. The only disadvantage is that you cannot learn from someone else's v/a eg. mindmap because you will not understand what is going on
No
V/a and their impact depends on the type of module I am working in. For example, it would not help in WTW as just looking at the work will not make you understand. It is useful for study or memorising work. For example, OBS where facts must be studied.
No comment.
Disadvantage is that is time-confusing.

No
Using visual aids makes me understand, grasp the work quicker as they summarise the work.
The advantage of a v/a to me was that info I would put to paper would stay for quite a long time unlike just writing whole story and the disadvantage I encountered was that if I forget one element from that particular v/a, it means everything will go wrong and this will mess up all my answers.
No
Advantage - Makes academic information accessible. Disadvantage - We be lazy.
Conceptual learning is needed more regularly for subjects such as OBS133, LST133, AIM111 & various other subjects with more written content. Although FRK, WTW & WST do require conceptual learning, repetition and practice is what's mainly required to master various concepts.
None
I feel that when I use study methods, I'm only memorising some key points and not actually understanding the work.
Adding colour to visual elements, also helps me remember the work.
Advantages = easy summarised. Disadvantages = need to be explained how it flows.
Visual elements makes it easy for one to remember the concepts during examinations or tests.
No.
I would suggest that during lectures we do questions that are tricky, because some of us is for the first time doing accounting.
Visual aids actually help us as students to see what exactly is the topic talking about and what is required for us to know and learn effectively.
The advantages of using visual elements is that in the process of writing an exam or test you can visualise what it is that you studied.
They help with memorisation but not understanding the work..
No. I think they help me understand everything better.
Visual aids provide a framework that I can later apply to different problems in the subject.
It depends on what subject/ module you use it for.
They help you to understand the subject better.
Advantage - it helps other students to interpret information easily while on the other hand it can be confusing to other students because there will be a lot going on the visual aid.
The advantages of using visual elements is that you would get to understand the work more than using paragraphs.
Visual aids can only be used to a certain extent. With respect to FRK visual aids are applicable in some learning areas, but others cannot be earned using visual aids, such as learning fundamental concepts.
No
By using v/a combined with power studying which is a method of studying formally developed by Darren Penheim. This includes journeys, abbreviations and visual elements to memorise a lot more work in a shorter period of time and with a much longer retention span.

Appendix F

Test group (BCom) students' post-intervention questionnaire qualitative responses		
Question 10: Which two aspects did you like most about concept mapping?	Question 11: Which two aspects did you like least about concept mapping?	Question 12: Is there anything further you would like to add about concept mapping?
It helped me to remember concepts quicker. It made it easy for me to understand.		
I don't like any.	I can't remember.	
Working with a classmate to figure out the answers. It joins the dots is I were to fill one out after studying a topic.	We can't keep the maps. I feel it doesn't help because I can't over it. Don't think I learn best this way (too much going on).	
It makes the concepts about accounting easy and it makes it more simple to understand accounting.		For me everything is perfect the way it is because it covers everything I've learned so far
Easy to use. A lot of info in fewer words.		
It is very easy to read and understand since everything is structured accurately and helps to remember some of it if you constantly practice or look at it.	Nothing unless is it's a chapter that I do not understand it becomes hard for me to know what which is.	It's very good and will take some getting used to.
This is how it tells me that the information is derived from this manner.	Drawing the actual map.	
I liked how c/m outlines important/key points of topic. It made it clearer to understand and see how different sections connect with each other.		
Made me understand the work better and I have a good accounting partner who helped me understand		
I enjoyed filling in missing words which helped me to realise that I do remember things that I have studied. It was easy to use & clear as well.	Nothing.	
It shows how ideas are linked; I summarised the w+AQ17:AR17ork on one page	Personally, I felt there was too much information on one page; I couldn't concentrate on one idea; It takes me a while to understand and why the ideas are linked	
Makes things clear. Is easy to understand.	Save time. Make student happy if they doing accounting.	Nothing.

It is easy to use; It summarises everything into simple and understandable work	I have to remember the work in the particular order. Is is a lot of word on one paper	
The structure of mapping is easy to understand; The given words give you a clue on what is the answer	It's too solid; Not every information can be covered in c/m	
easy to read layout. Pictures (flow diagram) easier to remember.	Time consuming.	
The simplicity; The flow diagrams as it clarified the accounting process more for me		
It clears out the process of the concept in different ways, e.eg. In credit/ cash	I do not really like mind maps because I get confused with linking words, it was long	
It lays out all important factors and easy to flow with as not too much wording is used.	They ae given to us unexpectedly.	
It helps us to understand the concept better.	When we have to link concepts and fill in answers in between.	
Shortened summaries of what each topic was about and how they all linked together to form the statements in the accounting process.		
Joining of concepts to show relationship. How to define concepts.	None.	
It has helped me with understanding different concepts in FRK' It simplifies FRK.	The questions can be vague and ambiguous.. Piecing together information can be challenging.	Make the questions clear so I know what is expected of me.
Being able to link ideas together. Writing in short phrases that I understand.	Takes up a lot of time with the drawing of mind clouds.	
The accrual concept and statements.	Joining words and the journals	
The filling in the blanks.		
There was a flow to it. Most things were added for us so you hd direction.	Can be difficult to interpret.	I do not think I would work with concept mapping because I would find it hard to start it from scratch myself.
	I have tried this and it did not work.	
The connected ideas which are related/ concepts. Makes it easy to understand concepts since we link them.	None	

One is able to make connections about the different concepts. It makes it easier to understand accounting.	It is too much administration. It takes my time and effort.	
It is easier to understand. One is able to remember facts.	If you missing one word the whole kind of loses meaning. It may sometimes be time consuming.	
It gets straight to the point. Sum up everything on one page - leaves room for mental stimulation.		
It is summarised easily; It is easy to follow.	At times there is not enough information; May be ambiguous.	
The part where you fill in the blocks.	When we had to fill in the empty spaces.	
	The diagram only	I don't understand it.
It is clear. It can be interpreted.	A lot of information (unrelevant information).	
It helped me understand the accounting procedures in that topic. It helped me remember the information easier	C/m did not help me to identify misconceptions I had about the topic	
Helps to reinforce information.	Concept mapping is too spread out for me, the information is everywhere.	
The easy about which makes it better to read and understand. It summarises the work very coherently.		
That everything is grouped under categories and the subheadings, information flows down, in the right category which makes it easier to understand.		
That everything is clear and much shorter than reading it out from the text book.	If you do not know your work, it can get very confusing. Some concepts are not explained in detail.	
The fact that concept of work is laid out in detail but in a way it is summarised so you are able to identify and remember concepts better.	There was nothing I didn't like. The concept of mapping assists me in studying so I find it effective.	No there is nothing I would like to add.
It has a lot of clues, so it makes it easier to fill out missing information.	It is just not how I prefer learning my school work. It takes up a lot of space.	
None	The drawing of the concept mapping.	

The link between similar ideas; The clarity of the overall look of concept maps.	If you do not know answer of specific idea. It ruins next one as answer is based on your specific answer.	I feel the concept maps only work for memorising modules or theory-based modules. They are difficult to implement for "understanding" modules.
Nothing.	Nothing.	No further information can be added at this time.
Makes it easier to remember important concepts when you need to use them. Not easy to forget important information.	Not easy to generate. Can be complicated and ununderstandable if one is not organised.	
It is easy presented and steps are clearly indicated.	The ones we're doing did not require lot of thinking (easy); we should have had more of the exercises.	
It is easy to understand. It summarises topics or a concept easily.	Might be complicated at some point. Sometimes confusing	
It shows how everything is linked together.	Sometimes the arrows/ flow is confusing.	
The summarising of different definitions. The setting up of the map.	Not all information is summarised. It's a bit time confusing.	
When you have full understanding of concept it is easy to use. Summarises points effectively & succinctly. Highlights gaps in knowledge. Shows links well.	Not easy for use when the concept is not understood entirely.	
Linked topics together; Understanding how one term can lead to another.	Can be confusing; Often not enough space for necessary info.	
None	Certain key points are left out. It creates additional study and because one has to remember the maps itself along with concepts.	? Such not study concepts like a parrot, only to memorise, cram and regurgitate info. Students should rather have a fundamental understanding.
Nothing	Nothing	It helps to understand accounting transactions, then we explain them
It makes it easier to differentiate between concepts; It is easier to understand as it is sort of like a summary.		
It is fast. It does not cover all the work, only main points.	No structure. If you don't know what point comes next you will not use it effectively.	

The linking of the topics; Everything is summarised effectively.	Can be tricky to understand; Needs to be explained first before understand.	How can it be applied to number or amounts, whether it will be recorded in this journal and be posted under which account on general journal.
It is easy to memorise; it can be understood	Time wasting; require drawing	
Orderly fashion it is done in. Enabled you to follow better.		
It summarises the work in a way that is easy to understand. It is a fast way to learn when you need to.	I do not always know what I need to put where. To do your own concept map is harder that to get one from someone.	Could we get the concept maps back to study from.
None as there are many things going on in the mapping.	Concept mapping is not for me.	
They summarise the whole work. It is easy to interpreted and understand work.	Filling in empty spaces	
It shows me how difficult concepts connect and come together, it also reveales some of the things I did noy understand.	Sometimes finding it difficult what exactly is needed for me to fill in.	
Keywords are used meaning it is easy to grasp and remember the specific topic being addressed	The fact that it was in black and white the use of colour would be great	Visual representation would be quite helpful and much more easier to remember. Use of colour
I could learn from it when it was completely filled.	Some things sounded similar so it was confusing. Natural flow of map can be difficult to comprehend if concept wasn't initially understood fully	
It allowed me to identify and correct all the concepts I had problems remembering.	It was very confusing at first.	
Explanation of connection of different concepts of topic. Brief and to the point points that were easy to remember.	None.	Colour codes to show steps for answering questions for example: green: step 1 for definition, yellow for analysis.
It helps one remember when the work follows. It is helpful tool for accounting concepts.	If you don't understand the first part of the mapping it will be harder to understand the rest of it.	It is a great tool for understanding.
Less information. It is in stages/steps.	It seems complicated. Not so accurate.	
Firstly c/m shows you relationship between concepts; Secondly, c/m shows you how different concepts yields one or more other concepts.	C/m had lot of concepts in it. It was busy.	C/m is really good for understanding of the relationship of concepts and how different concepts are connected in graphical sense, because people learn and

		remembers fast with imaging.
It mostly deals with key words. The diagram is easy to remember.	None.	
I liked how you could visually see how certain concepts here linked and how they are broken down. I also liked looking at the bigger picture.	Some parts of map are not appealing to eye, so already I'm not interested. The c/m doesn't consist of practical examples to illustrate each concept.	
The fact that it shows you essence of topic. The fact that it is easy to understand and it shows the complete picture of topic.	Sometimes misses critical concepts or info that you cannot add because of space.	
It puts information into visual diagrams which makes it easier to understand. Links different concepts and you are able to see exactly how they are linked and how they fir together.	We are not allowed to keep the maps and study from them at home.	
It summarises information. Makes it easier to read	It is a little bit confusing. It is not clear enough.	
Having to think of words I don't have in my head is hard (challenging). It's interesting to look at.	Made me feel stupid. Some terms I couldn't find.	
Visual representation of information and simplified information.	I like all aspects.	
It helps in the summarisation of information. It makes studying any theory-based module much easier to understand.		
It simplifies the theory.	I do not learn well using flowcharts.	
	I found it confusing and hard to understand so I did not the map	

Appendix G

Answer sheet

Surname and name	
Student number	

Transaction on 1 January 2016:   8 marks (8)

In the Statement of Profit & loss and Other Comprehensive income, the expense of R20000 incurred on the 1st of January 2016, which falls under the current financial year, would increase the insurance account by R2000 and would again be increased in February by R2000. In the Statement of Financial Position, the Remaining R16 000 from the R20000 meant to pay for insurance would be seen as a prepaid expense and therefore would be recorded in the Trade and Other Receivables as Prepaid expenses, which is an asset, for the following financial year.

Transaction on 1 February 2016: 8 marks 7

In the Statement of Profit & loss and Other Comprehensive Income, the amount of R5000 would be seen as an income earned for the business and would therefore be recorded as Sales with an increase of R5000. In the Statement of Financial Position, the amount of R7000, since the stock would be delivered in the following financial year, would be seen as Income Received in Advance which is a liability and therefore would be recorded in the Trade and Other Payables note as Income Received in Advance with an increase of R7000.

Answer sheet

Surname and name	
Student number	

Transaction on 27 February 2016:   7 marks   (0)

The transaction that happened on the 27th February 2016, It will be recorded in the statement of Profit and loss and other Comprehensive income under ~~expenses~~ incomes, because that bill At your service received will ~~reduce~~ increase their bank balance as there will be an ~~outflow~~ inflow of cash ~~from~~ to the entity.
~~The payment to At your service make~~ to the municipality ~~will be recorded under incomes in the books of the Municipality, and this will result in an increase in their bank Account.~~

Not used correctly

The transaction that happened on the 27 February 2016   (0)
Will be reflected in the statement of Financial position Under ~~Non~~ Non Current liabilities ✗ because the loan was granted to Bisho Enterprises. When Bisho Enterprises pay At your service in the Future, the amount will be recorded, ~~De~~ and this will increase the equity of At your service. In order words Bisho Enterprises owes us money —

Not correctly used.

Appendix H

Answer sheet

Surname and name	
Student number	

Transaction on 27 February 2016:   7 marks   ⑥

This transaction is an expense (5000)
in the books of At-Your-Service,
therefore this will be recorded
in the Statement of Profit or Loss
and other comprehensive income,
however seeing that this expense
will only be settled in March 2016
it is now seen as an expense
that the business has incurred ✓
and therefore will also be
recorded in the Statement of
financial position as an
accrued expense which is a
liability for the business
because the business still has
to settle the bill.

Transaction on 28 February 2016:   7 marks 6

This transaction will be recorded as an income (interest income), reason being that the business borrowed money to Bisho Enterprises and Bisho Enterprises has not yet paid the interest due on the loan, therefore the interest income is an income that the business earned and will be recorded in the financial statement of profit or loss and other comprehensive income as an income and in the Statement of financial position the transaction of the interest income will be recorded as an accrued income, cause which is an asset to the business. the business still needs to receive the money.

Answer sheet

Surname and name	
Student number	

Transaction on 1 January 2016: 8 marks

To the entity, business insurance cover, is an expense
As every month R2000 has to be paid. But as the
entity had prepaid expense

In Statement of profits and loss, the account that may be
affected is expenses and they decrease the financial
perfomance of an entity.

In the Statement of financial position of Softie Beverages
money paid before theie is an increase in assets.
How much?

Transaction on 1 February 2016:   **8 marks** ③

After mr Moloko ordered soft drinks and paid.
15000 ful, the Beverage recieved or gain 12000 which
increases the assets of the company with 7000
As the company since it did not deliver somedday
it is said to earned income recieved in advance.
It is as if now the company owes money to
Beverage It has incurred a liability.
In the Statement of Profit and loss, this transaction
will be recorded or have an influence under profit
Since the company does not lose money but gains,
It increases the performance of an entity.
In statement of Financial position of Softie Beverages
this transaction since they incurred R7000 without
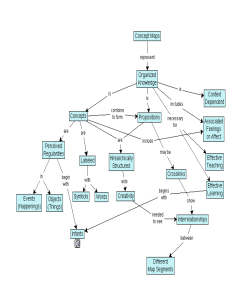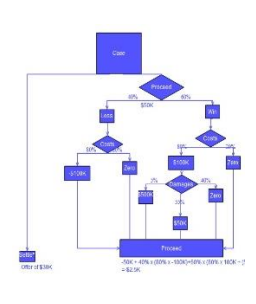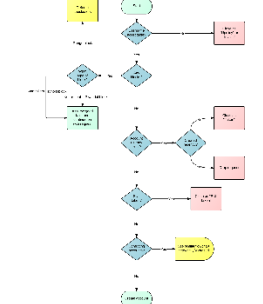delivery this will reflect as a liability.

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Appendix I

Table showing comparison of language distribution between test and control group

	English	Afrikaans	Sepedi	Other South African	Other African
Test	10	3	17	38	3
Control	1	1	11	20	1

Appendix I

Appendix J

Table showing comparison of different visual aids

Visual aid	Concept map	Mind map	Decision tree	Flow chart
Main function	Represent relationships between concepts to show how everything is connected.	Represent associations linked to a single topic. ..	Represents the possible consequences of a decision.	Represents a process.
Design	Starts with focus question. Concepts are represented in blocks with interrelationships represented by linking arrows.	Is hierarchical, has a radial display and is highly visual.	Branches out from original question to form tree-like branches that carry alternative consequences	Steps are given in boxes with arrows showing direction of the flow.
Use	Designed to enhance meaningful learning and develop logical thinking.	Used for memorisation and to organise information. Useful for taking notes and brainstorming.	Used to find best strategy.	Used to plan or analyse a process.
Example				

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