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SOCIAL AND COGNITIVE DIMENSIONS OF LANGUAGE IN THE LEARNING OF INTRODUCTORY ACCOUNTING

by

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ABSTRACT

SOCIAL AND COGNITIVE DIMENSIONS OF LANGUAGE IN THE LEARNING OF INTRODUCTORY ACCOUNTING

by

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SUPERVISOR: **Prof L.J. Stainbank**

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DEPARTMENT: Accounting

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In South Africa, introductory accounting students for whom English is an additional language face two linguistic barriers. Besides dealing with the social practices of communicating in academic English as the medium of instruction in higher education, students studying in English as an additional language (EAL) also have to acquire the language of accounting.

The rationale for this thesis is threefold: first, it is based on my personal experience, as well as research findings by other scholars, regarding the linguistic barriers facing first-year accounting students with EAL; second, it is my perception that in the context of accounting education, language learning is mainly viewed as a neutral instrument of communication, which students studying in EAL are expected to master through remedial academic literacy courses; and third, there are very few empirical studies in the discipline of accounting that investigate the social and cognitive dimensions of language in the learning of accounting and that considers it the responsibility of accounting educators to make the norms and context of accounting language apparent to students.

The purpose of this research was to consider the impact of social and cognitive dimensions of language in the learning of introductory accounting in English as an additional language. The theoretical framework combines an Interactionist perspective of Second Language Acquisition, which considers the social environment in which learning takes place, with Cognitive Load Theory (CLT) and the Cognitive Theory of Multimedia Learning (CTML). CLT accounts for students' prior knowledge (including language proficiency) levels when designing effective instructional practices, and the CTML is based on the assumption that learning is enhanced when we build mental representations from words and pictures. A mixed methods design was used, comprising a qualitative interview analysis and two experimental studies.

Three independent yet related studies were conducted to fulfil the main aim of the research. The first study (chapter 2) explores the individual and social learning experiences of first-year accounting students studying in EAL. The findings highlight the importance of formal and social interaction for students with EAL to deal effectively with the academic literacy requirements of studying accounting in the first year at university. The outcomes of the interview study provided the impetus for the two experimental studies that consider the effectiveness of different instructional practices in assisting students with diverse language backgrounds to access the language used in introductory accounting topics.

The first experiment (chapter 3) tested the effect of using everyday language versus accounting language and the provision of formulas on students' ability to transfer their knowledge of basic Cost-Volume-Profit analysis to application problems. The results indicate that students with EAL benefit more from the use of everyday language than students with English as a first language. The optimal condition for transfer performance was providing everyday language without formulas.

For the second experiment (chapter 4), a whiteboard animation was created to explain the concepts in the accounting equation by means of pictures and coloured blocks. The instructional efficiency of the animation was tested using a voice-over PowerPoint presentation as the control. All students enjoyed the animation more than the control presentation. The animation reduced the extraneous cognitive load of Grade 12 accounting students with EAL. The effect of both the test and control presentations were more beneficial for Grade 12 accounting students with EAL and for students without Grade 12 accounting.

The findings have implications for accounting educators in recognising the social and cognitive aspects of language use on learning in introductory accounting, particularly for students studying in EAL. This awareness should translate into pedagogical practices being adapted to accommodate the learning needs of students studying accounting through EAL.

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DEFINITION OF KEY TERMS

Key term	Definition
Accounting language	The technical language or disciplinary discourse of the subject of accounting, which is cognitively demanding, and which is normally used in situations where fewer contextual cues are available e.g. in textbooks, texts and examinations, and in classroom instruction. As opposed to Everyday language which is cognitively undemanding and more contextually embedded (Baker, 2006; Cummins, 2008).
African	At the university where this research took place, this is the term used to refer to 'Black' students. In the context of this work, the term 'Black African' is used. This is in line with the terminology used by Statistics South Africa.
African languages	In this thesis, the term encompasses the nine indigenous South African languages: IsiNdebele, IsiXhosa, IsiZulu, Sepedi, Sesotho, Setswana, SiSwati, Tshivenda and Xitsonga.[1]
Afrikaans	This is a neo-Germanic language that originated in Africa and is spoken by approximately 14% of South Africans (Statistics South Africa, 2012). While still used as a medium of instruction at all levels of education, its use in tertiary education has decreased in recent years. During the course of this research, Afrikaans was still an official language of instruction at the university where this research took place. However, it has been phased out of use from 2019.
Apartheid	From 1948 to 1994, a policy of separate development based on discrimination along racial lines existed in South Africa. The population was divided into four main racial groups: Whites, Natives (Blacks), Indians and Coloured people (people of mixed race). Whites were privileged politically, socially and economically by the apartheid system. During the apartheid period, the university at which this research took place used Afrikaans as its only official language of instruction.
Asian/Indian	At the university where this research took place, only the term 'Indian' is used. The term used in this thesis refers to students who self-identify as being of Asian or Indian descent. This term is used by Statistics South Africa.
Black	Under apartheid, indigenous African people were classified as 'Blacks'. The political rights of these individuals were limited, their movement around the country was restricted and they were only allowed to live in certain areas designated as homelands or townships. During apartheid, the education system to which Blacks were subjected was intentionally set up as inferior to the system used for Whites. In this work, 'Black' is used in conjunction with the word 'African'.

[1] Afrikaans is excluded from this definition and is defined separately. This classification corresponds to the definition for African languages as used in the 2015 report of the Department of Higher Education and Training regarding the use of African languages in higher education.

Key term	**Definition**
Black African	The term used in this thesis refers to students who self-identify as 'Black'. The majority of Black people in South Africa speak one of the country's nine official African languages as a home language. The term is in line with that used by Statistics South Africa.
Coloured	The term used in this thesis refers to students who self-identify as being of mixed race. This term is used at the institution where this research took place and by Statistics South Africa.
English as an additional language (EAL)	The term, as used in this thesis, refers to students who studied English at the first additional language level at school. It may be used differently in research undertaken by other scholars; therefore, when referencing other work, the term may refer to students for whom English is a language additional to their home language.
Everyday language	The day-to-day language needed to interact socially with other people, and which is cognitively undemanding. Many social (i.e. contextual cues) are available to assist understanding (Baker, 2006; Cummins, 2008).
First language	The term, as used in this thesis, refers to the language studied at home language level (as determined by the Department of Basic Education) at school.
First additional language	The term, as used in this thesis, refers to the language studied at first additional language level (as determined by the Department of Basic Education) at school.
First-year students	Students in their first year of study at university. In the context of this thesis, students study introductory accounting in their first year.
Grade 12	This is the final year of secondary (high) school in South Africa. A Grade 12 or equivalent qualification is the basic requirement for post-secondary (higher) education.
Home (primary) language	This term refers to the language an individual speaks at home. In this study, it is the self-reported language with which a student identifies. It is also sometimes referred to as a student's primary language in this research.
Introductory accounting	In the context of this thesis, introductory accounting is primarily studied by first-year students.
Second language	The term is not used in this thesis. Instead, the term 'additional language' is used, as it recognises that the language is added to what is already present, i.e. the home language of the student.
White	Under apartheid, individuals of European origin were classified as 'Whites'. These individuals were the beneficiaries of the apartheid system who enjoyed political rights and the benefits of a privileged education. Most White people in South Africa speak either English or Afrikaans (or both) as a home language. The term is used by Statistics South Africa and at the university where this research took place.

LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation	**Meaning**
ALNF	Accounting language no formulas (Ch 3)
ALWF	Accounting language with formulas (Ch 3)
ANCOVA	Analysis of covariance
ANOVA	Analysis of variance
BICS	Basic interpersonal communicative skills
CALP	Cognitive academic language proficiency
CLT	Cognitive load theory
CTML	Cognitive theory of multimedia learning
CVP	Cost-Volume-Profit
EAL	English as an additional language / English additional language
ELNF	Everyday language no formulas (Ch 3)
ELWF	Everyday language with formulas (Ch 3)
FAL	First additional language
FRK111	Financial Accounting III (1^{st} semester course in first year)
GMAT	Graduate Management Admissions Test
HL	Home language
IEB	Independent Examination Board
NSC	National Senior Certificate
OECD	Organization for Economic Cooperation and Development
SAICA	South African Institute of Chartered Accountants
SAIPA	South African Institute of Professional Accountants
UK	United Kingdom
UP	University of Pretoria
USA	United States of America
VIF	Variance inflation factor

CHAPTER 1
INTRODUCTION

"…language is not everything in education,
but without language everything is nothing in education…"
(Wolff, 2011)

The linguistic barriers facing first-year accounting students studying in English as an additional language (EAL) in South Africa are the motivation for this research. After 25 years of democracy, entrenched inequalities in our education system prevail and the playing fields have not been levelled for thousands of students with an African language as their first language.

In this chapter, I first provide the background and rationale for this research. The need for accounting education pedagogy to incorporate an understanding of the social context in which students studying in EAL operate, is then explained, and consideration is given to how the language of accounting could be made accessible to all students in the mainstream accounting classroom. A description of the role that language plays in South Africa's education system, and how this affects African first-language students, follows. I then explain my personal motivation for undertaking this research, and situate my work in the empirical literature. The pedagogical and theoretical frameworks that form the basis for this thesis are outlined. The research questions follow, which are answered by means of three separate studies (chapters 2, 3 and 4). Overviews are provided of the objectives of each of the three studies.

1.1 BACKGROUND AND RATIONALE

1.1.1 Education and language in South Africa

One of the legacies of South Africa's apartheid system of government is that the identity of the country's citizens is often connected to their home language and race. During apartheid Afrikaans and English were the only two official languages of the country. The country's African languages, spoken at home by most Black South Africans, were effectively ignored (Silva, 1997). Since the transition to majority rule in 1994, English has persisted as the language of higher education, business, science and technology, and as the domestic and international language of communication (Silvia, 1997). Although Afrikaans is still used in many South African schools, it has steadily been replaced by English in higher education. An important signal of South Africa's new democracy was the recognition of the nine African languages, spoken by the majority of the citizens of the country, as official languages. However, despite this recognition, the pre-existing structural injustices that apartheid produced in the country's education system continue to favour English and Afrikaans (mostly White) students over African language (mostly Black African) students (Antia, 2018).

Even though more than 75% of the country's population are African home language speakers (Statistics South Africa, 2012), school-leaving examinations can only be written in English and Afrikaans. It is therefore no surprise that in language intensive subjects, the performance of African first-language school-leavers with EAL lags behind that of English and Afrikaans first-language learners (Taylor, 2014). Based on these Grade 12 examination results, school-leavers have to compete for the limited places available in higher education institutions, where the medium of instruction is English (and Afrikaans in a limited number of cases).

This language policy has contributed towards the disproportionate racial representation in South Africa's institutions of higher learning. In 2016, only 16% of 20-24 year old Black Africans were enrolled in public higher education institutions, while for the same age category of the White population the participation rate was 50% (Council on Higher Education, 2018). Throughput rates are a further cause for concern. Only 24% of Black African students who enrolled for their first year of a 3-year degree in 2011 actually graduated within 3 years, while 43% of White students graduated in the same period. After 5 years 52% of Black African and 63% of White students had graduated (Council on Higher Education, 2018).

The disparate pattern of results repeats itself in the field of accounting where African first-language students underperform compared to their English and Afrikaans first-language counterparts (Barnes, Dzansi, Wilkinson and Viljoen, 2009; Sartorius and Sartorius, 2013). If accounting academics disregard the hegemony of the two languages and the impact that this has on the academic difficulties that students with EAL face in engaging with the language used in their accounting studies, they may consider this as a 'problem' that someone else must fix (Boughey, 2013; Boughey and McKenna, 2016). Alternatively, many concerned educators facing the issue may feel ill-equipped to deal significantly with the 'language problem'.

The predominant view is that in order to succeed at university, students require certain abilities, aptitudes and skills, and that students with EAL ‘lack’ the language proficiency necessary to succeed (Boughey, 2012). This individualised skills-based belief leads universities to employ remedial measures intended to address the gaps in students’ academic literacy (Boughey, 2012).

An alternative to this autonomous view of learning, where students are considered to be independent of the social contexts from which they come, is the viewpoint that learning is a “socially embedded phenomenon” (Boughey, 2012, p. 138). Accounting academics adopting this perspective will be aware that the differences in the success rates of students with different language backgrounds can be related to the fact that 25 years later, the consequences of apartheid are still evident in the social context in which most Black African students are situated and in their educational opportunities (Antia, 2018).

Generations of Black African people in South Africa were denied anything beyond the most elementary education during the period of apartheid. Unfortunately, the quality of schooling available to most Black African children since 1994 has not improved (Taylor, 2014). These children have very limited or no opportunity to attend the type of school which will allow them to access the necessary knowledge about the socially constructed values, beliefs and attitudes that underlie the use of language and the literacy practices required in higher education (Boughey, 2013).

1.1.2 The language of accounting and social exclusion

There are important differences between the academic language used at university and everyday language, and also in how to achieve proficiency in each. A disciplinary language, such as the language of accounting, possesses distinct lexical and grammatical characteristics (Belkaoui, 1980), and is a barrier to any non-accountant no matter whether English is their home language or not. This meta-language includes technical terminology with a specialised meaning such as ‘debit’ and ‘credit’, as well as terms that have both specialised and nonspecialised meanings such as ‘capital’ (Scarcella, 2003). In addition, several different labels may be used to describe the same item, for example, debtors, trade receivables, accounts receivable. Furthermore, accounting language enables the use of the same lexical form for different syntactic functions (Belkaoui, 1980); for instance, the term ‘debit’ may be used as a noun or a verb. As a noun a ‘debit’ entry in the financial accounts of a business represents money that has been used to pay an expense or buy an asset; and as a verb 'debit' is when the bank takes money out of your account.[2]

The problem of achieving proficiency in the academic English used at university is exacerbated by the fact that for many teachers and students in South Africa English is not an 'everyday' language (Paxton, 2009). English is generally only used at school and is often situated in a bilingual learning environment, and is context-embedded and somewhat cognitively unchallenging (Paxton, 2009). Context-embedded means that students can easily relate the English used to their prior knowledge (Cummins, 2008), are given interpersonal cues, such as gestures, and are able to negotiate for meaning with their teachers and peers (Paxton, 2009), often in their African home language (Pym and Kapp, 2013). The transition required from everyday English to the discipline-specific academic English, such as that used in accounting, is therefore problematic for these students (Paxton, 2009). Academic English is cognitively demanding and fairly decontextualized and requires a more advanced grasp of a range of linguistic features (Scarcella, 2003).

As many of the academic concepts of accounting have not been translated into African languages[3], African home language students do not have the opportunity to develop cognitive and academic proficiency in their first language in accounting. They may therefore find developing the cognitive academic language proficiency (CALP) (Cummins, 2008) for university accounting quite a challenge in English as an additional language (Paxton, 2007). The social exclusion many Black African students face due to their limited access to English as an academic language in the schools they attended, is also prevalent in the accounting profession (Barac, 2015).

For many Black South Africans aspiring to become accountants, the requirement to be fluent in English and/or Afrikaans to enter the profession, has acted as a form of professional closure (Hammond, Clayton and Arnold, 2009). In 2018 only 13% of the 47 781 members of South Africa's largest accounting association, the South African Institute of Chartered

[2] It is beyond the scope of this thesis to consider all of the multi-dimensional aspects of language. An important reference is Scarcella's (2003) framework for analysing academic English and how it compares to English used in everyday situations.

[3] Translating technical terms from English to the African languages is highly problematic and the discussion of the issues surrounding this are beyond the scope of this thesis.

Accountants (SAICA) were Black Africans (SAICA, 2018). For the second largest body, the South African Institute of Professional Accountants (SAIPA), 18% of its 11 969 members were Black African in 2016 (SAIPA, 2016).

The history of the accounting profession in South Africa is rooted in Anglo-American culture, which has determined the nature of the accounting discourse used in educating accounting students (Evans, 2010). As with any other variety of English for specific purposes, the development of the specialised language of accounting originated from the need to facilitate efficient and defined communication between members of the profession (Evans, 2010). However, the language also serves to demarcate who belongs to the profession and who is on the outside, by whether an individual can use contextually appropriate language or not. It provides the user with the 'social capital' of belonging to an exclusive group that has specialised knowledge and skills (Evans, 2010).

1.1.3 The research problem

Despite the importance of students being able to communicate in the way expected by the accounting profession, accounting educators may struggle to make the conventions of the language of accounting explicit. This is because while English speaking accounting educators possess tacit knowledge about the discourse of their discipline, they might not have the perspectives and metalanguage required to articulate this knowledge (DiCerbo, Anstrom, Baker and Rivera, 2014; Paretti, 2011). Some accounting lecturers may argue that they are not trained to teach English and it is the concern of academic literacy practitioners. However, many will say they do not have sufficient knowledge and expertise and the appropriate resources to provide students with EAL access to the cognitive and conceptual framework of the discipline (Koch and Kriel, 2005), which is required in order for them to learn effectively, and become conversant in the discourse of the discipline.

The objective of this research is therefore to investigate the impact of social and cognitive dimensions of language on the learning of introductory accounting. In addition, the role of cognitive learning theories in developing instructional techniques that make the language of accounting accessible to students in order for them to successfully analyse and solve accounting problems are considered. Before discussing this further, a more detailed background of the South African educational context and its effect on students studying in EAL is necessary.

1.2 SOUTH AFRICAN STUDENTS STUDYING IN ENGLISH AS AN ADDITIONAL LANGUAGE

A variety of terms is used to refer to students who speak another language besides English as their primary language. However, discussion of these is beyond the scope of this study. In this work, I use 'students studying in English as an additional language (EAL)', rather than the designation 'EAL students'. The phrase 'English as an additional language' acknowledges that students are already competent speakers of at least one primary language, and avoids focusing on the perceived deficits of students, such as that they are 'non-English speakers'. Furthermore, students' existing language and cultural identities and the additive nature of their learning of English are also acknowledged (Webster and Lu, 2012).

In the accounting education literature, the categorisation of students as studying in EAL is limited and also varies between studies. Students studying in EAL in English speaking countries, such as the United States of America (USA), United Kingdom (UK) and Australia, are mainly international students (Andrade, 2006; OECD, 2013). In Australia, the term EAL is used for all students who do not have English as their first language – both those to whom it is a foreign language and those to whom it is a second language. Rankin, Silvester, Vallely and Wyatt (2003) and Tickell and Smyrnios (2005) found that not being first-language English speakers did not affect students' performance in accounting. However, Smith, Therry and Whale (2012) concluded that students who did not speak English as their primary language had a higher risk of failure in first-year accounting. In a study based in the USA, Wagner and Huang (2011) determined that students classified as EAL (based on their performance in an English placement examination) significantly underperformed in an introductory financial accounting course compared, to English primary language students. They found that this effect disappeared in further years of study.

In South Africa, students' home language is only one of the ways they could be classified as studying in EAL. Another classification is the level at which they took English as a subject at school. Both these categories were tested by Smith, Pym and Ranchhod (2012). They found that speaking English as a home language and taking English at a first language level at school had no significant effect on students' first-year academic performance in accounting, but that student performance in an English placement test did. To explain the classification of students that I used in my three studies, some background to the role of language in the South African education system is necessary.

While there are 11 official languages in South Africa, English and Afrikaans, the two non-African (Department of Higher Education and Training, 2015) languages, dominate as the media of instruction in higher education and are the only two languages in which students may complete their school-leaving examinations. This is despite the fact that in the last official census completed in 2011, only 23.1% of South Africans spoke English or Afrikaans as their home language, with the majority (74.9%) speaking one of South Africa's nine African languages and 2% speaking another language (Statistics South Africa, 2012). Table 1.1 shows a breakdown of the home languages spoken by racial classification.

Table 1.1: Population by home language and race (%)

Race / Language	Black African	Coloured	Indian / Asian	White	Other	Total %
Total %	79.2	8.9	2.5	8.9	0.5	100.0
Afrikaans	1.5	75.8	4.6	60.8	15.2	13.5
English	2.9	20.8	86.1	35.9	29.5	9.6
African language	93.7	3.0	3.9	2.1	17.7	74.9
Other language	1.9	0.4	5.4	1.2	37.6	2.0
Total %	100.0	100.0	100.0	100.0	100.0	*100.0

*Total population estimated at 51 770 560

Source: Statistics South Africa (2012)

At the university where this study took place, 47.8% of the students registered in 2014 spoke English or Afrikaans as their home language (University of Pretoria, 2015). Until 2019, when the university's language policy changed, English and Afrikaans students were able to study in their home language. The rest of the students, of whom the majority speak an African language at home, do not have this advantage, and study mainly in English as an additional language. Table 1.2 provides the racial and home language demographics for students registered in 2014. Approximately 88% of Black African students reported speaking an African language at home.

Table 1.2: Student registrations by home language and race

Race	Black African	Coloured	Indian/ Asian	White	Unknown	Total
Contact	20 519	1 122	2 530	23 870	2	48 043
Distance[4]	13 215	88	77	154	0	13 534
Total	**33 734**	**1 210**	**2 607**	**24 024**	**2**	**61 577**
Language (contact and distance students)						
Afrikaans						13 997
English						15 485
African language						29 671
Other language						2 424
Total						**61 577**

Source: University of Pretoria (2015)

As mentioned, the university's language of instruction policy changed in 2019. In 2018 first-year students in the Faculty of Economic and Management Sciences (in which most of the students used in this study were registered) were still allowed to enrol for study in Afrikaans, but the continuation of this practice for the remaining years of their undergraduate study was not guaranteed. As a result many Afrikaans home language students opted to study in English when enrolling for the first-time in 2018. The first-year financial accounting Afrikaans class size dropped significantly and made up less than 10% of the total number of students enrolled. From 2019 first-year students were only allowed to register to study in English.

This thesis uses two ways to classify student participants and the languages they speak. The first one is based on whether students regard English as their home language or not. The students interviewed in chapter 2 all spoke a language other than English at home. Afrikaans home language students who studied in Afrikaans were excluded from the scope (as these students had the benefit of completing their higher education studies in their home language, i.e. Afrikaans). For the CVP-analysis experiment (chapter 3) only students studying in English were included. They had various home languages, including English. For the multimedia experiment (chapter 4), which was conducted in 2018, Afrikaans home language students studying in Afrikaans were included. For this experiment, all students (irrespective of their language backgrounds) were tested at the beginning of their first

[4] Distance education students were registered in the Faculty of Education and were outside the scope of this study. The home language information separated by contact and distance education registrations was not available.

academic year. As the language policy was about to change formally the following year (2019), most Afrikaans students were already studying in English as an additional language.

In this study, the second language classification is based on the level at which students took English as a subject in secondary school: at the level of home language (first language) or at the level of first additional language. All South African students are required to take at least two of South Africa's official languages in their school-leaving examinations, one at home language level and another at first additional language level. In the 2015 National Senior Certificate (NSC) examinations written by most school-leavers in the country, 25.2% of students studied either English or Afrikaans as their home language. The remaining students took one of the African languages as their home language (Department of Basic Education, 2015). Almost all students who did not study English at home language level took it at the first additional language level - the main reason being that the school-leaving examinations for all non-language subjects have to be written in either English or Afrikaans. In the chapter 2 study, only students who studied English at the first additional language level were interviewed. However, in chapter 3 and 4, students with Grade 12 English home language and first additional language were both included.

To compensate for the disadvantage African first-language students suffer of having to write the school-leaving examinations in a second or third language, they are awarded an additional percentage of their original mark to their final mark in each of the non-language subjects in the NSC examinations. The five percent awarded since 1999 changed to four percent in 2014, and remains at three percent from 2016 to 2022 (South African Government News Agency, 2016). For example, if a student gets 50% for a subject such as History, they are awarded an extra 1.5% (50% of 3%). This action by government is supported by a study undertaken by Taylor (2014, p.126), who found that students with an African first language were at a disadvantage in language-intensive subjects and also when responding to questions in mathematics that required substantial language proficiency. Taylor (2014) argued that there are sufficient statistical grounds for the policy to continue, but that if it is to be discontinued it should be phased out over a period of time, and effective measures should be implemented to support these learners in their transition to English as a language of instruction. Table 1.3 provides the breakdown of the percentage of students who registered to study English at home language and first additional language level for Grade 12 (NSC) in 2015.

Table 1.3: Grade 12 home language and first additional language (NSC) students (%)

Level / Language	Home language	First additional language
Afrikaans	8.2	12.7
English	17.0	83.9
African language	74.8	3.4
Total %	*100.0	**100.0

*658 785 students **629 222 students

Source: Department of Basic Education (2015)

Of the two language classifications discussed, it is African home language students who took English at the first additional language level who are the focus of this research, and are referred to as EAL students. They made up 75% of the school-leaving population in 2015 (Table 1.3). The move towards English and away from Afrikaans in higher education, does not alleviate the issues that these students face in writing their school-leaving examinations. Schools which served Black African students under apartheid are still largely dysfunctional, while those for White students under apartheid remain functional (Spaull, 2012). It is therefore no surprise that Taylor (2014) found that that African home language students are still at a disadvantage in the language-intensive subject examinations. The challenges these students face appear to continue into higher education in South Africa, as Sartorius and Sartorius (2013) found persistent disparities between the performance of English and African first-language students across the spectrum of their accounting studies at university. While improving the English proficiency of African language leaners in South African schools should be an educational imperative, it is fraught with political motives and economic implications (Taylor, 2014).

In the two experiments on which this thesis reports, the categorisation of students as EAL is not used to determine the effect of their language background on their performance. The intention is rather to determine the effect of the experimental conditions on the performance of students coming from different language contexts. The inclusion of language indicators in the experiments is to determine which teaching practices are better suited to assist students with EAL in activating the linguistic and cultural resources that African first-language students possess. These resources should be considered as assets (Núñez, Rios-Aguilar, Kanno and Flores, 2016). The agency that many students with EAL display in achieving academic success is indicative of this fact (Pym and Kapp, 2013).

My personal experiences as a researcher are now discussed, and my motivation for undertaking this work. While attempting to be as neutral as possible in analysing and interpreting the results of my studies, I acknowledge and accept that no research is value-free and that this work is therefore a product of my own world-view.

1.3 THE RESEARCHER

I am influenced by my own personal journey through the academe and the lives and stories of the many accounting students I have met in my career. I started teaching accounting in 1995, and through the years have taught both financial and management accounting at undergraduate level. In 2006, I was privileged to set up and manage the Thuthuka Programme (a transformation initiative of SAICA) at the institution where I am completing my PhD. Over the following ten years, I took care of more than 650 students who were mainly Black African and spoke an African first language. Many of them were the first in their family to enter university.

My position gave me a unique appreciation of the experiences of African first-language students studying at an English and Afrikaans university. One of the students in the interview study, who was part of the Thuthuka programme, said that on arriving at university I was the first white person he had ever spoken to in his life. I also realised during the course of my PhD study, that the South African experience was not unique. Terwijn (2015) conducted a similar interview study with international nursing students about their experiences of studying in Australia in EAL. Her words echo with me. I too witnessed “exclusion, desperation, shyness, academic misconduct, academic brilliance, being homesick, racism, difference and indifference” (Terwijn, 2015, p. 4). This journey with these students changed my life forever.

From my perspective, the main challenge facing all students studying in EAL is that they have to deal with the social and cultural practices of communicating in English on a sustained basis, as well as coping with the language of accounting. My perception is that in the context of accounting education, language learning is mainly viewed as a neutral instrument of communication that students with EAL are expected to master through remedial academic literacy courses.

It is not surprising that little attention has been paid to the socially embedded practices of the language used in accounting. While I have been privileged to work with world-class accounting educators as colleagues, we have all been under increasing strain in the South African higher education system. We must deal with the continued changes required in the accounting curriculum, larger classes, increased research output demands and students, who in the view of many, are more and more underprepared for higher education accounting study. The challenge now is for accounting educators to make the context and form of the language we instinctively use explicit to our students in the teaching and learning process. Many accounting educators may feel exhausted at the thought of yet another load that they have to carry.

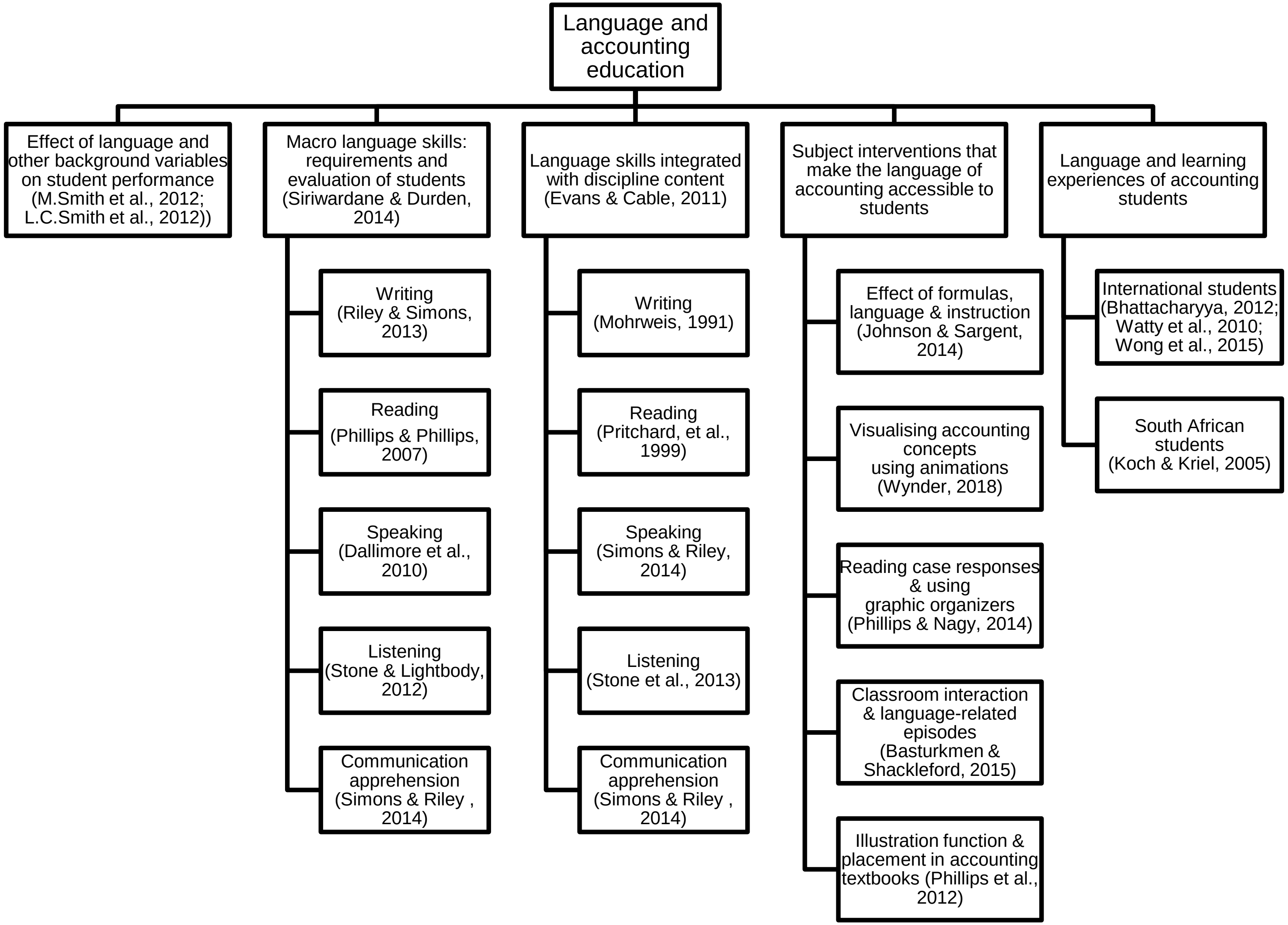
I hope that my research will provide useful insights and techniques to encourage accounting educators everywhere to take the time to walk in the shoes of students studying in EAL, and to think about the implicit assumptions in the language they use when teaching accounting.

1.4 OVERVIEW OF THE EMPIRICAL LITERATURE

To situate this work in the existing literature, prior research in accounting education that considers language has been classified into five broad categories. Refer to Figure 1.1. The first category consists of mainly quantitative studies measuring the effect of students' prior knowledge variables, including language background on their performance on introductory accounting courses (Smith L., *et al.*, 2012; Smith M., *et al.*, 2012). The focus of this type of research is on the student as an autonomous learner, who with the 'correct' combination of prior schooling experience, intellect, motivation and other background and personality factors, will achieve success in first-year accounting. In this thesis, students' language backgrounds are not used as predictors of performance. Instead, the purpose is to establish the effectiveness of the teaching and learning interventions employed in the two experiments for both English first and additional language students.

The second category is research that has focused on the macro language skills of writing (Riley and Simons, 2013) and reading (Phillips and Phillips, 2007), and to a lesser extent speaking (Dallimore, Hertenstein and Platt, 2010) and listening (Stone and Lightbody, 2012). Communication apprehension, both oral and written (Simons and Riley, 2014), has received a large amount of attention. Studies in this category cover the language skills accounting students require (Siriwardane and Durden, 2014), and the evaluation thereof. The two instances which included students studying in EAL were Janse van Rensburg, Coetzee and Schmulian (2014) who measured the reading competencies of accounting students, and

Figure 1.1: Categories of research literature relating to accounting education and language



Coetzee, Schmulian and Kotze (2014), who considered the effect of culture and language on students' communication apprehension.

Studies reporting interventions that integrate macro language skills with disciplinary teaching constitute the third category (Evans and Cable, 2011). Here, content area literacy instruction (Shanahan and Shanahan, 2008), which focuses on study skills that students can use when learning accounting, is investigated. Content area literacy is different from disciplinary literacy instruction, which focuses on the specific and unique tools needed to "create, communicate and use knowledge within disciplines" (Shanahan and Shanahan, 2012, p. 8). Mohrweis (1991) focused on improving accounting students' general written communication skills and measured these using the Graduate Management Admission Test (GMAT) questions. Pritchard, Romeo and Muller (1999) describe the integration of generalised reading strategies (that could be used in any discipline) in the accounting curriculum. Stone, Lightbody and Whait (2013) identify cross-disciplinary best listening practices that could be utilised to develop accounting students' listening skills. Development of students' speaking skills is addressed in oral communication apprehension studies (Simons and Riley, 2014). However, very few of these studies consider the impact of the suggested language skills interventions on the learning efficiency of students with EAL (Riley and Simons, 2013).

The fourth category of research that is relevant to this thesis is first-year accounting teaching and curriculum interventions that focus on making the language of accounting accessible to students. Two language specialists, Basturkmen and Shackleford (2015), observed experienced accounting lecturers engaging during class in language-related discussions with their students, thereby supporting students' accounting vocabulary development and their socialisation into the disciplinary discourse community. Their study provides useful examples of how accounting academics can integrate a focus on language in their teaching. The work of Phillips on introductory accounting tested various pedagogical interventions that scaffold accounting literacy. Together with Nagy, he tested the effectiveness of reading accounting case responses and using graphic organisers on developing students' case analysis skills (Phillips and Nagy, 2014). On analysing the effect of illustrations in accounting textbooks, Phillips, Alford and Guina (2012) found that students learnt more when decorational images preceded corresponding text, and conceptual illustrations followed corresponding text. Phillips and Schmidt (2010) used psycholinguistic theory to predict that students' comprehension of adjusting journal entries improves when they are provided with the opportunity to construct a mental representation of the accounting problem first. Also in this category of research is the Johnson and Sargent (2014) paper used as a basis for the first experiment in this thesis. They considered the effect of using accounting language versus everyday language, together with the use of formulas, on the performance of students completing Cost-Volume-Profit analysis questions at an introductory level. The second experiment is based on the work of Wynder (2018) who introduced animations as a tool to improve the learning efficiency of students with EAL in an accounting theory course.

The fifth category of research relates to the language and learning experiences of first-year students with EAL, which has received minimal attention (Riley and Simons, 2013; Wynder, 2018). The few papers that are relevant in this category are referred to in the interview study, which is detailed in chapter 2 of this thesis.

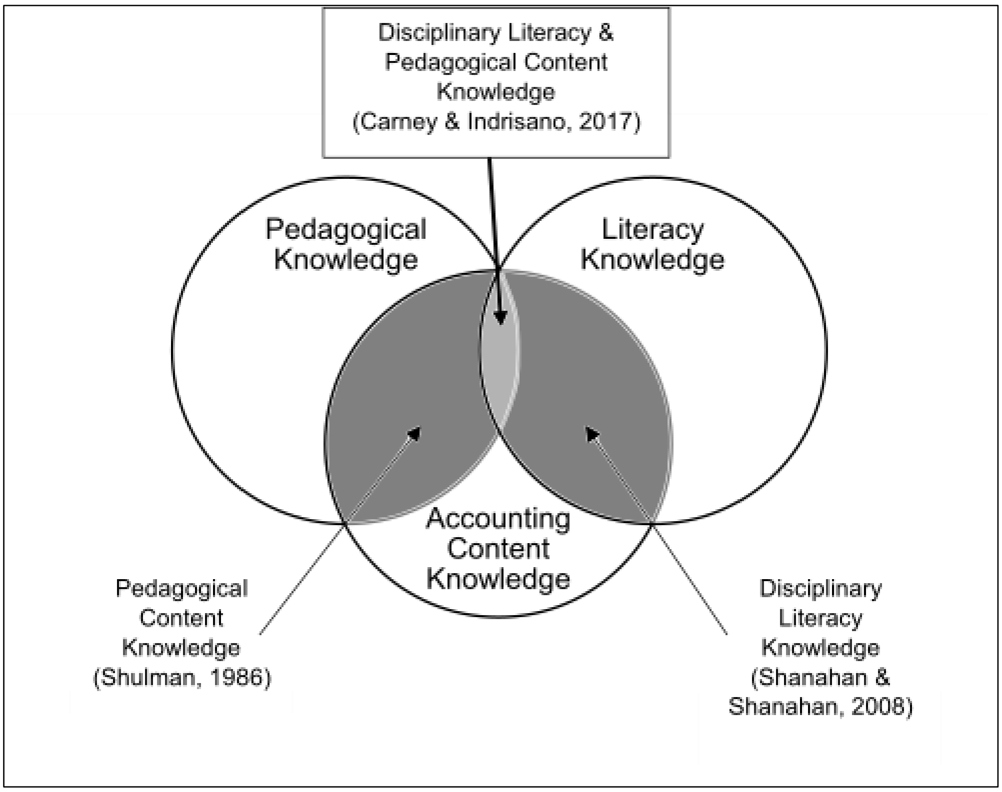
1.5 THEORIES AND FRAMEWORKS

The theories, concepts and frameworks on which this thesis is based are now discussed. An explanation of the pedagogical framework is provided first, and then the theoretical framework.

1.5.1 Pedagogical framework

Proficient accounting educators possess a distinctive skill-set of understanding what to teach and how best to teach it. This amalgamation of teaching and subject matter knowledge is represented in Figure 1.2 as pedagogical content knowledge which is a theoretical concept developed by Shulman (1986, 1987), that represents a unique domain of teacher knowledge - "subject matter knowledge for teaching" (Shulman, 1986, p. 9). Accounting educators appreciate what makes the learning of specific accounting content easy or difficult, and the conceptions and preconceptions that students of different backgrounds bring with them to the learning of the commonly taught topics. They also know how to organise and present accounting topics and problems to make them comprehensible to their students (Shulman, 1986).

Figure 1.2: Disciplinary literacy and pedagogical content knowledge



In the first year, when basic accounting concepts are being introduced, this amalgamation of the educator's knowledge of content and pedagogy is essential. Research in the field of accounting education abounds with examples that make up a distinctive body of knowledge for teaching accounting (Bernardi and Bean, 1999; Halabi, Tuovinen and Farley, 2005; Johnson and Sargent, 2014; Johnson and Slayter, 2012; King and McConnell, 2010; Phillips and Heiser, 2011; Siriwardane, 2014). Acquiring pedagogical content knowledge is essential in developing teaching professionals who are able to respond to the needs of diverse groups of students, including those studying in English as an additional language (Love, 2009). To support the conceptual development of these diverse groups of students, accounting educators need an understanding of the academic literacy requirements of the accounting specialisation (Love, 2010). The role of language and literacy in learning accounting content is therefore a crucial component of pedagogical content knowledge (Love, 2009).

In Figure 1.2, disciplinary literacy knowledge is what an accounting educator uses to teach students how to read, write and think in the same way that an accounting professional does in order to acquire knowledge and to analyse and solve accounting problems (Shanahan and Shanahan, 2008, 2012). Disciplinary literacy (as opposed to content area literacy, as discussed in the third category of the literature review) is developed in a learner over time.

At the introductory stage, learners have lower levels of prior knowledge. They may struggle to distinguish between concepts which are either more or less important when studying. For example, in accounting, a concept such as 'accrual' has to be understood by students. Not only do students need to know what 'accrual' means, they have to understand its "intent and import" (Carney and Indrisano, 2017, p. 42). Furthermore, they have to master the concept at an early stage, as it is positioned together with many other elements in accounting, such as assets and income, as their studies progress. As students' disciplinary literacy increases, their ability to engage with accounting content improves, and they begin to reason and perform more like members of the accounting community (Carney and Indrisano, 2017).

At the intersection of pedagogical content knowledge and disciplinary literacy knowledge in Figure 1.2, is the concept of 'disciplinary literacy pedagogical content knowledge'. Carney and Indrisano (2017, p.42) define it as "an understanding of how teaching and learning change in response to the domain content, and the ways of reading, thinking and knowing that are germane to the discipline". When describing knowledge of the process of acquiring disciplinary literacy, Carney and Indrisano (2017) focus on the cognitive processes used in constructing meaning while reading discipline-specific texts, as they argue that reading is central to students' development of discipline knowledge. The first two of the disciplinary literacy acquisition processes proposed by Carney and Indrisano (2017, p.43), namely, developing and activating schema, and, understanding vocabulary and concepts, as well as their final suggestion, the process of engagement in goal-directed learning, are relevant to this work.

The first disciplinary literacy acquisition process involves developing and activating students' prior knowledge (schema) to function as a mental scaffold on which to build new knowledge (Carney and Indrisano, 2017). A student's language background is one of the factors that affect his/her schema, and needs to be considered when designing instruction. In the two experimental studies (that test certain instructional techniques), cognitive load theory (CLT) is used to explain the effect of students' prior knowledge on student learning. This cognitive learning theory is discussed in the theoretical framework section that follows. Mcvee, Dunsmore and Gavelek (2005, p.542) advocate that when considering a student's schemata, it is important to focus not only on what the student 'knows', but also to consider the sociocultural background of the 'knower'. This is based on the Vygotskian perspective that social interaction is fundamental to cognitive development (Vygotsky, 2012). This social perspective forms the other part of the theoretical framework, and is the focus of the interview study.

The second aspect of disciplinary process knowledge discussed by Carney and Indrisano (2017) relates to understanding disciplinary vocabulary and concepts. As in other disciplines, when studying accounting students are not only learning a new word, but also a new concept. When this knowledge is transferred to new situations, it indicates that learning has taken place. The selection of strategies to teach students the meaning of accounting words and concepts needs to occur in the way that the latter are constructed in the discipline. This process of assisting students to access the meaning of accounting words and concepts is the focus of the two experimental studies.

The final process highlighted by Carney and Indrisano (2017), which is also relevant to this work, is that students need to be engaged in actively acquiring and using disciplinary literacy for effective learning to take place. Student engagement is both a personal and a social activity, and is influenced by the social context in which learning takes place (Kahu, 2013). This engagement process ties in with the second experiment, which uses whiteboard animations as a teaching method. Prior research has shown that animations have a positive effect on student engagement (Türkay, 2016).

The next section explains the theoretical framework that supports this thesis.

1.5.2 Theoretical framework

The theoretical framework combines an Interactionist perspective of Second Language Acquisition, which considers the social environment in which learning takes place, with Cognitive Load Theory (CLT) and the Cognitive Theory of Multimedia Learning (CTML). CLT accounts for students' prior knowledge (including language proficiency) levels when designing effective instructional practices. The CTML states that words and pictures are more conducive to students' learning, than words alone.

1.5.2.1 Theories with a focus on the sociocultural environment

Given the history of education in South Africa, and the diversity of languages and cultures in accounting classrooms, it is important to understand the sociocultural influences on student learning. A social understanding of learning is explained by Gee (1989, pp. 6–7) in terms of 'Discourses', which are "ways of being in the world; … forms of life which integrate words, acts, values, beliefs, attitudes, and social identities." Gee spells Discourse with a capital 'D' to distinguish it from 'discourse' which refers to written or spoken communication (Gee, 2015). Everyone develops their primary Discourse by learning to behave in a way that is appropriate in their home environment, as defined by their particular situation and culture (Gee, 1989). On the other hand, secondary Discourses are developed through involvement with social institutions beyond the family, such as educational and religious institutions, community and political organisations, and the work environment (Boughey, 2012; Gee, 1989). All secondary Discourses involve written and oral language use that go beyond our primary Discourse (Gee, 1989).

To explain primary and secondary Discourses I will use myself as an example. I am an accounting lecturer and researcher. This is the realm of my secondary Discourse, which determines how I act, talk and write, as well as my recognition of others in this particular role. I bring my beliefs, values and practices associated with my secondary Discourse into the primary Discourse of the home that I share with my family, who are White, English speaking South Africans. This means that my children have access to the Discourse that they need to succeed at an English-medium university, whereas a child from a home where the parents have never been to university, and the family speaks an African language, does not have this access.

The view of disciplinary literacy explained in the previous section fits within Gee's (1989, 2015) conception of a secondary Discourse. The language of accounting, as it is used in a social context in education and training environments and in practice, is itself a secondary Discourse. It involves ways of thinking, doing, acting and speaking, which are based on a set of beliefs about what constitutes knowledge and how that knowledge should be understood (Boughey, 2012). The group identity of the accounting profession (including educators and practitioners) is found in its secondary Discourse (Evans, 2010).

As accounting educators, we are promoters of this Discourse, and need to bear in mind the socially constructed nature of what we teach, say and do. Language learning should not be viewed as a neutral instrument of communication that is independent from the subject of accounting. If students are expected to understand and use language appropriately, they need to be taught the conventions of accounting language.

In the context of this research, language is regarded as a socially embedded practice in the discipline of accounting. From this viewpoint, the difficulties of students with EAL are perceived to arise from their status as outsiders to academic discourses and their lack of familiarity with the rules of academic literacy (Boughey, 2002). This social-contextual view of learning has traditionally been separated in education research from individual/cognitive learning perspectives. However, as mentioned earlier, when discussing Carney and Indrisano's (2017) suggestions for building students' disciplinary literacy knowledge, a bridge over the divide between these two views of learning has already been built by researchers such as Vygotsky (2012), as well as proponents of the New Literacy Studies (Gee, 1989; Street, 1988) and South African researchers such as Boughey and McKenna (2016).

Vygotsky incorporated both the social and the individual into his sociocultural theory. He described human learning as an inherently cognitive process that develops through interaction within cultural, linguistic and institutional settings (Lantolf and Thorne, 2007). Vygotsky believed that individual learning happens on two levels: basic learning occurs first through a process of social interaction between people, and as this learning is consolidated, it is internalised within an individual's cognitive function (Vygotsky, 2012). This provides a transactional relationship between the individual as a student and the collaborative shared educational space (Mcvee *et al.*, 2005). The first study in this thesis (chapter 2) therefore explores the individual and social learning experiences of first-year students studying accounting in English as an additional language.

As this thesis is premised on the basis that the cognitive processes of a student are a result of their human experience in their social and cultural environment (Mcvee *et al.*, 2005; Varela, Thompson and Rosch, 2016), theories that focus on individual cognition are now discussed.

1.5.2.2 Theories with a focus on individual cognition (CLT and CTML)

Primary and secondary Discourses can be linked to the concepts of primary and secondary biological knowledge used in evolutionary theory – on which Sweller's (1994) CLT is founded. Biologically primary knowledge is what humans have evolved to acquire, such as the ability to listen and speak in their primary Discourse (Sweller, 2011). In contrast, biologically secondary knowledge is mainly acquired through explicit instruction, such as learning to read and write (Sweller, 2011). Knowledge of the subject of accounting can therefore be defined as both biologically secondary knowledge and a secondary Discourse.

CLT is directed at the instructional process involved in assisting students to acquire secondary knowledge (Sweller, 2011). It requires educators to focus on both the instructional task and the learner characteristics when developing suitable pedagogical practices (van Merriënboer and Sweller, 2005). CLT takes into account the mental load that a student experiences when working on an instructional task. This mental (cognitive) load results from the interaction between the characteristics of the task students are given and the characteristics of the learner, which includes their prior knowledge (van Merriënboer and Sweller, 2005). For example, learners with no prior knowledge of accounting may experience higher levels of mental effort (cognitive load) when engaging with academic tasks that demand conceptual knowledge, as opposed to learners with accounting knowledge, who could experience lower levels of mental effort. Learners who study through English as an additional language may experience an additional cognitive load if the size of their English technical vocabulary is limited. For speakers of African languages, the problem is compounded, as to a large extent, their home languages lack technical vocabularies.

African home language students will probably, at least initially, understand a new technical concept better when explained in everyday English. Students learning through English as an additional language may benefit from another type of scaffolding for certain types of problems - viz. problems that are solvable by use of traditional cost-volume-profit formulas. Such formulas may help to make calculations more transparent, and can therefore also help to reduce cognitive load. In addition to these scaffolds which have been experimentally tested in chapter 3, spaces may also be created for students to use both English and their home languages for exploring new ideas and concepts in class to facilitate access to the Discourse of accounting (Paxton, 2009).

Finally, the use of multiple modes and media in designing effective instruction cannot be ignored. In chapter 4, an experiment testing the effect of animations on student learning is described. The principles of the cognitive theory of multimedia learning (CTML) were used to design the animation. The CTML is based on the work of Mayer (2002, 2005) and postulates that effective multimedia learning happens when students are able to build mental representations from both words and pictures. It focuses on how to design multimedia instruction, taking into account the role of different types of cognitive processing during learning and the capacity constraints on students' working memory. The CTML and CLT are linked in several research studies (DeLeeuw and Mayer, 2008; Mayer, Lee and Peebles, 2014) that measure the cognitive load imposed by multimedia instructional tasks. This is also done in chapter 4 of this thesis.

1.6 RESEARCH QUESTIONS

The main research question of this thesis is: What is the impact of social and cognitive dimensions of language on the learning of introductory accounting in English as an additional language? In addition, the role of cognitive learning theories in developing instructional techniques that make the language of accounting accessible to students in order for them to successfully analyse and solve accounting problems are considered.

The sub-questions, therefore, are:

1. What are the language and learning experiences of students studying accounting in English as an additional language?
2. How do formulas and register (everyday versus specialised language) effect the performance and cognitive load of English first language students and students with EAL in an introductory accounting topic, Cost-Volume-Profit (CVP) analysis?
3. What is the effect of a multimedia presentation of the accounting equation on the quality of the learning outcomes of students with EAL, as measured by their performance and cognitive load experiences?

To answer the research questions, a mixed method design was used, including an interview analysis and two experimental studies. Study 1 is in response to the first sub-question.

1.6.1 Study 1: Experiences of students studying accounting in English as an additional language

The first study explores the individual and social learning experiences of fourteen first-year accounting students studying in EAL. The challenges of these students relating to listening, reading, speaking and writing in English, and the impact of these on their academic outcomes, are examined. Using the argument of Núñez *et al.* (2016) that the 'funds of knowledge' students with EAL bring to higher education should be viewed as an asset, I wanted to understand the processes that convert these students' 'funds of knowledge' into academic success in the higher education environment (Rios-Aguilar, Kiyama, Gravitt and Moll, 2011).

A qualitative approach was considered appropriate for exploring the complexities of language and learning and to facilitate a deep understanding of the experiences of students studying in EAL. Face-to-face semi-structured interviews were conducted with 14 students, both academically successful and unsuccessful, who had already completed their first year. A skills-based linguistic framework was used to develop the interview questions.

A hybrid approach of deductive and inductive coding was used to interpret the data (Fereday and Muir-Cochrane, 2006). This entailed that a language skills-based framework of teaching and learning was applied to the first-order process (first cycle) of coding. An "iterative and reflexive" process (Fereday and Muir-Cochrane, 2006, p. 83) allowed themes to emerge from the data. These themes, in turn, sparked second-order (inductive) codes that resonated with aspects of the Interactionist approach to Second Language Acquisition.

It is anticipated that the results will contribute towards building a bridge between accounting education and language acquisition research and provide a more informed linguistic foundation for incorporating language skills into the accounting curriculum and learning materials.

The results of the first study provide the impetus for the following two experimental studies, which respond to the second and third research sub-questions. The impact of instructional practices designed to assist students to access the language used in introductory accounting topics, is examined.

1.6.2 Study 2: The impact of formulas and language on students' transfer of learning on Cost-Volume-Profit problems

In this study, the impact of providing formulas and using everyday rather than technical language on the ability of a diverse group of students to transfer knowledge gained in an introductory accounting topic, Cost-Volume-Profit (CVP) analysis, to new situations was tested. The students had never been taught the CVP topic before, and they had to use their background knowledge and language skills to answer the questions in the assessment. CLT is used to explain the results of the experiment.

This study replicates and extends a quasi-experiment undertaken in the USA by Johnson and Sargent (2014), in a controlled environment in a South African setting. Different from the original research, the transfer effect that students' results on formula-facilitated questions had on their performance on questions where they had to apply the knowledge gained from the formula-facilitated questions was examined. The cognitive load effects of the provision of formulas, and accounting versus everyday language on students' ability to transfer knowledge, are considered. Students' academic and language background variables were controlled for, unlike in the Johnson and Sargent (2014) study. The effect of the experimental conditions on students with EAL was analysed.

Using the principles of CLT, this research provides empirical support for instructional practices that improve students' capacity to transfer their learning when studying a topic such as CVP for the first time. Specific reference is made to how the practices may benefit students with EAL. A unique measure was used to test the ability of students to transfer their learning. Instructional design guidelines based on CLT, which should assist educators in teaching students to transfer their learning, are proposed.

1.6.3 Study 3: The instructional efficiency of multimedia presentations of the Accounting Equation for students studying in English as an additional language

This study focused on the process of engaging students while learning an introductory accounting concept, as suggested by Carney and Indrisano (2017). The purpose of this experiment was to determine if a whiteboard animation using pictures together with narration to explain the accounting equation is more effective than a voice-over PowerPoint (Microsoft, 2013) presentation in improving the quality of the learning outcomes of first-year accounting students' learning in EAL. The CTML was used to design the animation. The types of cognitive load in CLT are related to the types of processing in the CTML. These theories are used to explain the impact of the two presentations on students' performance and the mental effort they expended on the task.

Accounting students who were entering university for the first time participated in the experiment. They were randomly allocated to either the whiteboard animation or the PowerPoint presentation condition explaining the accounting equation. For the first level of analysis, participants were divided into whether they had taken Grade 12 accounting or not. For the second level of analysis, participants were split into whether they had English as a first or additional language. Besides measuring students' pre-test and post-test results, the time they took to complete both tests was used as a measure of their cognitive load. The test results and cognitive load measures were used to calculate instructional efficiency scores for the various student groups.

A controlled experiment was conducted in order to test the prediction of Wynder's (2018) non-experimental study that visualisations may increase the learning efficiency of students with EAL. The findings encourage efficient teaching practices that improve the quality of learning outcomes for novice EAL accounting students by using multimedia presentations. By quantifying the mental effort expended by students in achieving their test grades, insight is provided into the cognitive consequences of the accounting equation assignment for students with diverse language backgrounds. Using the principles of the CTML, this research encourages accounting educators to consider the cognitive load and instructional efficiency effects of their teaching practices.

1.7 SUMMARY

This thesis aims to build a bridge between accounting education and language acquisition research by empirically testing the effectiveness of instructional strategies that are aimed at reducing cognitive load and by utilising different modalities in accounting classrooms where the majority of students learn through English as an additional language.

The dynamic relationship between content, pedagogy and disciplinary literacy forms the basis for this work. Good teaching requires understanding the mutually reinforcing connection between all three elements taken together to develop appropriate and context specific pedagogical practices that assist students with diverse language backgrounds in their study of introductory accounting.

The thesis considers the social context in which many African first-language students who are studying accounting in English as an additional language are situated, as well as the utility of two techniques for scaffolding learning of accounting concepts in EAL. In chapter 2 the effect of the language and learning experiences of students with EAL in the first year of study on their academic outcomes are explored. In chapters 3 and 4, pedagogical techniques for two separate introductory accounting topics are tested in experimental conditions. The aim of the experiments was to determine whether the techniques assist first-year students in transferring their learning and improving their academic performance, while considering their effect on the cognitive load of students with EAL. CLT is used as the theoretical basis in the two experimental studies, as it allows for the prior knowledge (including language background) of students to be taken into account. The CTML allowed for effective design principles for multimedia instruction to be tested in the experiment described in chapter 4.

This introductory chapter is followed by the three separate research studies (chapters 2 to 4), from which three distinct research articles have been prepared. Chapters 3 and 4 provide the full versions of the studies undertaken, and not the condensed article format. Each chapter details the particular study's implications for practice and recommendations, as well as the study's limitations and a reference list. The concluding chapter provides an overview of the social and cognitive dimension of language in the learning of introductory accounting, the implications for practice and recommendations resulting from this thesis and the contribution of this research.

1.8 REFERENCES

Andrade, M.S. (2006), "International students in English-speaking universities: Adjustment factors", *Journal of Research in International Education*, Vol. 5 No. 2, pp. 131–154.

Antia, B.E. (2018), "Multilingual examinations: towards a schema of politicization of language in end of high school examinations in sub-Saharan Africa", *International Journal of Bilingual Education and Bilingualism*, Vol. 0050, pp. 1–16.

Baker, C. (2006), *Foundations of bilingual education and bilingualism*, 4th edition, Multilingual Matters, Clevedon, England, Buffalo, NY.

Barac, K. (2015), "Helping Disadvantaged Students: Findings from the Thuthuka Programme", *Accounting Education: An International Journal*, Vol. 24 No. 2, pp. 75–101.

Barnes, H., Dzansi, D., Wilkinson, A. and Viljoen, M. (2009), "Researching the First Year Accounting Problem: Factors Influencing Success or Failure at a South African Higher Education Institution", *Journal for New Generation Sciences*, Vol. 7 No. 2, pp. 36–58.

Basturkmen, H. and Shackleford, N. (2015), "How content lecturers help students with language : An observational study of language-related episodes in interaction in first year accounting classrooms", *English for Specific Purposes*, Elsevier Ltd, Vol. 37, pp. 87–97.

Belkaoui, A. (1980), "The Interprofessional Linguistic Communication of Accounting Concepts: An Experiment in Sociolinguistics", *Journal of Accounting Research*, Vol. 18 No. 2, pp. 362-374.

Bernardi, R.A. and Bean, D.F. (1999), "Preparer versus user introductory sequence: The impact on performance in Intermediate Accounting I", *Journal of Accounting Education*, Vol. 17 No. 2, pp. 141–156.

Bhattacharyya, A. (2012), "Enhancing Accounting Learning of the International Students: Strategies and their Effectiveness", *The International Journal of Learning*, Vol. 15 No. 3, pp. 261–277.

Boughey, C. (2002), "'Naming' Students' Problems: an analysis of language-related discourses at a South African university", *Teaching in Higher Education*, Vol. 7 No. 3, pp. 295–307.

Boughey, C. (2012), "Social Inclusion and Exclusion in a Changing Higher Education Environment", *Multidisciplinary Journal of Educational Research*, Vol. 2 No. 2, pp. 133–151.

Boughey, C. (2013), "What are we thinking of? A critical overview of approaches to developing academic literacy in South African higher education", *Journal for Language Teaching*, Vol. 47 No. 2, p. 25.

Boughey, C. and McKenna, S. (2016), "Academic literacy and the decontextualised learner", *Critical Studies in Teaching and Learning*, Vol. 4 No. 2, pp. 1–9.

Carney, M. and Indrisano, R. (2017), "Disciplinary Literacy and Pedagogical Content Knowledge", *Journal of Education*, Vol. 193 No. 3, pp. 39–49.

Coetzee, S.A., Schmulian, A. and Kotze, L. (2014), "Communication Apprehension of South African Accounting Students: The Effect of Culture and Language", *Issues in Accounting Education*, Vol. 29 No. 4, pp. 505–525.

Council on Higher Education. (2018), *Vital Stats: Public Higher Education 2016*, Council on Higher Education, Pretoria, available at: http://www.che.ac.za/sites/default/files/publications/CHE_VitalStats_2016 webversion_0.pdf.

Cummins, J. (2008), "BICS and CALP: Empirical and Theoretical status of the Distinction", *Encyclopedia of Language and Education, 2nd Edition, Volume 2: Literacy*, New York: Springer Science + Business Media LLC.

Dallimore, E.J., Hertenstein, J.H. and Platt, M.B. (2010), "Class participation in accounting courses: Factors that affect student comfort and learning", *Issues in Accounting Education*, Vol. 25 No. 4, pp. 613–629.

DeLeeuw, K.E. and Mayer, R.E. (2008), "A Comparison of Three Measures of Cognitive Load: Evidence for Separable Measures of Intrinsic, Extraneous, and Germane Load", *Journal of Educational Psychology*, Vol. 100 No. 1, pp. 223–234.

Department of Basic Education. (2015), *2015 National Senior Certificate Examination Technical Report*, available at: https://www.education.gov.za/Portals/0/Documents/Reports/2015 NSC Technical Report.pdf?ver=2016-01-05-050208-000.

Department of Higher Education and Training. (2015), *Report on the Use of African Languages as Mediums of Instruction in Higher Education*, available at: https://www.justice.gov.za/commissions/FeesHET/docs/2015-Report-UseOfAfrican Languages-MediumsOfInstruction.pdf

DiCerbo, P.A., Anstrom, K.A., Baker, L.L. and Rivera, C. (2014), "A review of the literature on teaching academic English to English language learners", *Review of Educational Research*, Vol. 84 No. 3, pp. 446–482.

Evans, E. and Cable, D. (2011), "Evidence of improvement in accounting students ' communication skills", *International Journal of Educational Management*, Vol. 25 No. 4, pp. 311–327.

Evans, L. (2010), "Observations on the changing language of accounting", *Accounting History*, Vol. 15 No. 4, pp. 439–462.

Fereday, J. and Muir-Cochrane, E. (2006), "Demonstrating Rigor Using Thematic Analysis: A Hybrid Approach of Inductive and Deductive Coding and Theme Development", *International Journal of Qualitative Methods*, Vol. 5 No. 1, pp. 80–92.

Gee, J.P. (1989), "Literacy, Discource, and Linguistics: Introduction", *The Journal of Education*, Vol. 171 No. 1, pp. 5–176.

Gee, J.P. (2015), "Discourse, small-d, Big D", in Tracy, K., Ilie, C. and Sandel, T. (Eds.), *The International Encyclopedia of Language and Social IInteraction*, Wiley-Blackwell and the International Communication Association, Hoboken, New Jersey, pp. 1–5.

Halabi, A.K., Tuovinen, J.E. and Farley, A.A. (2005), "Empirical Evidence on the Relative Efficiency of Worked Examples versus Problem-Solving Exercises in Accounting Principles Instruction", *Issues in Accounting Education*, Vol. 20 No. 1, pp. 21–32.

Hammond, T., Clayton, B.M. and Arnold, P.J. (2009), "South Africa's transition from apartheid: The role of professional closure in the experiences of black chartered accountants", *Accounting, Organizations and Society*, Elsevier Ltd, Vol. 34 No. 6–7, pp. 705–721.

Janse van Rensburg, C., Coetzee, S.A. and Schmulian, A. (2014), "South African financial reporting students' reading comprehension of the IASB Conceptual Framework", *Journal of Accounting Education*, Vol. 32 No. 4, pp. 1–15.

Johnson, B.G. and Sargent, C.S. (2014), "Impact of Formulas, Language and Instruction on Student Performance on Cost-Volume-Profit Problems", *Accounting Education: An International Journal*, Vol. 23 No. 1, pp. 22–41.

Johnson, B.G. and Slayter, E. (2012), "Impact of structure of early practice on student performance in transaction analysis", *Issues in Accounting Education*, Vol. 27 No. 1, pp. 101–112.

Kahu, E.R. (2013), "Framing student engagement in higher education", *Studies in Higher Education*, Vol. 38 No. 5, pp. 758–773.

King, G.H. and McConnell, C. (2010), "Using a common experience to teach introductory managerial accounting", *Journal of Instructional Pedagogies*, Vol. 4, pp. 1–8.

Koch, E. and Kriel, M. (2005), "An argument for integrating language or language related skills in the accounting curriculum", *South African Journal of Higher Education*, Vol. 19 No. 3, pp. 218–229.

Lantolf, J.P. and Thorne, S.L. (2007), "Sociocultural Theory and Second Language Learning", in van Patten, B. and Williams, J. (Eds.), *Theories in Second Language Acquisition: An Introduction*, Lawrence Erlbaum Associates, Inc., Mahwah, New Jersey, USA, pp. 201–224.

Leppink, J. and van den Heuvel, A. (2015), "The evolution of cognitive load theory and its application to medical education", *Perspectives on Medical Education*, Vol. 4 No. 3, pp. 119–127.

Love, K. (2009), "Literacy pedagogical content knowledge in secondary teacher education: Reflecting on oral language and learning across the disciplines", *Language and Education*, Vol. 23 No. 6, pp. 541–560.

Love, K. (2010), "Literacy pedagogical content knowledge in the secondary curriculum", *Pedagogies*, Vol. 5 No. 4, pp. 338–355.

Mayer, R.E. (2002), "Cognitive Theory and the Design of Multimedia Instruction: An Example of the Two-Way Street Between Cognition and Instruction", *New Directions for Teaching and Learning*, Vol. 2002 No. 89, pp. 55–71.

Mayer, R.E. (2005), "Cognitive Theory of Multimedia Learning", *The Cambridge Handbook of Multimedia Learning*, pp. 31–48.

Mayer, R.E., Lee, H. and Peebles, A. (2014), "Multimedia Learning in a Second Language : A Cognitive Load Perspective", *Applied Cognitive Psychology*, Vol. 28, pp. 653–660.

Mcvee, M.B., Dunsmore, K. and Gavelek, J.R. (2005), "Schema Theory Revisited", *Review of Educational Research*, Vol. 75 No. 4, pp. 531–566.

Mohrweis, L.C. (1991), "The Impact of Writing Assignments on Accounting Students' Writing Skills", *Journal of Accounting Education*, Vol. 9 No. 2, pp. 309–325.

Núñez, A.-M., Rios-Aguilar, C., Kanno, Y. and Flores, S.M. (2016), “English Learners and Their Transition to Postsecondary Education”, *Higher Education Handbook of Theory and Research*, Vol. 31, pp. 41–90.

OECD. (2013), “How is international student mobility shaping up?”, *Education Indicators in Focus*.

Paretti, M.C. (2011), “Interdisciplinarity as a Lens for Theorizing Language / Content Partnerships”, *Across the Disciplines*, Vol. 8 No. 3, Retrieved from: http://wac.colostate.edu/atd/clil/paretti.cfm.

Paxton, M. (2009), "'It's easy to learn when you using your home language but with English you need to start learning language before you get to the concept': bilingual concept development in an english medium university in South Africa", *Journal of Multilingual and Multicultural Development*, Vol. 30 No. 4, pp. 345-359.

Phillips, B.J. and Phillips, F. (2007), “Sink or Skim : Textbook Reading Behaviors of Introductory Accounting Students”, *Issues in Accounting Education*, Vol. 22 No. 1, pp. 21–44.

Phillips, F., Alford, S.J. and Guina, S. (2012), “Illustrations in financial accounting textbooks: Function and placement interact to affect student learning”, *Issues in Accounting Education*, Vol. 27 No. 4, pp. 999–1017.

Phillips, F. and Heiser, L. (2011), “A field experiment examining the effects of accounting equation emphasis and transaction scope on students learning to journalize”, *Issues in Accounting Education*, Vol. 26 No. 4, pp. 681–699.

Phillips, F. and Nagy, A. (2014), “Does Reading Case Responses and Using Graphic Organizers Enhance Accounting Students’ Case Analyses?”, *Issues in Accounting Education*, Vol. 29 No. 1, pp. 149–168.

Phillips, F. and Schmidt, R.N. (2010), “Creating early success in financial accounting: Improving performance on adjusting journal entries”, *Accounting Perspectives*, Vol. 9 No. 2, pp. 87–96.

Pritchard, R.E., Romeo, G.C. and Muller, S.A.B. (1999), "Integrating reading strategies into the accounting curriculum", *College Student Journal*, Vol. 33 No. 1, p. 77.

Pym, J. and Kapp, R. (2013), "Harnessing agency: towards a learning model for undergraduate students", *Studies in Higher Education*, Vol. 38 No. 2, pp. 272–284.

Rankin, M., Silvester, M., Vallely, M. and Wyatt, A. (2003), "An analysis of the implications of diversity for students' first level accounting performance", *Accounting and Finance*, Vol. 43 No. 3, pp. 365–393.

Riley, T.J. and Simons, K.A. (2013), "Writing in the Accounting Curriculum: A Review of the Literature with Conclusions for Implementation and Future Research", *Issues in Accounting Education*, Vol. 28 No. 4, pp. 823–871.

Rios-Aguilar, C., Kiyama, J.M., Gravitt, M. and Moll, L.C. (2011), "Funds of knowledge for the poor and forms of capital for the rich? A capital approach to examining funds of knowledge", *Theory and Research in Education*, Vol. 9 No. 2, pp. 163–184.

Sartorius, K. and Sartorius, B. (2013), "The comparative performance of chartered accountancy students in South Africa: The impact of historical legacies", *Development Southern Africa*, Vol. 30 No. 3, pp. 401–416.

Scarcella, R. (2003) "Academic English: A Conceptual Framework", *UC Berkeley: University of California Linguistic Minority Research Institute*. Retrieved from: https://escholarship.org/uc/item/6pd082d4.

Shanahan, T. and Shanahan, C. (2008), "Teaching Disciplinary Literacy to Adolescents : Rethinking Content-Area Literacy", *Harvard Educational Review*, Vol. 78 No. 1, pp. 40–59.

Shanahan, T. and Shanahan, C. (2012), "What is Disciplinary Literacy and Why Does It Matter ?", *Topics in Language Disorders*, Vol. 32 No. 1, pp. 7–18.

Shulman, L.S. (1986), "Those Who Understand: Knowledge Growth in Teaching", *Educational Researcher*, Vol. 15 No. 2, pp. 4–14.

Shulman, L.S. (1987), "Knowledge and Teaching: Foundations of the New Reform", *Harvard Educational Review*, Vol. 57 No. 1, pp. 1–22.

Silva, P. (1997), "South African English: oppressor or liberator", *The major varieties of English*, MAVEN 97.

Simons, K.A. and Riley, T.J. (2014), “Communication Apprehension in Accounting Majors: Synthesis of Relevant Studies, Intervention Techniques, and Directions for Future Research”, *Advances in Accounting Education: Teaching and Curriculum Innovations*, Emerald Group Publishing Limited, Vol. 15, pp. 1–32.

Siriwardane, H.P. (2014), “Kiondo Bag Boutique : A Serial Case for Introductory Financial Accounting”, *Accounting Education: An International Journal*, Vol. 1, pp. 95–113.

Siriwardane, H.P. and Durden, C.H. (2014), “The Communication Skills of Accountants : What we Know and the Gaps in our Knowledge”, *Accounting Education: An International Journal*, Vol. 23 No. 2, pp. 119–134.

Smith, L.C., Pym, J. and Ranchhod, V. (2012), “Explaining the first-year academic performance of commerce academic development students : A statistical analysis”, *SA Journal of Accounting Research*, Vol. 26 No. 1, pp. 43–65.

Smith, M., Therry, L. and Whale, J. (2012), “Developing a Model for Identifying Students at Risk of Failure in a First Year Accounting Unit”, *Higher Education Studies*, Vol. 2 No. 4, pp. 91–102.

Spaull, N. (2012) "Poverty & Privilege: Primary School Inequality in South Africa", Working paper, Stellenbosch Economic Working Papers: 13/12.

South African Government News Agency. (2016), “Umalusi retains language compensation for matric learners”, *SAnews.Gov.Za*, available at: https://www.sanews.gov.za/south-africa/umalusi-retains-language-compensation-matric-learners, (Accessed: 2019-05-09).

South African Institute of Chartered Accountants. (2018), “Membership Statistics”, available at: http://www.saica.co.za/Portals/0/Members/Aboutmembers/Race2018Oct.pdf.

South African Institute of Professional Accountants. (2016), *Annual Integrated Report 2016*, available at: https://www.saipa.co.za/wp-content/uploads/2017/07/9028_SAIPA_Annual_Report_2016_Final-LowRes1.pdf.

Statistics South Africa. (2012), *Census 2011: Census in Brief*, Statistics South Africa, Pretoria, available at: http://www.statssa.gov.za/census/census_2011/census_products/Census_2011_Census_in_brief.pdf.

Stone, G. and Lightbody, M. (2012), “The Nature and Significance of Listening Skills in Accounting Practice”, *Accounting Education: An International Journal*, Vol. 21 No. 4, pp. 363–384.

Stone, G., Lightbody, M. and Whait, R. (2013), “Developing Accounting Students’ Listening Skills: Barriers, Opportunities and an Integrated Stakeholder Approach”, *Accounting Education: An International Journal*, Vol. 22 No. 2, pp. 168–192.

Street, B. V. (1998) “New Literacies in Theory and Practice : What are the Implications for Language in Education ?”, *Linguistics and Education*, Vol. 10 No. 1, pp. 1–24.

Sweller, J. (1994), “Cognitive Load Theory, Learning Difficulty, and Instructional Design”, *Learning and Instruction*, Vol. 4, pp. 295–312.

Sweller, J. (2011), “Chapter Two - Cognitive load theory”, *Psychology of Learning and Motivation*, Elsevier Inc., Vol. 55, pp. 37–76.

Taylor, S. (2014), “Reviewing the language compensation policy in the National Senior Certificate”, *Perspectives in Education*, Vol. 32 No. 1, pp. 124–141.

Terwijn, R. (2015), *Pedagogy of Us: A Critical Research Study of the Experiences of EAL and International Nursing Students*, University of Southern Queensland.

Tickell, G. and Smyrnios, K.X. (2005), “Predictors of tertiary accounting students’ academic performance: A comparison of Year 12-to-university students with TAFE-to-university students”, *Journal of Higher Education Policy and Management*, Vol. 27 No. 2, pp. 239–259.

Türkay, S. (2016), “The effects of whiteboard animations on retention and subjective experiences when learning advanced physics topics”, *Computers and Education*, Elsevier Ltd, Vol. 98, pp. 102–114.

University of Pretoria. (2015), “University of Pretoria Statistics at a Glance 2014”, available at: http://www.up.ac.za/media/shared/371/ZP_Files/dipbook_2015.zp43519.pdf van Merriënboer, J.J.G. and Sweller, J. (2005), *Cognitive Load Theory and Complex Learning: Recent Developments and Future Directions*, *Educational Psychology Review*, Vol. 17 No. 2, pp. 147–178.

Varela, F.J., Thompson, E. and Rosch, E. (2016), *The Embodied Mind: Cognitive Science and Human Experience*, Revised., MIT Press, Cambridge, Massachusetts, USA.

Vygotsky, L. (2012), *Thought and Language*, edited by Hanfmann, E., Vakar, G. and Kozulin, A., The MIT Press, Cambridge, Massachusetts, USA.

Wagner, R.M. and Huang, J.C. (2011), "Relative Performance Of English Second Language Students In University Accounting Courses", *American Journal of Business Education*, Vol. 4 No. 5, pp. 31–38.

Watty, K., Jackson, M. and Yu, X. (2010), "Students' Approaches to Assessment in Accounting Education: The Unique Student Perspective", *Accounting Education: An International Journal*, Vol. 19 No. 3, pp. 219–234.

Webster, N.L.E.E. and Lu, C. (2012), "'English Language Learners': An Analysis of Perplexing ESL-Related Terminology", *Language and Literacy*, Vol. 14 No. 3, pp. 83–94.

Wolff, E. (2011), "Background and history - language politics and planning in Africa", in Ouane, A. and Glanz, C. (Eds.), *Optimising Learning, Education and Publishing in Africa: The Language Factor A Review and Analysis of Theory and Practice in Mother-Tongue and Bilingual Education in Sub-Saharan Africa*, UNESCO Institute for Lifelong Learning (UIL), Association for the Development of Education in Africa (ADEA) / African Development Bank, Hamburg, Tunis Belvédère, pp. 49–104.

Wong, G., Cooper, B.J. and Dellaportas, S. (2015), "Chinese Students' Perceptions of the Teaching in an Australian Accounting Programme – An Exploratory Study", *Accounting Education: An International Journal*, Vol. 24 No. 4, pp. 318–340.

Wynder, M. (2018), "Visualising accounting concepts: insights from Cognitive Load Theory for English as a Second Language students", *Accounting Education*, Vol. 27 No. 6, pp. 590–612.

CHAPTER 2
EXPERIENCES OF STUDENTS STUDYING ACCOUNTING IN ENGLISH AS AN ADDITIONAL LANGUAGE

2.1 INTRODUCTION

With the dawn of democracy in South Africa in 1994, the doors of historically White (English and Afrikaans) universities were opened to students of all races. By 2016, total student enrolments in higher education institutions had doubled (Council on Higher Education, 2018). This has resulted in a significant increase in the proportion of students studying in English as an additional language. The potential adverse effect of this on students' throughput rates presents a complex challenge to educators (Sartorius and Sartorius, 2013).

Despite this real-world concern, there is a lack of research exploring and attempting to understand the experiences of students studying accounting in English as an additional language. In South Africa, this type of research carries moral, economic and political imperatives (Boyce, Greer, Blair and Davids, 2012). Against the backdrop of these imperatives, this chapter aims to explore and describe how accounting students who are more proficient in another language (usually their home language) than in English, experience studying accounting through the medium of English, and how these experiences impact their academic success. The author has explicitly chosen to avoid focusing on the perceived deficits of students, and to acknowledge their existing language and cultural identities as well as the additive nature of their learning of English (Webster and Lu, 2012). Therefore, this study uses the term 'students with EAL' rather than 'EAL students'.

One of the few studies that used interviews to determine the language needs of accounting first-year students with EAL and how to address these needs was conducted by Koch and Kriel (2005). A main finding was that students had trouble in conceptualising accounting concepts. These authors concluded that the accounting classroom, rather than the language classroom, was the best place to teach the linguistic concepts of accounting. They pointed out that accounting educators need to be aware of the language of accounting that they possess and use, and can develop the academic literacy knowledge required to teach this by collaborating with their academic literacy colleagues. Carstens (2013) reiterates the importance of this teamwork. She suggests that in addition to academic literacy knowledge, content lecturers need some understanding of the theories of Second Language Acquisition, in order to deal with the challenges students face learning English as an additional (second) language in the context of studying a particular discipline.

This study contributes to a better understanding of the learning experiences of accounting students with EAL through interviews with a sample of first-year students. By building a bridge between accounting education and Second Language Acquisition research, a linguistic foundation is provided for how and why some students with EAL manage to achieve success in their studies, and why others do not.

The methodology used is unique in accounting education research, as it comprises a hybrid approach of deductive and inductive coding and theme development. A skills-based framework of teaching and learning, analysing students' listening, reading, speaking and writing experiences in accounting, informed the *a priori* codes. During the coding and analysis process, themes emerged that indicated that aspects of the Interactionist approach to Second Language Acquisition were relevant to understanding students' learning outcomes. These were therefore referenced to develop the *a posteriori* codes used in subsequent cycles of coding. The evaluation of accounting students' interaction experiences, both inter- and intra-personal, and the impact of these experiences on their academic success, provides a grounding for future work regarding the use and acquisition of language in improving accounting education.

In the remainder of this chapter an overview of the empirical literature on the language and learning experiences of accounting students with EAL is given, followed by the theoretical frameworks that informed the study: a skills-based framework and the Interactionist approach in Second Language Acquisition. Subsequently, the research project on which this chapter reports is described. The project description includes contextual information about the role of language in the South African education system and its effect on accounting students with EAL, and the research methodology used for the project. The results of the analysis of the interview data, and the themes that emerged from the main thread of the discussion and secondary threads are discussed. Finally, recommendations are made based on the analysis of the students' experiences. The limitations of the study are then outlined, and suggestions for further research are provided.

2.2 OVERVIEW OF THE EMPIRICAL LITERATURE ON THE LANGUAGE AND LEARNING EXPERIENCES OF ACCOUNTING STUDENTS WITH EAL

As already mentioned, there are very few qualitative studies of the language and learning experiences of accounting students with EAL. Interviews of international first-year accounting students (who are mainly students with EAL) have focused on particular aspects of their learning. Watty, Jackson and Yu (2010) studied how assessment practices influenced the quality of international students' learning, whereas Wong, Cooper and Dellaportas (2015) were interested in students' perceptions of the teaching and learning experience in Australia based on their prior educational experience in China. Bhattacharyya's (2012) goal was to identify international students' primary learning problems and how best to address them. Besides the local study of Koch and Kriel (2005), scant reference is made to students' experience of studying accounting in English as an additional language in any of these studies.

Although previous empirical research on language issues in accounting education has explored students' macro language skills of listening, reading, speaking and writing, there is very limited focus on how these impact students with EAL. International studies have examined the reading behaviours of accounting students (Phillips and Phillips, 2007), and their anxiety about communicating orally and in writing (Byrne, Flood and Shanahan, 2012; Simons and Riley, 2014). Research on the listening skills of accounting students is meagre (Stone, Lightbody and Whait, 2013) compared to writing skills (Riley and Simons, 2013). These international studies do not consider students with EAL, although these students constitute the majority of the student body in South Africa.

Locally, Janse van Rensburg, Coetzee and Schmulian (2014) found that students with EAL who attended English classes had better English reading comprehension levels than those who received instruction in Afrikaans – their first language. Furthermore, students with EAL from underprivileged schools in South Africa were more apprehensive about communicating in English orally than those from advantaged schools (Coetzee, Schmulian and Kotze, 2014).

In summary, there is limited mention of students with EAL and their needs in research on the language proficiencies of accounting students and on strategies for incorporating language skills into the accounting classroom in South Africa and abroad. There is also very little inter-disciplinary work between accounting education and second language learning research.

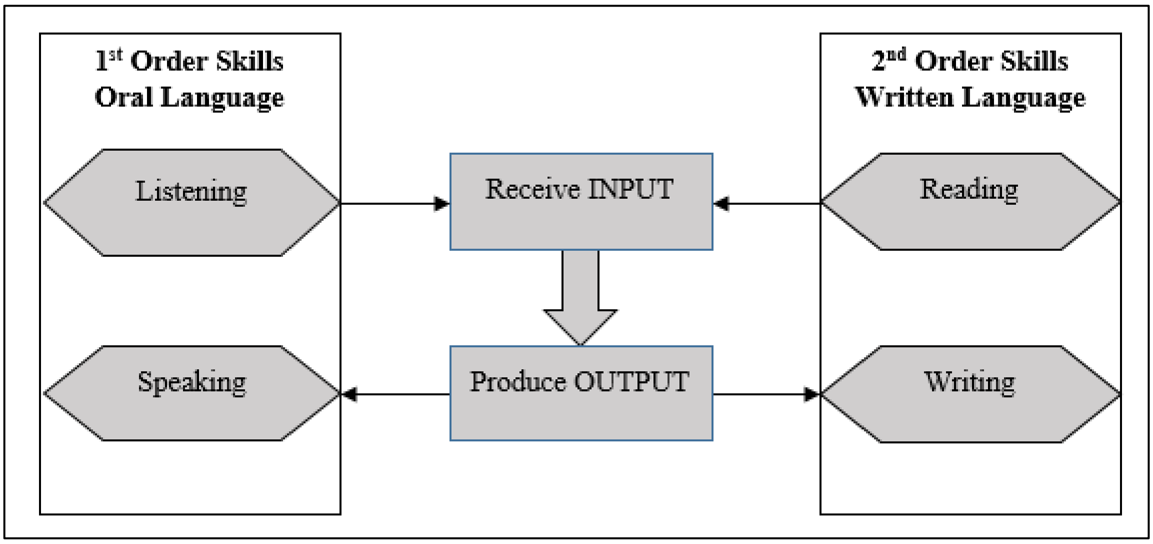
2.3 FRAMEWORK OF THE STUDY

This section gives an overview of the integrated framework that guided the compilation of the interview schedule and the interpretation of the results: the skills-based approach to teaching and learning accounting, and the Interactionist model of Second Language Acquisition.

2.3.1 Skills-based approach

The broad framework for the study was constructed by reviewing research on the macro language skills (see Figure 2.1) of accounting students. The four skills can be paired together as first-order skills in the language learning process, namely listening and speaking, and second order skills, namely reading and writing (Emig, 1977). The framework assumes that the student receives cognitive input while listening and reading, and has to produce meaningful output by speaking and writing, which gives an indication of the learning that has taken place.

Figure 2.1: Basic grouping of macro language skills



2.3.1.1 Listening

Listening is a complex cognitive process that is crucial for learning. Achieving comprehension does not only require receiving and deciphering auditory input. When listening, students are required to utilise their social and cultural knowledge to understand the speakers' intentions and expectations (Becker, 2016). Comprehension is affected by internal listener-related distractions and negative reactions, as well as external factors that students with EAL have to deal with, such as unfamiliar vocabulary, cultural references, speaker accents, and the rate of speech (Lynch, 2011).

Lynch (2011) recognises the multi-faceted dimensions of listening that university students are exposed to and expands the conception of one-way academic listening to lectures to include reciprocal (two-way) listening. Two-way listening is also supported by Stone *et al.* (2013), who are among the few researchers who have explored accounting students' listening skills. It is this interaction while listening, where speakers check their understanding with each other, which leads to students' cognitive development.

2.3.1.2 Reading

A predictive factor for achievement in higher education is reading comprehension (Pritchard, Romeo and Muller, 1999). Phillips and Phillips (2007) studied the textbook reading behaviours of introductory accounting students. They found that academically stronger students were motivated to read with better attention and focus in order to comprehend the text. These students read in preparation for class, persisted even when the material was difficult, and resolved uncertainty quickly. In contrast, weaker students were more likely to postpone reading and give up when it became too difficult. They read just to 'get through' the material and sacrificed comprehension.

Second language reading research often assumes that students' reading ability in their first language is unproblematic and that reading in English as an additional language is therefore a language problem and not a reading one (Pretorius and Mampuru, 2007). However, due to the scarcity of reading material in South Africa's nine African languages, first-language speakers of these languages have limited opportunities to read in these languages, and as a result their first-language reading skills are poorly developed (Pretorius and Mampuru, 2007). Students with EAL are therefore not only learning the language, they also have to deal with under-developed first-language reading skills.

2.3.1.3 Speaking

Studies on speaking focus primarily on communication apprehension. An interview-based study on the oral communication apprehension of first-year accounting students was conducted in Ireland. The authors do not identify whether the students were monolingual English speakers or not. They found that fear of being judged by their peers, as well as their previous experiences of talking to new people and being prepared for the communication event, influenced students' level of apprehension (Byrne *et al.*, 2012).

In a South African study Coetzee *et al.* (2014) found that accounting students from previously disadvantaged African communities who attended poorly resourced schools, were more likely to experience higher levels of communication apprehension. These students are similar to the students in this study, who spoke an African language at home, and took an African language as their first language at school. However, existing research does not indicate how oral communication apprehension influences students' academic outcomes.

2.3.1.4 Writing

Riley and Simons (2013) found a paucity of research on the writing skills of students with EAL. In their review of both oral and written communication apprehension research, Simons and Riley (2014) postulate that students with EAL may experience higher levels of communication apprehension when communicating in English compared to their first language.

Now that the skills framework on which the interview questions for this study were based has been explained, a theoretical overview of the Interactionist model of Second Language Acquisition is provided next. This framework was triggered by the first-order thematic analysis of the interview corpus.

2.3.2 Interactionist model of Second Language Acquisition

A socio-cognitive perspective of Second Language Acquisition ascribes language learning to the interaction between a student's cognitive abilities and the linguistic environment (Tarone, 2009). Researchers in the field recognise that social factors underlie the nature of students' participation in interaction, and impact learning opportunities through interaction (Mackey, Abbuhl and Gass, 2014; Tarone, 2009).

Interaction connects what students hear and read (input), through their internal cognitive capacities, to generate output in an iterative and productive process (Gass and Mackey, 2007). Input must be comprehensible and accessible to students, but it should also assist students in extending their current level of proficiency (Krashen, 1985). Students are active participants in creating meaning from reading and listening, and acquisition depends on their correct interpretation of the input (van Patten, 2007). Comprehensible output (what students produce) compels students with EAL to progress from comprehension to a more complete and accurate grammatical use of English. Regular speaking and writing also promotes spontaneous language use (Gass and Mackey, 2007).

Second Language Acquisition research postulates that the links between interaction and learning are mediated by students' cognitive mechanisms, including their memory and attention capacities (Mackey *et al.*, 2014), and that acquisition is the product of a relationship between learner-internal and -external processes (Ellis, 2012, p. 933). External interaction is a social behaviour that occurs when people communicate with each other orally or in writing. Reading can be construed as a learner-internal interaction that brings together different components of the reader's intellect, including the ability to decipher the written text, knowledge of the language being read and background knowledge (schema) of the discipline, in order to form an understanding of the written text (Ellis and Fotos, 1999, p. 1).

During interaction, students may receive feedback either directly, indicating that their spoken output is correct or incorrect, or indirectly, by noticing how more proficient English speakers produce the same output (Gass and Mackey, 2007). Due to the very large first-year classes (from 600 to 1 500 students) that accounting educators at the institution at which this research was conducted have to contend with, students seldom receive explicit feedback on their written work and speech. It is more likely that students will receive implicit feedback on their oral output by negotiating meaning in a less stressful environment, such as consulting with lecturers, in small group tutorials, or talking with their peers. However, students' negative affective states, such as anxiety, may hinder their ability to produce output and learn from corrective feedback (Krashen, 1985; Mackey *et al.*, 2014).

The language interaction experiences of the students interviewed are discussed further in the Results section.

2.4 RESEARCH METHODOLOGY

2.4.1 Design

This study was conducted using a hybrid approach of deductive and inductive coding and theme development (Fereday and Muir-Cochrane, 2006). It took place in 2014 at a large residential South African university where the author worked.

2.4.2 Interviewees

To ensure participant homogeneity, a set of common criteria were used to determine the population from which the sample was drawn (Guest, 2006). There were 72 students who spoke a language other than English at home and who studied a language other than English as a first language in their final year of high school, and who had registered for the first time for the Accounting Sciences degree in 2013 and were studying in English. These students all completed the most common school leavers' examinations in South Africa – the National Senior Certificate (NSC) or the Independent Examinations Board (IEB) examination – in 2012.

This population was then split into students who passed their first-year compulsory courses at their first attempt (33 students) and those who did not (39 students). Seven students from each of these two groups were randomly chosen and personally invited by email to participate in the interviews. All of the students who were approached agreed to be interviewed.

The decision to conduct 14 interviews was based on the work of Guest (2006) who found that for purposive sampling, where participants in the sample are relatively similar in their experiences in respect of the research domain, data saturation typically occurs within the first 12 interviews. In order to conduct pilot interviews, an extra two participants were added (one from each group), making a total of 14 interviewees. The data from these two interviews were included in the final analysis, as both students made unique contributions that assisted in increasing the understanding of the experiences of first-year accounting students studying in EAL.

Table 2.1 shows the profile of the 14 students interviewed. The first language of 13 of the 14 students was an African language. In the rest of this study, the language students speak

Table 2.1: Profile of the participating students

Student pseudonym	Race	Gender	Home language	Grade 12 first language	Pass/Fail[1]	High school quintile[2]	High school language[4]	Primary school language[4]
P1	White	Male	Afrikaans	Afrikaans	Pass	5	English/Afrikaans	Afrikaans
P2	Black	Male	Sepedi	Sepedi	Pass	2	Sepedi	Sepedi
P3	Black	Female	Tshivenda	Tshivenda	Pass	3	Tshivenda	Tshivenda
P4	Black	Male	Sepedi	Sepedi	Pass	Ind.[3]	English	English
P5	Black	Male	Sepedi	Setswana	Pass	1	Setswana	Setswana
P6	Black	Female	Sepedi	Afrikaans	Pass	5	Afrikaans	English
P7	Black	Female	Xitsonga	Xitsonga	Pass	3	Xitsonga	English
F1	Black	Female	Xitsonga	Setswana	Fail	4	Setswana	Setswana
F2	Black	Male	IsiXhosa	Setswana	Fail	3	English	Setswana
F3	Black	Male	IsiZulu	isiZulu	Fail	4	English	IsiZulu
F4	Black	Female	Sepedi	Sepedi	Fail	3	English	Sepedi
F5	Black	Male	Tshivenda	Tshivenda	Fail	2	Tshivenda	Tshivenda
F6	Black	Female	Sepedi	Sepedi	Fail	1	Sepedi	Sepedi
F7	Black	Male	Setswana	Setswana	Fail	4	Setswana	Setswana

[1] Pass = Passed first-year compulsory courses on first attempt otherwise = Fail
[2] Quintile ranking of the high school student attended: Quintile 1 being the poorest schools and quintile 5 the least poor schools
[3] Ind. = Independent school, i.e. not funded by the government, but the students write the same school leavers' examination
[4] Language mainly spoken in school classroom by teachers

at home is referred to as their ‘home language’. The language they took as a subject at first-language level at school is referred to as their ‘first language’.

2.4.3 Ethical considerations

Approval was obtained from the Faculty Ethics Committee (Appendix A). All participants completed a consent form that described the nature and purpose of the research, and assured them of anonymity (Appendix B).

2.4.4 The interviewer

The author, who has 18 years of experience teaching and consulting accounting students of various races and language groups at higher education institutions in South Africa, personally conducted all the interviews. There was potential for interview bias attributable to the ‘teacher/pupil’ environment, as the students knew her as an academic. This limitation in data collection was considered acceptable, given that her direct experience with some of the courses that the students had taken in first year improved her ability to analyse the students’ responses more authentically (Jackling, 2005).

2.4.5 Research instrument

A semi-structured interviewer guide was used to conduct the interviews. The questions were formulated using the skills-based framework discussed in Section 2.3.1. Questions regarding the use of language were incorporated from the studies of Bangeni and Kapp (2007) and Berman and Cheng (2010). Pilot interviews were conducted with one “passing” student and one “failing” student. The purpose of the pilot interviews was to test for the suitability and structure of the questions, allowing for refinements to the interview protocol (Turner, 2010).

The interviews opened with questions about the students’ home, school and language backgrounds, and their experiences of the level of English at university. These were followed by questions operationalised from the skills-based framework, which dealt with listening and speaking during lectures and tutorials, students’ interactions with lecturers, tutors and fellow students, reading their textbooks and assessments, and writing assessments.

The questions in the research instrument were designed to explore students’ listening experiences in both social and academic situations. The type of school they attended, where they lived while studying, who they spent time with and who they relied on for support, all played a role in the development of their basic interpersonal communication skills (BICS) in English (Cummins, 2008). However, participation and success in the academic environment required cognitive academic language proficiency (CALP). Students were exposed to lectures as well as small-group tutorials with senior students as tutors. In both settings, students were encouraged to ask questions. They could also consult with lecturers and tutors on a one-to-one basis to discuss their problems with their accounting work.

Reading skills were considered with questions about students' experiences of reading the prescribed textbooks and other learning material provided to them, as well as their encounters with reading and comprehending accounting assessments in their first year. First-year students in the setting of this study are required to use textbooks for almost all their courses. The financial accounting textbook is specifically designed for the first-year course, and the management accounting lecturers provide their own notes to students electronically.

Concerning second order language skills, students' opportunities to speak English in both a social and an academic context were explored. They were asked to explain how they felt about speaking in front of large lecture groups, smaller tutorial groups and in consulting situations. Students were also asked how they felt about writing in English for assessment purposes. However, their opportunities in the first year to produce written output in accounting were limited, as both financial and management accounting assessments mainly require calculations and their application, using accounting formats.

The interview questions are provided in Table 2.2.

2.4.6 Data collection

Individual, face-to-face, semi-structured interviews were conducted with the participants during the first semester of their second year of study. By this stage, they had already completed a one-year introductory course in financial accounting, and a semester course in management accounting.

Table 2.2: Interview questions and development of codes and themes

Questions	Macro Language skills (Figure 2.1)	1st Order (*a priori*) Codes	Difference between two groups	2nd Order (*a posteriori*) Codes
Which language do you speak at home? Which language did your primary and high school teachers mostly speak?	Background	Home language School language	Two groups identified: Six students with English/Afrikaans high school Eight students with limited English exposure – greater adjustment required to English at university.	
What was your experience in coming to university and studying in English?	Experience of English environment	English level first year: Easy/moderate/difficult		
Where did you live while you were studying in first year?	ORAL SKILLS/ INPUT AND OUTPUT Opportunities for **listening** to and **speaking** English **socially.**	Social environment: Private/Home/Residence	Positive verbal interaction opportunities in a social context	Lived in English speaking environment Support from English speaking peers Feelings of isolation
Where did you go for help and support in first year?		Support structures: Family/Peers/Senior students		
Tell me about your experiences of being able to listen to your lecturers in class.	ORAL SKILLS/ INPUT Reflections on **listening** to lecturers	Listening to lecturers: Easy/Problematic/Reason Note-taking in class: Not done/easy/difficult	Comprehensible (oral) listening input	Prepared for class Emotional attitude Understood lecturers
Tell me how you feel that you cope with the amount of reading you have to do and the textbooks and notes that you use to study and how long it takes to read and understand?	WRITTEN SKILLS/ INPUT Reflections on **reading:** Study material and Assessments	Reading English textbooks Easy/Problematic/Reason	Comprehensible (written) reading input	Time taken to understand Persistence through difficulty Feeling of being over-whelmed
Reflect on the tests and exams you wrote and your ability to understand the questions and what was required.		Reading Assessments: Easy/Problematic/Reason		
How do you feel about communicating in English?	ORAL SKILLS/ OUTPUT Reflections on English **speaking** ability	Perception of ability to speak English: Easy/Problematic/Reason	Positive verbal interaction opportunities	Level of confidence Lived in English speaking environment
How do you feel about asking questions and/or participating in class discussions during lectures (tutorials)?	**Speaking during** lectures (large groups) and tutorials (smaller groups)	Class Participation: Yes/No/Reason	Positive verbal interaction opportunities in an academic context	Anxiety in large groups Willingness to consult with lecturers and tutors Participation in tutorials
Are you comfortable consulting with lecturers (tutors)? Why/why not?	**Speaking** to lecturers and tutors **in person**	Consulting Lecturers: Yes/No/Reason		
Tell me about how you experience writing (assignments, test, and exams) using the level of English required at university.	WRITTEN SKILLS/ OUTPUT Reflection on writing for assessments.	Assessment writing: Easy/Difficult/Reason	Students did not express undue concern about writing in English.	

At the beginning of each interview, students were encouraged to feel at ease. They were assured of the confidentiality of the process and informed that their participation was voluntary; in other words, they could withdraw the data they contributed at any stage. After the purpose of the study had been explained to them, they were informed that the researcher was interested in their reflections on their first-year experiences. They were encouraged to be as frank as possible. The interviewer aimed to establish a non-judgemental atmosphere where the students could express themselves freely. At the end of each interview, students were asked to reflect on the interview experience. The response by student F6 is typical of the responses of the sampled students:

> *It was touching, because I was able to talk to you about things I've never spoke to anyone about…* F6

During the interviews, the reliability of students' responses was verified by asking them similar questions in different ways. The researcher was satisfied that students were consistent in their responses.

Adequate re-occurrence of themes emerged after the completion of 14 interviews (7 from each group) (Guest, 2006). The interviews were recorded and transcribed verbatim in order to be able to conduct detailed analysis of the students' responses. The average duration of the interviews was 50 minutes.

2.4.7 Data analysis

In the first phase of the data analysis, the first author transcribed eight of the interviews, and audited the professional transcriptions of the remaining six interviews. This allowed full immersion into the data. Repeated reading of the transcripts further enhanced understanding. The completed transcripts were made available to the students interviewed in order for them to confirm their authenticity.

The first round of coding of the interview data was directed by the language skills framework of teaching and learning on which the semi-structured nature of the interviews was based. Students' verbal and written input (listening and reading) and output (speaking and writing experiences were the focus of the *a priori* codes (refer Table 2.2). The first-order codes were applied to the transcripts in order to classify meaningful units of text. The coding was done using ATLAS.ti (version 7, 2016). During the coding process, the codes were refined as more groupings of responses emerged, and the coding of transcriptions already analysed was redefined where necessary.

Similarities and differences between students who had been successful in first year and those who were not were then analysed. On repeated reading of the transcripts, codes that were representative of the two groups of students were grouped and categorised. Themes emerged from the data indicating that interaction (or the lack thereof) played an important role in the success of the students. Students' experiences, attitudes and actions (or lack thereof), as identified, were mapped onto the Interactionist approach to Second Language Acquisition. Subsequent cycles of coding therefore used second-order codes (a-posteriori) that indicated the type of verbal interaction opportunities students experienced, their actions and emotions when dealing with oral and written input, and their interaction with reading material and assessments (refer Table 2.2).

In order to establish credibility, data were selected for reporting based on responses and reflections that were consistent between several of the participants (Thomas and Maglivy, 2011). In addition, the researcher's background, as detailed in Sections 1.3 and 2.4.4, of working with accounting students studying in EAL, allowed her to recognise the reality of the students' experiences. The reflexivity of the analysis process (Fereday and Muir-Cochrane, 2006) means that the position of the author is embedded in this research as an advocate for the stories and struggles of these students.

2.5 RESULTS AND ANALYSIS

2.5.1 Students' language backgrounds

Students P2, P3, P5 and P7, who passed all their first-year courses, had very limited English backgrounds.

Students P2 and P3 came from rural areas in South Africa where their teachers taught them in their African home languages. The limited exposure to English is emphasised by student P3:

> *…a lot of students… don't have the English knowledge, because most of their parents didn't go to school …*

Student P2, for whom the interviewer was responsible as a bursary student, had this to say about meeting her on his arrival at university:

> *…actually I never spoke English back home, as in 'English'. The first time I remember was speaking to you; you were the first white person I spoke to in my life.*

Students P5 and P7 went to high schools in township areas. In South Africa a township is a suburb or city that under Apartheid legislation was officially designated for occupation by underprivileged black people. The school language experiences and difficulties in transitioning to university for these students echoed those of students from rural schools. Arriving at university, students such as these experience a culture shock. Student P2 was placed in a university residence with students of other races and languages:

> *…we couldn't really understand one another. So I had to use English. I remember the first 3 days I ended up locking myself in my room, because I couldn't deal with it anymore.*

Student P3 talked about her transition from her rural African home life to an urban English university environment, where she lived in private accommodation:

> *… It was all overwhelming, because … I'm the rural village girl in the city… I was alone, and emotionally it was overwhelming … I didn't know how to study … because accounting at university was different from accounting at high school… even the language – I remember the first time I went to class, I was just sitting there and I didn't get most of the words that was said in class… the lecturer would make a joke, and then I wouldn't hear the joke because it was hard.*

The family backgrounds of these successful students influenced their decision to enter university. Student P5's mother completed her schooling as an adult, but was unemployed, having previously been a domestic worker. His father had never been to school and was a construction worker. He talked about his parents' influence on him and why he was at university:

> *…it was … the circumstances at home. You want to break that cycle and also you want to see yourself somewhere better... my parents … wanted to see us progressing…*

In contrast to the four students who were identified earlier as having limited English backgrounds, students P1, P4 and P6 (successful in their first-year studies) had far more exposure to English at high school. Students P1 and P6 went to well-resourced quintile 5 (predominantly white, government) schools, and were educated in English and Afrikaans, while student P4 went to an independent school:

> *I was in an English medium school … I suppose I could say on average my English, and the knowledge I have of English was …on par with what the university required.*

The seven students who were academically unsuccessful in their first year had a variety of language backgrounds. They all came from either township or rural schools. The under-resourced nature of these schools often resulted in a lack of suitably qualified teachers. Students were often required to study on their own in critical subjects such as mathematics*:*

> *…we didn't have a math teacher, throughout our matric year. So we were basically studying on our own, from study groups and watch learning channel materials, then I was able to do fairly well to get into the degree at least.* F3

Many of the students who were unsuccessful in their first year were the first in their family to come to university. The expectations of their families are often very high. Student F7's mother is a cleaner. His home circumstances placed additional pressure on him:

> *…my Mother she was retrenched last year, she started working this year. It brings pressure to me, because I have a younger brother who I have to look for.*

Students who struggled academically often came from relatively sheltered and structured backgrounds. They were likely to find university life liberating, and the unbridled freedom may account for their academic failure:

> *…there is freedom here and back in high school I always knew that my life was rooted in a way …But here …you have the freedom to do whatever we want …* F1

Students F2, F3 and F4 came from high schools where the teachers spoke English to them. For the other four students who went to non-English speaking high schools, the experience of not being able to speak in their home language at university was often overwhelming and resulted in anxiety:

> *… coming from a school where all the teachers speak your home language... it was very hard… I couldn't like raise out my own opinion, I couldn't ask a question, because I'm scared. What if I'm not going to say it …right, the way I want it to be?* F6

The limited English language backgrounds of the four students who were successful – P2, P3, P5 and P7 – were most similar to those of the unsuccessful students – F1, F5, F6 and F7. The linguistic experiences of these two groups of students are therefore specifically examined and compared in the following analysis.

2.5.2 Analysis of the interviews

Upon analysis of the first-order codes relating to students' experiences of and opportunities for using the macro language skills, differences were detected between the students, based on whether they had achieved academic success or not. The first-order codes were clustered into two main themes that emerged. The second order codes were developed from these two themes (refer Table 2.2). Firstly, students who were academically successful were more likely to have participated in positive verbal interaction (listening and speaking) opportunities in both formal and informal contexts. Secondly, students' ability to interact with the written input they were provided with (reading) affected their academic outcomes. Students' experiences are therefore discussed in this order, and the analysis concludes with a discussion of their writing experiences.

2.5.2.1 Theme 1: Positive verbal interaction opportunities

Students' experiences of and attitudes towards listening and speaking socially or in an academic context were first-order codes in the analysis. The symbiotic relationship between these two skills became clear in students' interaction opportunities (or lack thereof). The second order codes identified external environmental factors and internal cognitive and social factors, which, in the instance of the students who did well in their studies, played a positive role in their verbal interactions. For students who did not get ahead academically, the factors either negatively affected their verbal interactions, or meant that positive interaction opportunities did not occur.

2.5.2.1.1 Listening

In Lynch's (2011) review of listening research, he ascribes the inherent complexity of the listening process to internal listener related factors and, in particular for students with EAL, to external factors. Many of the students interviewed referred to these external factors related to the speaker's rate of speech and accent, the novel expressions and content used, as well as cultural references as being a challenge. For example, lecturers spoke too fast, made jokes they could not understand, and used unfamiliar terminology. The negative effect of these factors on the emotions and self-confidence of students who did not do well was evident.

> *Some words I did not really understand and I'd … have to ask someone…'what does this mean'? And at times I felt stupid…* F7

Successful students were more likely to have positive experiences of listening in lectures. For example, student P3 admitted to struggling at first to understand her lecturers, but her motivation to learn and positive attitude aided her. She also quickly understood the benefit of preparing for her lectures:

> *I prepare for class and most of the time when I prepare for class I understand the work.*

Students who were academically unsuccessful were more likely to disengage during lectures. They could not understand what was being said and became de-motivated, which meant that they were also less likely to prepare for class.

Besides better academic listening experiences, students who were successful also had more opportunities to interact socially and develop their reciprocal listening skills. This process of interaction is discussed further in the next section.

2.5.2.1.2 Speaking

In the context of this study, interaction occurred when students asked questions in a classroom or tutorial, consulted with their lecturer or tutor, and/or spent time in conversation with peers who had more advanced English language proficiency.

Students who came from schools where their teachers spoke to them mainly in an African language (not in English), professed to greater levels of anxiety when required to speak in lectures and when consulting with their lecturers, than students who had been to schools where the teachers spoke to them only in English. Other factors were the large class sizes, and students' anxiety that their level of English was not good enough, and that they might be judged or mocked if they spoke aloud in class. Successful students who felt anxious about speaking in class were, however, more willing to consult with their lecturers:

> *…I'm feeling the pressure that if maybe I ask something and then my language is not that good, then I will turn into a laughing stock …if I couldn't ask questions in class then I made sure that I went to the lecturer to consult, because then it's better, it's one on one…* P5

Student P2 felt more comfortable participating during smaller peer group tutorials. He was then exposed to and could produce more language than he would have in a large classroom setting:

> *In a formal lecture, I really feel intimidated – I can't ask any question. But then tutorials …it's a small group and … my tutors were black guys… even if I use some slang …he can relate. So in tutorials, I didn't have any problems participating or asking any questions.*

Unsuccessful students were less likely to consult with their lecturers due to their lack of confidence in their use of English, and feelings of inferiority:

> *The English thing was also a problem, going to consult. And going there and asking a question, for me I felt like, 'okay if I go there, maybe the lecturer won't understand what I'm trying to say, maybe I'm too dumb, and I should just understand this.'* F6

The interaction of successful students with other English speakers enabled them to gain access to comprehensible input and extend their speaking capabilities.

One of the first probable reasons for student P2's eventual academic success in the first year was his response to the situation in which he found himself in residence when he was placed with students who could not speak his home language. He understood that he needed to interact with students who were more proficient in English than he was. This interaction would have exposed him to the terminology and grammatical constructions used by English speakers, thus promoting the development of his own English.

> *But then I just told myself… I have to engage – put me in a situation where I will be forced to speak English…luckily I had some relaxed guys. They were patient with*

me… I would ask them to repeat …what they're saying… Then even when I was talking …broken …they could just bear with me.

While interviewing students who had failed their first year and who lived at home or in private accommodation, there was usually little evidence of sustained interaction with more proficient English speakers. They tended to be more insecure about their ability to speak English and often felt isolated. Student F5 talked about his struggles to make friends. He appeared to be very lonely in his first year and had no one to confide in when he was failing:

I felt so ashamed like to tell …even my friends … I couldn't tell my family... Because actually I don't have those people who I call …best friends.

The extent of formal and social interaction that students who passed their first year were exposed to appeared to be significantly greater than for those who had failed. Social interaction with English speaking peers, and more formal interaction with tutors and lecturers all appeared to have a positive effect on the students who passed their first year.

2.5.2.2 Theme 2: Students' interaction with written input received

2.5.2.2.1 Reading

Studies of accounting students' reading behaviours and comprehension highlight the importance of students' interaction with the academic text. The interaction of successful students with their textbooks was evident in their willingness to do pre-reading before class, their persistence with material, even when it became difficult, and clearing up any misunderstanding as soon as it arose. In this study successful students preferred studying from their textbooks, and despite finding it time consuming, took the time to make sure they understood what they read.

I'm the kind of person who in order to understand something, I have to sit down and read and concentrate ... it took time for me to start preparing for class, because … I didn't know how do you prepare for class when you don't understand anything? I had to …read. The textbooks were different … the level of complexity … was challenging. P3

While both students who had passed and those who had failed encountered problems understanding and interpreting assessment questions, students who had been successful were more likely to display the meta-cognitive ability required to understand what their mistakes were:

> *It's what actually happened with me, with our year test. Like I looked at it, and I realized that many of the mistakes … I did read the information, but then I did not interpret it correctly.* P7

In the case of students who were academically weaker, their limited interaction with the prescribed reading material was indicated by their failure to internalise their work:

> *…there were things you'd read maybe 10 times, I still don't get what's happening. I can't like take the information and make it my own.* F6

Students who were unsuccessful were more likely to misunderstand the information provided in assessments, as well as what was required in the assessments:

> *… So I realized sometimes we don't fail because we don't know what is required, but we fail because we don't understand the information given there.* F5

The interactive process required for readers to construct meaning from written material explains the differences in reading comprehension between the two groups of students. Reading comprehension requires the interaction of various cognitive skills of the reader. If readers use many of their working memory resources to process lower-level information, such as the words and phrases used in the text, they will have less capacity left for higher-level comprehension processes. Due to less efficient construction processes, these readers' working memory resources may be depleted in generating the text-base. Consequently, less skilled second language readers may need to read the text more slowly or may need to reread it so that in the subsequent readings they have enough working memory resources for the second phase, namely to integrate meanings with prior knowledge and constructing a coherent mental representation of the text (Nassaji, 2007).

2.5.2.3 Writing

There were no identifiable differences between the two groups of students' writing experiences. The results of the first-order codes relating to written output are discussed here.

Students who were academically successful considered answering questions in English in written assessments relatively easy in their first year.

> *Writing English for me is not that much of a problem… because I'm not under pressure like having to respond on the spot as you're talking with someone, because I can re-think, gather my vocab together, and write exactly what I want to write.* P2

They did, however, find that it took them longer to write in English, and then they did not always finish their assessments on time:

> *…there are instances where I want to write something –but then to get the right word … is quite a challenge. … It's one of the things that contributes to not finishing the paper.* P5

Students who were academically unsuccessful were more likely to experience problems in writing English. Students F1, F2 and F4 expressed their discomfort, while students F3, F5 and F7 did not believe they had problems writing in English. Student F6 took her inability to write adequately during her tests very personally:

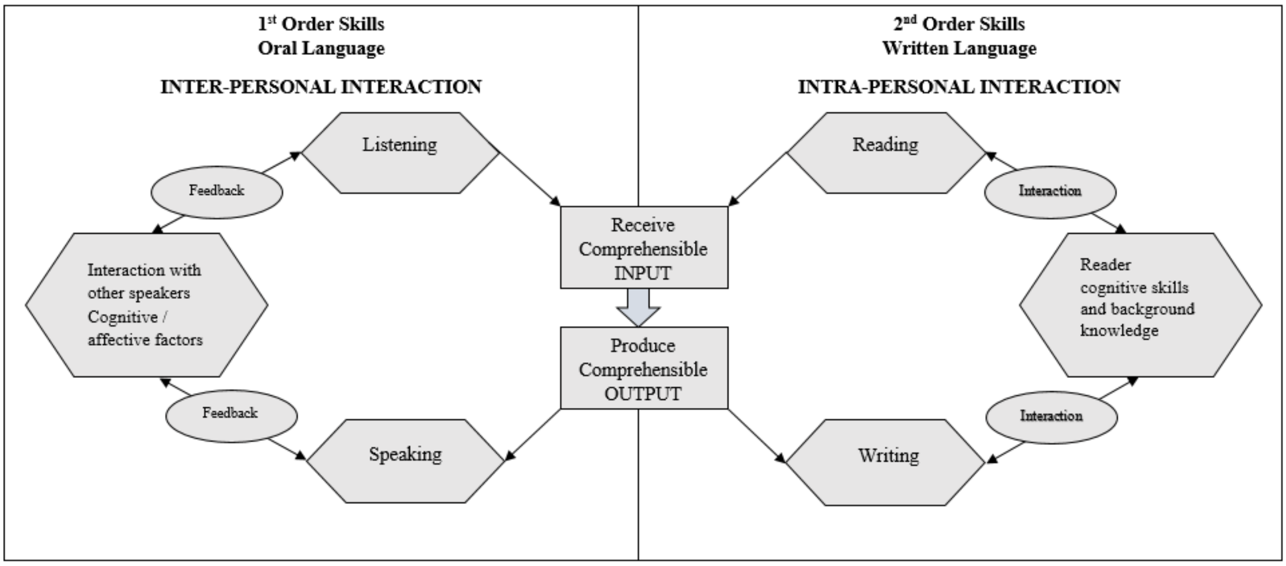
> *'Maybe I'm just too stupid …I don't understand' …because… under test conditions I had a problem writing…* F6

Students did not always believe they had difficulty in producing written output. This could be because the amount of writing required in the assessments for their two main first-year courses, financial and management accounting, is limited, as they are more format and calculation based.

2.5.3 Summary

The results of this study indicate that the development of students' macro language skills is partially dependent on two factors: their exposure to positive external interaction opportunities, and their ability to engage in deep mental processing while reading to promote their understanding of academic material. A schematic representation of the interaction between students' oral and written input and output that ensued from the results of the study is provided in Figure 2.2.

Figure 2.2: Interaction between students' oral and written input and output



The benefit of inter-personal interaction in this study came about because students were able to negotiate for meaning with other English speakers. Feedback received during listening and speaking allowed students to make connections between what was said and what was meant, and to adjust and improve their comprehension and language use. However, this negotiation process would have been moderated by cognitive factors, such as attention paid by the student to feedback received, and by students' emotions and attitudes (affective factors). Students who lived in an English-speaking environment and who had support from English speaking peers were less isolated and were therefore more likely to have the self-confidence necessary to engage in positive social interaction. Students who were successful displayed more motivated behaviours, such as preparing for class and being willing to consult when they did not understand, thereby improving their academic interaction opportunities.

Intrapersonal interaction took place through students' ability to make sense of written input. Students' cognitive processing abilities are reliant on their level of background knowledge. Students' willingness to improve their knowledge by taking time to understand what they were reading, persisting even when they found material difficult, and obtaining assistance when necessary, appeared to have better comprehension of written input.

2.6 CONCLUSION AND RECOMMENDATIONS

The purpose of this research was to consider the impact of social dimensions of language on the learning of introductory accounting in English as an additional language. First-year

EAL accounting students' listening and reading (input) and speaking and writing (output) experiences were examined, and the impact of these on their academic outcomes.

Using thematic analysis the individual students' descriptions of their experiences could be preserved (Smith and Firth, 2011), while exploring connections within the data. The themes that emerged indicated that students' ability to interact with their study material, and their exposure to positive verbal interaction opportunities in both formal and informal contexts, may have contributed to their academic success.

Through linking the findings of this empirical research to Interactionist aspects of Second Language Acquisition theory, a more rigorous linguistic foundation is proposed for incorporating language skills into the accounting curriculum and learning material. This research suggests that students with EAL may be assisted in the study of accounting by:

- Educators taking cognisance of the communication anxieties of students with EAL and structuring the interactions during lectures, tutorials and consulting to provide a comfortable environment for students to engage.
- Ensuring that students learning materials are accessible and comprehensible, particularly at the introductory accounting level. Accounting educators can assist students in improving their reading behaviours by paying attention to the type, format and level of learning materials they provide and prescribe to their students.
- Investigating and implementing techniques such as previewing the chapter, developing focus questions, mapping, learning Cloze[5] terms, talking-the-chapter and thinking meta-cognitively (Pritchard *et al.*, 1999), which could also help to improve students reading abilities and comprehension.
- Allowing students to collaborate on academic tasks that require extensive language use in groups specifically configured to include both English first-language speakers and students with EAL, would give the latter group of students the opportunity to access meaningful input and to produce output (Lucas and Villegas, 2011). 'Collective scaffolding', where students work together on a task, has been shown to produce results that students would not have been able to produce individually.

[5] Cloze exercises help students acquire relevant terminology, by requiring them to find the most applicable term(s) to complete one or more sentences with missing words. The intention is that students must read for meaning and synthesize their knowledge (Pritchard *et al*., 1999).

- Providing tutorials or consulting opportunities to students with EAL in their home language(s), and glossaries of terms and definitions translated into their home language(s). Successful senior students with EAL could be gainfully employed as tutors and mentors for entry-level students. Research has shown that the use of code-switching between an individual's home language and English is important in allowing students to explore the meaning of concepts, and allows their learning to be scaffolded to broaden their understanding (Paxton, 2007; Setati, Adler, Reed and Bapoo, 2002). Restricting students to using English when discussing concepts amongst each other deprives them from using all their resources to make meaning. It may also encourage students to conceal their misconceptions by using rote learning to memorise technical English terminology (Paxton, 2007).

2.7 LIMITATIONS OF THE STUDY AND DIRECTIONS FOR FUTURE RESEARCH

The findings of this study are grounded in the language and learning experiences of 14 students at one higher education institution in South Africa. It is possible that a larger sample of students across different institutions may have provided additional and different insights into the language and learning experiences of students with EAL. This study also only focused on first-year students. It is expected that students with EAL may carry their language-related challenges with them into senior years of study. No attempt was made to examine all the many other varied reasons for the academic success, or failure of students with EAL.

The findings of this study indicate that inter-disciplinary research is needed to determine the most effective pedagogical strategies to employ in the accounting and academic literacy classroom to incorporate Second Language Acquisition theories.

2.8 REFERENCES

Bangeni, B. and Kapp, R. (2007), "Shifting Language Attitudes in Linguistically Diverse Learning Environment in South Africa", *Journal of Multilingual and Multicultural Development*, Vol. 28 No. 4, pp. 253–269.

Berman, R. and Cheng, L. (2001), "English academic language skills: perceived difficulties by undergraduate and graduate students, and their academic achievement", *Canadian Journal of Applied Linguistics / Revue canadienne de linguistique appliquée*, Vol. 4 No. 1, pp. 25–40.

Becker, A. (2016), "L2 students' performance on listening comprehension items targeting local and global information", *Journal of English for Academic Purposes*, Elsevier Ltd, Vol. 24, pp. 1–13.

Bhattacharyya, A. (2012), "Enhancing Accounting Learning of the International Students: Strategies and their Effectiveness", *The International Journal of Learning*, Vol. 15 No. 3, pp. 261–277.

Boyce, G., Greer, S., Blair, B. and Davids, C. (2012), "Expanding the Horizons of Accounting Education: Incorporating Social and Critical Perspectives", *Accounting Education: An International Journal*, Vol. 21 No. 1, pp. 47–74.

Byrne, M., Flood, B. and Shanahan, D. (2012), "A Qualitative Exploration of Oral Communication Apprehension", *Accounting Education: An International Journal*, Vol. 21 No. 6, pp. 565–581.

Carstens, A. (2013), "Collaboration : The key to integration of language and content in academic literacy interventions", *Journal for Language Teaching*, Vol. 47 No. 2, pp. 109–126.

Coetzee, S.A., Schmulian, A. and Kotze, L. (2014), "Communication Apprehension of South African Accounting Students: The Effect of Culture and Language", *Issues in Accounting Education*, Vol. 29 No. 4, pp. 505–525.

Council on Higher Education. (2018), *Vital Stats: Public Higher Education 2016*, Council on Higher Education, Pretoria, available at: http://www.che.ac.za/sites/default/files/ publications/CHE_VitalStats_2016 webversion_0.pdf.

Cummins, J. (2008), "BICS and CALP: Empirical and Theoretical status of the Distinction", *Encyclopedia of Language and Education, 2nd Edition, Volume 2: Literacy*, New York: Springer Science + Business Media LLC.

Department of Basic Education. (2012), *2012 National Senior Certificate Examination Technical Report*, Pretoria, available at: http://www.education.gov.za/Portals/0/ Documents/Reports/TECHNICAL REPORT LQ 11-01-2013 - 12h25.pdf?ver=2013-03-12-225642-000.

Ellis, R. (2012), *The Study of Second Language Acquisition*, 2nd ed., Oxford University Press.

Ellis, R. and Fotos, S. (1999), *Learning a Second Language Through Interaction*, John Benjamins Publishing Co., Amsterdam/Philadelphia.

Emig, J. (1977), "Writing as a Mode of Learning", *College Composition and Communication*, Vol. 28 No. 2, pp. 122–128.

Fereday, J. and Muir-Cochrane, E. (2006), "Demonstrating Rigor Using Thematic Analysis: A Hybrid Approach of Inductive and Deductive Coding and Theme Development", *International Journal of Qualitative Methods*, Vol. 5 No. 1, pp. 80–92.

Gass, S.M. and Mackey, A. (2007), "Input, Interaction and Output in Second Language Acquisition", in VanPatten, B. and Williams, J. (Eds.), *Theories in Second Language Acquisition: An Introduction*, Lawrence Erlbaum Associates, Inc., Mahwah, New Jersey, USA, pp. 175–200.

Guest, G. (2006), "How Many Interviews Are Enough?: An Experiment with Data Saturation and Variability", *Field Methods*, Vol. 18 No. 1, pp. 59–82.

Jackling, B. (2005), "Perceptions of the learning context and learning approaches: Implications for quality learning outcomes in accounting", *Accounting Education: An International Journal*, Vol. 14 No. 3, pp. 271–291.

Janse van Rensburg, C., Coetzee, S.A. and Schmulian, A. (2014), "South African financial reporting students' reading comprehension of the IASB Conceptual Framework", *Journal of Accounting Education*, Vol. 32 No. 4, pp. 1–15.

Koch, E. and Kriel, M. (2005), "An argument for integrating language or language related skills in the accounting curriculum", *South African Journal of Higher Education*, Vol. 19 No. 3, pp. 218–229.

Krashen, S. (1985), “The Input Hypothesis”, *The Input Hypothesis. Issues and Implications*, Longman Group UK Ltd., London, pp. 77–109.

Lucas, T., and Villegas, M. (2011). A Framework for Preparing Linguistically Responsive Teachers. In T. Lucas (Ed.), *Teacher Preparation for Linguistically Diverse Classrooms* (pp. 55–72). New York: Routledge.

Lynch, T. (2011), “Academic listening in the 21st century: Reviewing a decade of research”, *Journal of English for Academic Purposes*, Elsevier Ltd, Vol. 10 No. 2, pp. 79–88.

Mackey, A., Abbuhl, R. and Gass, S.M. (2014), “Interactionist approach”, in Gass, S.M. and Mackey, A. (Eds.), *The Routledge Handbook of Second Language Acquisition*, Routledge, London and New York, pp. 7–23.

Nassaji, H. (2007), “Schema Theory and Knowledge-Based Processes in Second Language Reading Comprehension: A Need for Alternative Perspectives”, *Language Learning*, Vol. 57 No. Suppl. 1, pp. 79–113.

Paxton, M. (2009), "'It's easy to learn when you using your home language but with English you need to start learning language before you get to the concept': bilingual concept development in an English medium university in South Africa", Journal of Multilingual and Multicultural Development, Vol. 30 No. 4, pp. 345-359.

Phillips, B.J. and Phillips, F. (2007), “Sink or Skim : Textbook Reading Behaviors of Introductory Accounting Students”, *Issues in Accounting Education*, Vol. 22 No. 1, pp. 21–44.

Pretorius, E.J. and Mampuru, D.M. (2007), “Playing football without a ball: Language, reading and academic performance in a high-poverty school”, *Journal of Research in Reading*, Vol. 30 No. 1, pp. 38–58.

Pritchard, R.E., Romeo, G.C. and Muller, S.A.B. (1999), “Integrating reading strategies into the accounting curriculum”, *College Student Journal*, Vol. 33 No. 1, p. 77.

Riley, T.J. and Simons, K.A. (2013), “Writing in the Accounting Curriculum: A Review of the Literature with Conclusions for Implementation and Future Research”, *Issues in Accounting Education*, Vol. 28 No. 4, pp. 823–871.

Sartorius, K. and Sartorius, B. (2013), “The comparative performance of chartered accountancy students in South Africa: The impact of historical legacies”, *Development Southern Africa*, Vol. 30 No. 3, pp. 401–416.

Setati, M., Adler, J., Reed, Y. and Bapoo, A. (2002) "Incomplete Journeys: Code-switching and Other Language Practices in Mathematics, Science and English Language classrooms in South Africa", *Language and Education*, Vol. 16 No. 2, pp. 128-149.

Simons, K.A. and Riley, T.J. (2014), “Communication Apprehension in Accounting Majors: Synthesis of Relevant Studies, Intervention Techniques, and Directions for Future Research”, *Advances in Accounting Education: Teaching and Curriculum Innovations*, Emerald Group Publishing Limited, Vol. 15, pp. 1–32.

Smith, J. and Firth, J. (2011), “Qualitative data analysis: the framework approach”, *Nurse Researcher*, Vol. 18 No. 2, pp. 52–62.

Stone, G., Lightbody, M. and Whait, R. (2013), “Developing Accounting Students’ Listening Skills: Barriers, Opportunities and an Integrated Stakeholder Approach”, *Accounting Education: An International Journal*, Vol. 22 No. 2, pp. 168–192.

Tarone, E. (2009), “A Sociolinguistic Perspective on Interaction in SLA”, in Mackey, A. and Polio, C. (Eds.), *Multiple Perspectives on Interaction in SLA*, Routledge, New York, pp. 41–56.

Thomas, E. and Maglivy, J. (2011), "Qualitative Rigor or Research Validity in Qualitative Research", *Journal for Specialists in Pediatric Nursing*, Vol. 16 No. 2, pp. 151-155.

Turner, D.W. (2010), “Qualitative Interview Design : A Practical Guide for Novice Investigators”, *The Qualitative Report*, Vol. 15 No. 3, pp. 754–760.

University of Pretoria. (2015), “University of Pretoria Statistics at a Glance 2014”, available at: http://www.up.ac.za/media/shared/371/ZP_Files/dipbook_2015.zp43519.pdf

van Patten, B. (2007), “Input Processing in Adult Second Language Acquisition”, in van Patten, B. and Williams, J. (Eds.), *Theories in Second Language Acquisition: An Introduction*, Lawrence Erlbaum Associates, Inc., Mahwah, New Jersey, USA, pp. 115–135.

Watty, K., Jackson, M. and Yu, X. (2010), "Students' Approaches to Assessment in Accounting Education: The Unique Student Perspective", *Accounting Education: An International Journal*, Vol. 19 No. 3, pp. 219–234.

Webster, N.L.E.E. and Lu, C. (2012), "'English Language Learners': An Analysis of Perplexing ESL-Related Terminology", *Language and Literacy*, Vol. 14 No. 3, pp. 83–94.

Wong, G., Cooper, B.J. and Dellaportas, S. (2015), "Chinese Students' Perceptions of the Teaching in an Australian Accounting Programme – An Exploratory Study", *Accounting Education: An International Journal*, Vol. 24 No. 4, pp. 318–340.

CHAPTER 3
THE IMPACT OF FORMULAS AND LANGUAGE ON STUDENTS' TRANSFER OF LEARNING ON COST-VOLUME-PROFIT PROBLEMS

3.1 INTRODUCTION

Most accounting educators will agree that we do not want students to merely learn accounting, we want them to 'learn how to think'. Learning to think implies that students are able to transfer the knowledge and skills they acquire while studying accounting to solve new problems they have not encountered before (Koedinger and Roll, 2012). The question is: how do we teach students to think? Do our current teaching methods facilitate students' ability to transfer their learning?

For example, in a topic such as cost-volume-profit (CVP) analysis, the learning objective is that students must understand how the cost structure, volume of output and profits of a business are interconnected. Using Bloom's revised taxonomy, the knowledge dimension of this outcome is 'conceptual' and the cognitive process level is 'analyse' (Krathwohl, 2002). Of even more consequence is that students are able to use (transfer) their CVP analysis knowledge to solve real-life problems about pricing, break-even sales, target profits and margins of safety. To achieve this outcome, students are expected to have 'procedural knowledge' and to operate at the cognitive process level of 'evaluation' (Krathwohl, 2002). Typical teaching practices to realise both of these objectives is to use technical terminology, such as 'variable costs' and 'contribution margin', and to provide students with formulas. This study investigates the impact of using technical terminology and formulas on introductory accounting students' performance.

The language of accounting is challenging, even for proficient speakers of English. When introducing accounting concepts such as CVP analysis, using only technical vocabulary, without making sure that students understand these concepts, and first explaining them in everyday English, may result in many students reverting to rote-learning, and also to incomplete and/or incorrect understanding of concepts. On the other hand, if students are only exposed to accounting concepts in everyday language, their understanding may be technically incorrect, as everyday expressions cannot necessarily capture the precise meaning of technical accounting terms. These language challenges need to be taken into account in the accounting classroom. Instructional techniques that use language to construct meaning can play a major role in giving students access to accounting knowledge, in particular in making it comprehensible to students with EAL.

There is obviously still much to be done in dealing with the linguistic challenges of accounting in order for students to be able to construct knowledge about accounting concepts in ways that can enhance their learning. This study is in response to this issue, and replicates and extends the work of Johnson and Sargent (2014), who tested the effect of providing technical versus everyday language on student performance on CVP problems. They found that everyday language improved student performance. This study focuses on the effect of everyday language on the learning outcomes and cognitive load of students with English as a first language as well as those with EAL.

Johnson and Sargent (2014) also found that providing formulas helped students complete formula-facilitated questions but appeared to hamper their performance on application questions (for which formulas were not useful). Due to insufficient usable application questions, the authors acknowledged that the effect of formulas on these questions needed further scrutiny. In order to test whether the provision of formulas at an introductory stage in learning CVP is beneficial or not, the application problems in the original research instrument were adapted for this study.

Different from Johnson and Sargent (2014), the effect of formulas and language on students' ability to transfer knowledge gained from the formula-facilitated questions to the application questions was tested. For this purpose, the change between students' scores on formula-facilitated and application questions was measured. This measure of transfer performance is unique, as in prior research students' scores on only application type questions have been used to test for transfer (DeLeeuw and Mayer, 2008; Paas and van Merriënboer, 1994; van Merriënboer, de Croock and Jelsma, 1997).

In the Johnson and Sargent (2014) study, students with no previous CVP instruction were capable of understanding basic CVP questions framed in everyday language, and of using formulas correctly in formula-facilitated questions. Therefore, to ensure the homogeneity of the participants in this experiment, only students who had not studied the CVP topic before, were recruited. As South African students have a diversity of language backgrounds this study provides a more sensitive measure of the treatment effect by including covariates for the influence of students' school-leaving and first-year results as well as their English language background on their performance.

This work extends the discussion of cognitive load theory (CLT) which Johnson and Sargent (2014) referred to when discussing the expected impact of technical terminology on students' cognitive learning processes. However, they did not use CLT to explain the impact of formulas. CLT seeks to explain why students may struggle when studying intellectually complex tasks for the first time (Sweller, 1988). In this study, the principles of CLT are used to explain how the high levels of interactivity between elements in a CVP question affect intrinsic, extraneous and germane cognitive load. The cognitive load effects of both formulas and language on students' performance are used to explain the results.

The results of this experiment indicate that using everyday rather than accounting language may improve students learning outcomes when they are introduced to CVP analysis. Students with EAL appeared to benefit more than English home language students. Providing students with formulas in everyday language appeared to limit their ability to transfer their knowledge gained from the formula-facilitated questions to the application questions. As technical terminology in CVP analysis must be understood as students' progress in their studies, further work is required in order to determine how to develop academic accounting literacy through the use of language that moves from an everyday to a technical register. Similarly, the use of formulas should be limited at the initial stages of learning, as when students are grappling with new concepts, formulas may serve as a deterrent to their assimilation of the concepts and interrelationships between them. The suggestion is that formulas are introduced at a more advanced stage of students' learning. While the results of this study will assist accounting educators who develop the materials for and teach CVP analysis at an introductory level, the development of instructional practices for other introductory accounting topics will also benefit.

The rest of the chapter proceeds as follows: First an explanation of CLT and the development of the hypotheses are provided. The next section discusses the research methodology. This is followed by the results and data analysis. The conclusion includes a summary of the implications and limitations of the study, and highlights possible directions for future research.

3.2 COGNITIVE LOAD THEORY

CLT aims to develop teaching and learning methods that efficiently utilise students' limited cognitive processing capacity, so that they can apply acquired knowledge and skills to new situations (i.e. transfer) (Paas, Tuovinen, Tabbers and van Gerven, 2003, p. 63). CLT argues that the working memory capacity and prior knowledge (schema) contained in the long-term memory of students affects their learning processes (Sweller, 1994). For example, when studying CVP for the first time, students limited prior knowledge regarding cost behaviours, and their relation to the sales levels and profits of a business restricts their working memory capacity (Johnson and Sargent, 2014). When a learning task requires more capacity than working memory has available, it hampers students' learning (Sweller, 1988).

CLT refers to three types of cognitive load. The first two, intrinsic and extraneous load, together determine the total cognitive load imposed by a learning task (Kalyuga, 2011; Leppink and van den Heuvel, 2015). Intrinsic load is the effort related to achieving the task's learning objectives. To minimise intrinsic load, learners' prior knowledge should serve as a basis for teaching new knowledge (Leppink, Paas, van der Vleuten, van Gog and van Merriënboer, 2013). On the other hand, activities not necessary for learning impose an extraneous cognitive load on working memory. The third element, germane load, refers to the working memory resources applied to manage the intrinsic cognitive load of the topic (Sweller, 2010a). The level of germane load expended is determined by the extent to which the student has dealt with the intrinsic cognitive load of the learning task (Kalyuga, 2011; Leppink, 2017; Sweller, 2010b). If students are successful in a learning task, then all the intrinsic load of the task has been dealt with, and germane load and intrinsic load are equal. However, if students are completely unsuccessful in achieving a learning outcome, then their germane load represents zero percent of the intrinsic load of the task (Leppink, 2017).

The goal of CLT is that teaching practices should balance the mental effort (germane load) required to cope with the intrinsic load of a topic by reducing the extraneous cognitive load as far as possible (Sweller, 2010a). When learners' intrinsic load is optimal and extraneous load is low, their unused working memory capacity can engage in cognitive processing that enforces germane load relevant to the creation and automation of schemata (Leppink *et al.*, 2013; Paas *et al.*, 2003).

The inherent complexity of a specific topic imposes the intrinsic cognitive processing required of a student for comprehension (Sweller, 1994). Besides students' prior knowledge, this intrinsic load depends on the number of interacting elements that must be considered together (Sweller and Chandler, 1994). The CVP topic has a high intrinsic cognitive load, as it requires students to understand the essential CVP elements and to simultaneously construct connections between them.

The example provided in Exhibit 1 explains the cognitive load effects of a typical CVP problem. Requiring students to consider the interconnected selling price, variable cost and contribution margin elements simultaneously to solve this problem imposes a high intrinsic cognitive load on their working memory.

EXHIBIT 1

Cost-Volume-Profit Example

Assume students are given the selling price and variable cost of a product and must work out the new selling price if the variable cost increases, but the contribution margin percentage remains constant. The steps they could follow are:

1. Determine the current selling price per unit.
2. Determine the current variable cost per unit. The student needs to know that this is the cost required to buy or make a particular unit.
3. Calculate the current contribution margin per unit. The student needs to know that this is the difference between the selling price and variable cost per unit. Provision of a formula would facilitate this calculation.
4. Calculate the current contribution margin percentage. The student needs to know that they must divide the contribution margin per unit by the selling price per unit and multiply by 100. Providing a formula would also assist students here.
5. Determine the new variable cost per unit from the information provided.
6. Determine that the current contribution margin percentage must equal the new contribution margin divided by the new selling price per unit multiplied by 100.
7. Decide to make the new selling price equal to *x*.
8. Create formula to solve for *x*: Current contribution margin percentage = [(*x* – new variable cost per unit) / *x*] X 100
9. Solve for *x* to determine the new selling price.

In the example, if the student is not familiar with the terms 'variable cost' and 'contribution margin', the cognitive effort required to solve the problem increases. Whether knowledge of these terms is part of the intrinsic or extraneous load of the question depends on the learning objective (Kalyuga and Singh, 2016). Technical vocabulary increases the extraneous cognitive load if knowledge of the terminology is not essential to the learning objective. The cognitive effort required to solve the problem is increased, and students' limited working memory is taxed, as they grapple with the inherent difficulty of the material provided (Johnson and Sargent, 2014). Expressing these two terms in everyday language would decrease the extraneous load. In this case, the variable cost would become 'cost to make/buy per unit', and unit contribution margin would be 'for each taco sold how much profit is made?'. On the other hand, if the learning objective is that students must understand the technical terminology in order to solve CVP problems in the future, including the CVP terms increases the intrinsic load of the learning task and not the extraneous load.

The interactivity, and hence the intrinsic load of the above example, also increases as students need to calculate the contribution margin and contribution margin percentage to determine the new selling price per unit given an increase in the variable cost, but keeping the contribution margin percentage constant. The provision of formulas for how to calculate the contribution margin and the contribution margin percentage could assist students in mentally organising the material, relating it to their prior knowledge and solving the problem, thereby improving their germane load (DeLeeuw and Mayer, 2008). If the formulas provided for the two contribution margin calculations allow students to understand how the various elements interact with each other, then they should be able to transfer this knowledge to work out the new selling price.

Alternatively, formula provision could increase students' extraneous load and reduce the working memory resources available to deal with the topic's intrinsic load. While providing students with formula may assist them in solving a particular problem, it does not mean that they have engaged in the deep cognitive processing required to develop and automate the relevant schemata in their long-term memory to apply the same knowledge and skills to new situations (Paas *et al.*, 2003). In the example, students may calculate the contribution margin and the contribution margin percentage by plugging amounts into the formulas provided using only surface learning (Johnson and Sargent, 2014). In the final part of the question if students have not understood how the elements interact in the formulas they used previously and try to work out the new selling price, using the formulas could increase their extraneous cognitive load and inhibit their ability to solve the problem.

As discussed above, the learning objective of a task needs to be identified before the intrinsic and extraneous cognitive load can be identified. Educators need to decide what cognitive activity is required on the part of the student to successfully deal with the intrinsic load of the task. Students' level of background knowledge needs to be taken into account when determining the appropriate level of intrinsic cognitive load to attribute to a specific assignment. Any attribute of the learning task that is not essential to learning or that may hinder learning (i.e. extraneous load) should be minimised. While extraneous load must always be reduced, or where possible eliminated completely, intrinsic load does not have to be reduced for optimal learning to occur. The intrinsic load must however be managed (Kalyuga, 2011).

The learning outcome of this experiment was whether students were able to apply what they learnt in the formula-facilitated questions to the application questions, i.e. transfer of learning. A misconception of CLT is that lower overall cognitive load always optimises learning (Leppink and van den Heuvel, 2015). For complex learning tasks, such as the one used in this study, meaningful learning cannot occur without cognitive effort on the part of the student, and with related working memory load (Kalyuga, 2011). Based on this learning objective, what follows is a discussion of how the intrinsic and extraneous cognitive load were controlled in this experiment, to test for the optimum condition(s) for transfer of learning to occur.

Sequencing learning tasks from low to high element interactivity improves students' ability to deal with the intrinsic load (van Merriënboer, Kester and Paas, 2006). This approach enables students to apply the necessary cognitive (germane) processing to each part of the task by freeing up working memory capacity at the early stages of learning, which enables the student to make the necessary connections from the lower-interactive material and to transfer this knowledge correctly to higher-interactive material (van Merriënboer *et al.*, 2006). In this study, the number of interacting elements in the formula-facilitated questions are lower than for the application questions. Studies indicate that the transfer performance of learners with low expertise improves with this part-whole approach, particularly when the material includes highly interactive elements (van Merriënboer *et al.*, 2006).

As knowledge of the technical vocabulary was not part of the required learning outcome for this task, accounting language was extraneous to the learning process required of the students. The other potential source of extraneous load was the provision of formulas. Implementing an intrinsic load reducing method, such as part-whole sequencing of learning tasks, should improve the germane load. Simultaneously, withholding formulas should also induce the productive germane load of students.

By identifying the constraining factors on students' mental processes, CLT enables educators to develop instructional practices that accommodate the intrinsic cognitive load of a topic such as CVP, and contribute towards improving students' ability to transfer their acquired knowledge and skills to different conditions (Paas *et al.*, 2003). For teaching to be effective, the extraneous cognitive load imposed by resources that are not necessary to the learning process, such as formulas and technical language, should be minimised. The reduction in extraneous load and the correct formulation of the intrinsic load required for the learning objective, should maximise the germane cognitive load of a student, by encouraging mental activities that are productive to learning. Providing students with the means to access their prior knowledge and to deal with the intrinsic cognitive load of the topic, without overloading working memory, reduces the mental effort required to construct updated schemata in long-term memory (Mostyn, 2012).

3.2.1 Measuring cognitive load

To support the central claim of CLT that the effectiveness of an instructional technique is influenced mainly by cognitive load, researchers have investigated ways of measuring cognitive load (Leppink *et al.*, 2013; Leppink, Paas, van Gog, van der Vleuten and van Merriënboer, 2014). While there is still no standardised method, empirical research has generated two accepted approaches for the measurement of cognitive load (Brünken, Seufert and Paas, 2010). The first method, which is the most common, is to ask students to rate their perceived cognitive load subjectively. The second method uses objective measures relating to learning outcomes, task complexity and behavioural data (Brünken *et al.*, 2010).

Subjective mental effort rating scales (Paas, van Merriënboer and Adam, 1994) have been used extensively to measure cognitive load. Based on the traditionally accepted formulation of cognitive load as three separate and additive types of load, researchers have attempted to establish separate measures for intrinsic, extraneous and germane load (DeLeeuw and Mayer, 2008; Leppink *et al.*, 2013, 2014). However, this has proved problematic.

In their 2013 study, Leppink *et al.* found evidence for the separable measurement of the three types of cognitive load. They used a multiple item psychometric instrument in their work. However, in follow-up experimental studies, Leppink *et al.* (2014) found no support for their previous measure of germane load (Leppink and van den Heuvel, 2015). The currently accepted CLT model advocates for only the two factors of intrinsic and extraneous load contributing to total cognitive load (Leppink, 2017). Germane load is measured in the proportion to which a student's learning process has dealt with the intrinsic load of the topic (Leppink, 2017; Sweller, 2010b).

In their 2014 work, Leppink *et al.* found evidence that asking participants questions about the complexity of an activity, including its formulas, concepts and definitions, is a measure of intrinsic cognitive load. They also demonstrated that asking questions about the clarity and effectiveness of the instructions and explanations received during an activity is a measure of extraneous cognitive load.

In the current study, two single-item effort ratings relating to students' perceptions of difficulty and clarity to measure intrinsic and extraneous load were used. Although single-item measures for cognitive load have not always proved reliable (Leppink, 2017), they were used in this study due to their accessibility. The results therefore do not offer definitive measures of intrinsic and extraneous cognitive load, but rather are perceived levels of cognitive load. These two measures were also used to enable comparison with the Johnson and Sargent (2014) study. However, Johnson and Sargent (2014) did not relate these two survey questions to measurements of cognitive load.

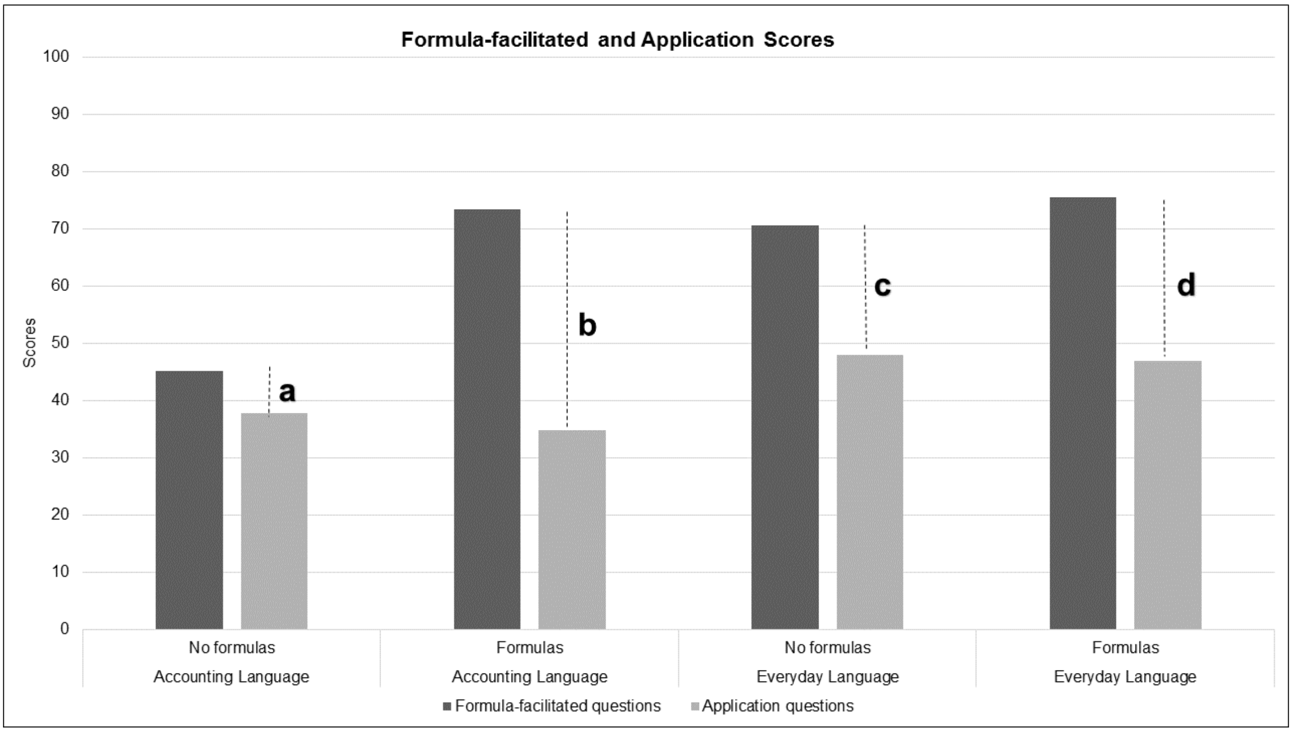
The hypotheses that follow were developed using the discussion above on CLT and the results of the Johnson and Sargent (2014) study.

3.3 HYPOTHESIS DEVELOPMENT

The results of the Johnson and Sargent (2014) study for uninstructed students are provided in Figure 3.1. The following should be noted:

- All scores decreased from the formula-facilitated to the application scores. The difference between the two scores represents the transfer score as lines (a), (b), (c) and (d).
- A comparison of line (a) to (b), and line (c) to (d) represents the formula effect. In both cases, the line becomes longer when formulas are provided.
- Comparing line (a) to (c), and line (b) to (d) represents the language effect. Without formulas, the decreased score for everyday language was bigger (c) than the decrease in accounting language scores (a). With formulas, the decrease in accounting language scores (b) was bigger than the decrease in everyday language scores (d).

Figure 3.1: Johnson and Sargent (2014) results: Formula-facilitated and application scores for the language and formula conditions for uninstructed students



Source: Adapted from Johnson and Sargent (2014)

3.3.1 Impact of language on student performance

In the Johnson and Sargent (2014) study, uninstructed students' total scores in both formula conditions were higher for everyday language compared to accounting language. This is because technical terminology increases the extraneous cognitive load on students' working memory, as it is not essential for students' understanding of the topic. Alternatively, providing students with problems in everyday language accommodates the intrinsic load of the topic without overloading working memory (Johnson and Sargent, 2014).

In the no formula condition, students given accounting language scored low marks on both the formula-facilitated and application scores (refer Figure 3.1 (a)). The small difference between the scores of the two types of questions indicates that the extent to which students were able to answer the formula-facilitated questions correctly, without any additional assistance in the form of everyday language or formulas, was similar to their ability to answer the application questions correctly. The difference between the formula-facilitated and application scores in the everyday language condition was bigger than for the accounting language condition (Figure 3.1 (c)). However, this does not mean that the effect of everyday language was negative, as both scores were better in the everyday language condition compared to the accounting language condition.

When students were provided with formulas, there was very little difference between the formula-facilitated scores for the two language conditions. However, students' application scores were higher when given everyday language instead of accounting language. The ability of students who were given everyday language to transfer their knowledge from the formula-facilitated to the application questions was better than for those given accounting language (refer Figure 3.1 (b) and (d)). Everyday language appears to have improved students' comprehension of the application problems.

Based on the results of the prior study, the hypotheses for the effect of language are as follows:

H1a: Everyday language will improve students' scores on formula-facilitated and application questions compared to accounting language, in both formula conditions.

H1b: When formulas are provided, everyday language will improve students' transfer scores more than for accounting language, i.e. everyday language will improve the transfer of learning when formulas are provided.

3.3.2 Impact of formulas on student performance

Johnson and Sargent (2014) split their research instrument into two parts, first assessing formula-facilitated CVP problems and then application problems, which could not be solved using formulas. They hypothesised that the provision of formulas would assist students to perform better when answering formula-facilitated questions but that providing formulas would not affect students' performance when answering application questions. The Johnson and Sargent (2014) study did not investigate the impact of providing formulas on students' ability to transfer their knowledge from formula-facilitated to application questions.

The assessment was set up with four business scenarios testing the CVP topics of contribution margin, break-even point, target profit and margin of safety analyses respectively (Johnson and Sargent, 2014). For each of the scenarios, students could answer the first one or more question(s), by using formulas, followed by one or two application question(s) that had no formulas. Students could apply what they learnt in the formula-facilitated questions to the application questions. In terms of CLT, it is this transfer of acquired knowledge to new situations that indicates whether learning has taken place or not (Paas *et al.*, 2003). To test whether formulas assisted students in transferring their knowledge, half of the students received formulas to use for the formula-facilitated questions, and half did not.

3.3.2.1 Formula-facilitated questions

The findings of Johnson and Sargent's (2014) study support formula provision when students can solve the problems by using formulas. They found that formulas benefited uninstructed students more than previously instructed students. Formulas may have improved the germane load of the students by providing them with a structured means to use information from the question, i.e. they were able to slot the information into the formula provided and solve the problem.

The provision of formulas to the uninstructed students in the Johnson and Sargent (2014) study assisted them more for questions phrased in accounting language compared to everyday language. As discussed previously, students with limited prior knowledge have insufficient working memory with which to process unknown technical concepts. Supplying students with CVP formulas, therefore, improves their germane cognitive load and working memory capacity by providing them with the required elements to complete a calculation, thereby increasing the chances that students will implement the formula correctly (Johnson and Sargent, 2014; Kirschner, Sweller and Clark, 2006). The effect of formula provision on the results of students given questions in everyday language was not as marked as for the accounting language condition. The reason could be that eliminating the unfamiliar technical terminology reduced the extraneous load of the problems and made the use of formula less necessary.

Based on these findings the hypothesis is as follows:

H2: Formula provision will result in a greater increase in students' performance on formula-facilitated questions when accounting language is provided than for students supplied with everyday language.

3.3.2.2 Application questions and transfer of learning

While Johnson and Sargent's (2014) results indicated that the provision of formulas might have reduced the performance of students on application questions, they were inconclusive. The authors attributed this to limitations in the questions. There were not enough application questions, two of the four questions were either too easy or too complicated, and what was required in one application question was the same as the formula-facilitated questions, i.e. the formula would have been of help in answering the question. In this study, the application problems in the research instrument were adapted by moderating the questions that were too difficult or too easy and changing the application question that was formula-facilitated. A further application question was also added.

The principles of CLT indicate that the conceptual demands of application questions, requiring students to consider the inter-connected CVP elements simultaneously impose a higher intrinsic cognitive load on their working memory. Formulas increase extraneous cognitive load as students need to hold segments of information in working memory while searching for the corresponding elements in the formula (Johnson and Sargent, 2014). Students may also try to use the formulas provided to answer the application questions without thinking logically about how to solve the problem. Together the intrinsic and extraneous cognitive loads result in total cognitive load exceeding the students' working memory capacity, thereby interfering with their learning.

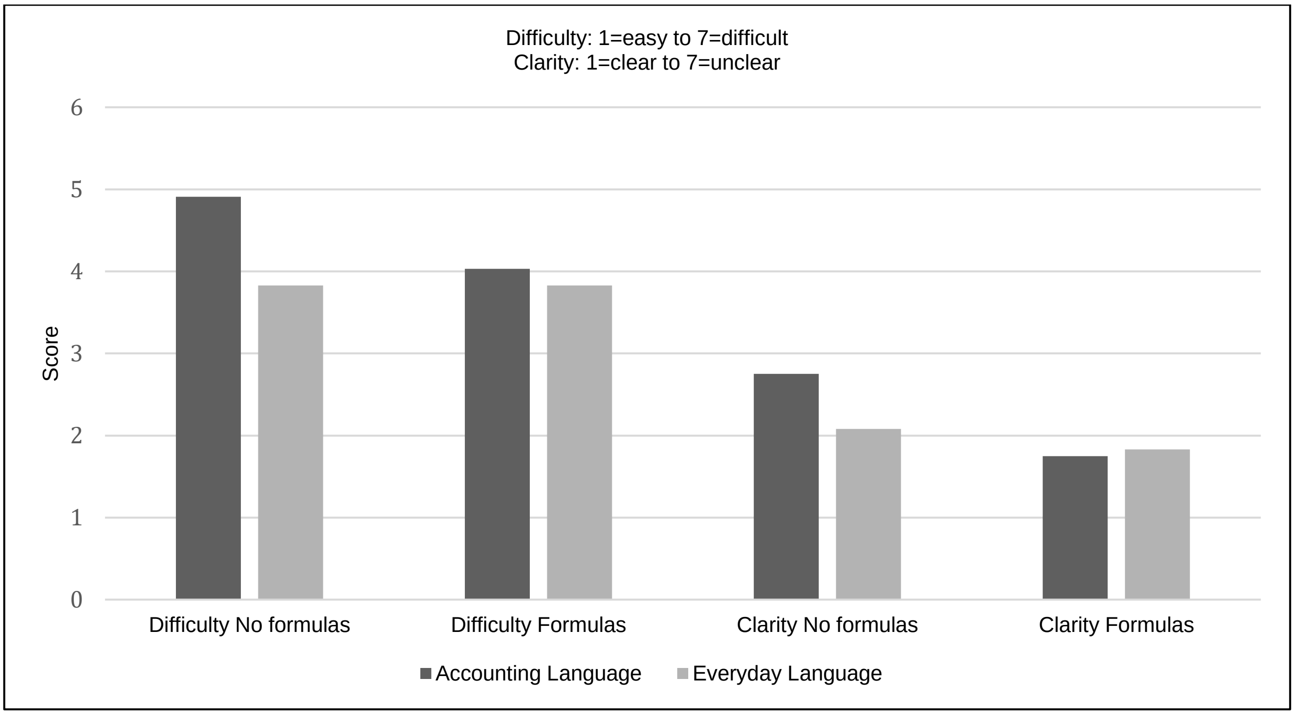
To determine whether formula provision assisted learners in transferring the knowledge gained from the formula-facilitated questions to the application question(s), the formula-facilitated and application question results of students were compared with each other. If formula provision hampers student performance on application questions, the hypothesis is as follows:

H3: Without formulas provided, students transfer scores will be better than when formulas are provided, for both language conditions, i.e. formulas will hamper the transfer of learning.

3.3.3 Impact of language and formulas on cognitive load

Johnson and Sargent (2014) did not make any hypothesis about the survey questions they asked students relating to students' perceived difficulty (intrinsic load) and clarity (extraneous load) levels. Focusing only on the results of the uninstructed students in the Johnson and Sargent (2014) study, Figure 3.2 illustrates how uninstructed students' perceived difficulty and clarity levels changed on the basis of the experimental conditions.

Figure 3.2: Johnson and Sargent (2014) results: Perceived difficulty and clarity scores for the language and formula conditions for uninstructed students



Source: Adapted from Johnson and Sargent (2014)

The order of the clarity measure used by Johnson and Sargent (2014) was changed to start with the clear score (1) and end with unclear (7). This was to make it comparable to the measure of difficulty which started with easy (1) and ended with difficult (7).

Prior research has used a measurement of difficulty as an indication of the perceived intrinsic load experienced by a student, and a clarity measurement to capture perceived extraneous load (Leppink *et al.*, 2014). In this experiment, the goal of students would have been to do as well as possible on all questions without understanding that there were questions that were formula-facilitated and others that required the application of knowledge acquired from previous questions. The meaning of CVP terminology would have been necessary to them only in as far as it assisted them in getting as many questions as possible correct. As there were more formula-facilitated questions, students provided with formulas would have found the test easier than those without formulas. Accounting language would have been extraneous to their learning process, especially when not accompanied by formulas. Using the results of the Johnson and Sargent (2014) study, the hypotheses therefore are as follows:

H4a: Students with accounting language and no formulas will rate the test as more difficult (higher intrinsic load) than those given everyday language and/or formulas.

H4b: Students with accounting language and no formulas will rate the test as less clear (higher extraneous load) than those given everyday language and/or formulas.

Students' language backgrounds were controlled for in this experiment. English home language students and those who took English at the first-language level in Grade 12 were expected to experience a lower intrinsic cognitive load when answering the questions. Their prior English knowledge and more advanced English language schemata were expected to reduce the intrinsic load they faced as a result of the new CVP terms and concepts and the element interactivity of the problems (Leppink *et al.*, 2013). However, due to the small numbers of English additional language (EAL) students in each group, a hypothesis could not be formulated regarding the expected performance or cognitive load of students from different language backgrounds.

3.4 RESEARCH METHODOLOGY

A 2 x 2 between-subjects design was used to examine the effect of formula provision and language use (accounting versus everyday language) and their interaction on student results and ability to transfer their learning. Transfer performance is the effect that student performance on formula-facilitated questions had on their performance on the subsequent application type questions.

3.4.1 Determination of sample size

The effect size from the Johnson and Sargent (2014) study on total scores between the four groups of uninstructed students was higher than 0.4, indicating a large effect in terms of Cohen's f-test guidelines (Cohen, 1988, p. 285-287). To calculate the required sample size, an *a priori* statistical power analysis was conducted using G*Power (version 3.1.9.2) (Faul, Erdfelder, Lang and Buchner, 2007). A sample size of 112 students was required to detect a large effect size (f>0.4) with an alpha of .05 and power of 95% using an ANCOVA with fixed effects, main effects and interactions. A target of 120 students was set initially, and 116 ended up participating in the experiment.

3.4.2 Participants

The participants were 116 second-year accounting students from a large residential South African university, who were randomly allocated to the four treatment groups. There were 29 students in each group. All of the students had passed a full year introductory financial accounting course and a six-month module in basic management accounting in the previous year. The experiment was conducted during the first three weeks of their second academic year. The students had already learnt costing concepts in their first year, but the second-year syllabus only covered CVP analysis later on; therefore, they had not yet received specific instruction regarding this topic at the time of the experiment.

The sample came from a population of 213 second-year B.Com (Accounting Sciences) students registered in 2017 to study in English. To ensure the homogeneity of the population, only students who completed their schooling in 2015 were included. Students who attended Afrikaans lectures were excluded as they were studying in their home language. Students attending the English lectures included both students with English as their home language and those with EAL. The students in this study would have been among the top school-leavers in South Africa in 2015. The South African Institute of Chartered

Accountants (SAICA) accredits the B.Com (Accounting Sciences) degree as part of the educational requirement allowing students' entry to Part 1 of the qualifying examination to become a chartered accountant. SAICA accredits only 15 universities in South Africa. The entry requirements for the degree at this university are in most cases above those of other accredited universities. Students registering for the first time in 2016 needed to have obtained a minimum Admission Point Score (an average grade measure) of 34 out of a maximum of 42; 60% for English, either at home or first additional language level; and 70% for mathematics in their school leaving examinations. In 2015 only 6.6% of the 263 903 students writing the National Senior Certificate (NSC) mathematics examination achieved more than 70% (Department of Basic Education, 2015). Accounting at school is not a pre-requisite for this degree.

To investigate the effect of the experimental conditions on participants with different language backgrounds, the population of students was divided into language blocks, based on whether they spoke English as their primary (home) language or not, as well as whether they studied English at the home or first additional language level in their school-leaving examinations. Participants from the various language background blocks were spread proportionally through the four experimental groups using random allocation.

3.4.3 Ethical considerations

Before inviting students in the population to participate, the necessary ethical clearance was obtained from the Faculty Ethics Committee (refer Appendix C). Students were told that participation was voluntary and that the results of the experiment would not form any part of their assessment for the year and would remain confidential. All participants in the experiment completed and signed an informed consent letter before testing commenced (refer Appendix D).

As participation was voluntary, students could not be given extra credit points, as Johnson and Sargent (2014) had done. Instead, based on the practice in prior experiments conducted by Hwang, Lui and Tong (2005, 2008), students were given a monetary reward to remain focused during the assessment and deliver their best effort. Students were paid based on the result of the test, receiving R5 for each question answered correctly, with a maximum of R70 being available per student. A question answered incorrectly was awarded R2.50. For example, if a participant attempted to answer all 14 questions but incorrectly answered four of them, then he/she received R60 ([10 x R5] + [4 x R2.50] = R60). This amount is comparable to the hourly rate that student assistants working at the university earned.

3.4.4 Procedure

The participants had forty minutes to complete the 14 CVP questions in the test. All the students managed to finish within this time limit. Students were required to complete the assessment in pen directly on the research instrument provided. They could use calculators. Students wrote under examination conditions and had no access to outside resources. They wrote in venues they were familiar with for writing tests and examinations, invigilated by the researcher. Students received no information before the time regarding the topic of the assessment. This was to prevent them from preparing for the experiment, which would have confounded the results. The testing took place in two group sessions that were two weeks apart. This was an inevitable consequence of trying to find a date and time that suited all the participants outside of their regular work schedule. All assessments were taken in at the end of each session to control for any possible information leakage that may have favoured the results of the second group. Students in the second session all signed a disclaimer to say they had received no prior information about the content of the assessment before writing. A comparison of the results of the two groups was conducted, and no significant differences were found between them.

Half of the students in each of the four groups received the questions in the opposite order to account for any possible learning effect during the test.

3.4.5 Research Instrument

The research instrument used by Johnson and Sargent (2014) was adapted and extended. The nine formula-facilitated questions did not change. Three of the original four application questions were adapted, and an application question was added. Twelve questions require calculated answers, and two are multiple-choice questions. The different amounts in the four versions of the previous study's instrument were made identical in each of the versions to avoid confounding the results. The conceptual content of the information in the questions and what was required for students to do, was similar in both language versions. As Johnson and Sargent (2014) had done, the CVP-specific terms were replaced with the everyday equivalent definition. For example, the term 'variable cost' became 'cost to make/buy per unit', and 'unit contribution margin' became 'for each taco sold how much profit is made?'.

Table 3.2 portrays the accounting language version of the questions and formulas. (Refer Appendix E for the everyday language version and solutions.)

The assessment consists of four business situations, relating to the CVP topics of contribution margin, break-even, target profit and margin of safety (Johnson and Sargent, 2014). After providing information regarding each business situation, the formula-facilitated question(s) and then the application question(s) follow. The formula-facilitated questions can be completed using conventional CVP formulas (where provided). The application questions, however, cannot be solved directly using formulas, as the student needs to perform an analysis by breaking the information down into constituent parts, i.e. volumes, sales, variable/fixed costs and profits, and detecting how these elements relate to one another and the overall business purpose.

As stated by Johnson and Sargent (2014, p. 35) in their study: "the inventory of application questions useful to study any formula effect was too small". They found that the application question about contribution margin was too complicated, and the break-even application question, was too easy. These questions were therefore moderated. As their margin of safety application question repeated what was required in a formula-facilitated question, this problem was also adapted. The one remaining application question about target profit was left unchanged and a further application question about target profit was added. It is acknowledged that these changes may impact on the comparability of these results to the previous study. This is discussed further in Section 3.15.3.

Students in the two formula experimental groups received a numbered list of typical CVP formulas either in accounting or everyday language, matching the language in the research instrument. Refer to Table 3.2 for the accounting language formulas. (See Appendix F for formulas in everyday language.) To achieve maximum formula use in the formula-facilitated questions, these two groups of students received explicit instructions to use the formula reference page (cheat sheet) and to provide the formula number they used for each question. The application questions did not require students to offer formula numbers.

Students had to give feedback on the clarity and difficulty of the assessment, once they had completed it, using a seven-point Likert scale. The scales were symmetrical with a neutral midpoint (i.e. '1=very clear, 7=very unclear'; and '1=extremely easy, 7=extremely difficult').

After making the adjustments to the questions and before conducting the experiment, eight academic staff members completed the test and survey questions. Because of this process, minor changes were made to the problems. The reviewers rated the clarity of the test at 1.5 (clear to very clear), and the difficulty at 3.25 (moderately easy).

3.4.6 Measures

A list of the variables used in this experiment are provided in Table 3.1. Students' answers to the assessment questions were marked as either correct or incorrect. The differences between students' formula-facilitated and application scores for each of the five transfer score cases were calculated as per Table 3.2.

Table 3.1 Variable names and descriptions

Variable Name	Type	Description
Dependent variables		
Test results		
% Total Correct	Continuous	% correct out of all 14 questions
% Formula Correct	Continuous	% correct out of 9 formula-facilitated questions
% Application Correct	Continuous	% correct out of 5 application questions
Transfer scores (Table 3.2)		
Contribution Margin (CM)	Ordinal	CM: Application Qu 4 – Formula-facilitated Qu 2
Break-even (BE)	Ordinal	BE: Application Qu 3 – Formula-facilitated Qu 2
Target Profit 1 (TP1)	Ordinal	TP1: Application Qu 2 – Formula-facilitated Qu 1
Target Profit 2 (TP2)	Ordinal	TP2: Application Qu 3 – Formula-facilitated Qu 1
Margin of Safety (MS)	Ordinal	MS: Application Qu 4 – Formula-facilitated Qu 1
Cognitive load measures		
Difficulty (intrinsic load)	Ordinal	1 = extremely easy, 7 = extremely difficult
Clarity (extraneous load)	Ordinal	1 = very clear, 7 = very unclear
Monetary incentive	Ordinal	1 = no extent, 7 = very big extent
Independent variables		
LanguageGroup	Categorical	Accounting language (AL) or Everyday language (EL)
FormulaGroup	Categorical	With formulas (WF) or No formulas (NF)
Control variables		
Gr 12 Maths result	Continuous	Grade 12 Mathematics result
Gr 12 English result	Continuous	Grade 12 English result
Gr 12 Acc result	Continuous	Grade 12 Accounting result
Gr 12 APS	Continuous	Grade 12 Admission Point Score
Gr 12 English HL	Categorical	Grade 12 English first language or first additional language level
English primary language	Categorical	English or Other home language

Table 3.2 provides an analysis of how the formula-facilitated questions for each of the four business scenarios used in the assessment, i.e. contribution margin, break-even, target profit and margin of safety, linked to the application question. For example, the contribution margin question (2) asking students to calculate the contribution margin ratio, should have assisted them in the answering the application question (4). Some of the formula-facilitated questions did not have a direct link to the application question(s), and were excluded from

this analysis. For example, contribution margin question (1) which asked for the unit contribution margin and question (3) which asked for the total contribution margin for selling additional units, did not link to the application question.

The measurement of transfer performance was based on the following logic:

Students who answered both the formula-facilitated and application questions incorrectly were given a score of -1. Those who answered the formula-facilitated questions correctly, but got the application question(s) wrong, had an opportunity to transfer their knowledge but did not do so. The score then allocated was 0. Students who correctly answered the application questions, but not the formula-facilitated questions, were allocated a score of 1. In this case, even though students' answers to the formula-facilitated questions did not match those of the solution, solving the formula-facilitated question first, and then using this as a basis to correctly answer the application question, indicates that they could transfer what they had learnt from the former to the latter. Finally, if students completed both the formula-facilitated and application questions correctly, then they were able to transfer what they had learnt from the former to the latter. These students were given a score of 2.

Students were asked to rate the level of difficulty (a measure of intrinsic load) and clarity (a measure of extraneous load) of the assessment on a scale of 1 to 7. They also had to indicate on the same scale to what extent the monetary incentive provided motivated them to remain focused during their completion of the assessment. The survey questions are provided in Appendix G.

As measures of their background knowledge the following data were collected for each student: the primary language they spoke at home; whether they studied English at home or first additional language level in their school-leaving examinations; their school-leaving results for English, mathematics and accounting; their Admission Point Score; and their results for the first-year financial and management accounting courses.

Table 3.2: Analysis of links between formula-facilitated and application questions
(accounting language version)

Question 1: Contribution Margin (Question 2 links to question 4)	
Taco Joe's owned and operated by Joe Cool, Jr., is a favourite of the local university students. Joe’s tacos are priced at R1.50 and the variable cost per taco is R1.20.	
1. What is Taco Joe's unit contribution margin?	Formula: Unit Contribution Margin = Selling price per unit – Variable cost per unit
2. What is Taco Joe's contribution margin ratio?	Formula: Contribution Margin Ratio = $\frac{\text{Unit Contribution Margin}}{\text{Selling price per unit}}$ X 100
3. What is Taco Joe’s total contribution margin for selling 200 additional units?	Formula: Total Contribution Margin = Unit Contribution Margin X Number of Units Sold
4. Application: If the variable cost per taco increased by R0.20 to R1.40 what should the new selling price per taco be if Joe wants to keep the same contribution margin ratio?	

Question 2: Break-even (Question 2 links to question 3)	
Top-loading Tyler's Video Emporium sells classic 1980's movies in the vintage VHS tape format. Tyler’s movies are priced at R20 and his variable cost per unit is R16. He pays R1 600 per month for rent on his store location. For simplicity let’s assume there are no other revenues or expenses.	
1. What is Tyler's breakeven point in product units?	Formula: Break-Even Units = $\frac{\text{Total Fixed Costs}}{\text{Unit Contribution Margin}}$
2. What is Tyler's break-even sales revenue?	Formula: Break-Even Sales = Break-Even Units X Selling price per unit
3. Application: Tyler moves into cheaper premises where the rent is only R1 300 per month. By how much will this change Tyler's breakeven sales revenue? Choose one option: A Decrease sales revenue by R300 B Decrease sales revenue by R1 500 C No change D I’m not sure	

Table 3.2 (continued): Analysis of links between formula-facilitated and application questions
(accounting language version)

Question 3: Target Profit 1 (Question 1 links to Question 2) and (Question 1 links to Question 3)	
April Lou Harvey is the founder of April Showers' Flowers, a multimillion-rand floral empire. April got her start as a humble flower girl selling roses to diners at fancy romantic restaurants for R3.00 each. A well-known florist supplied her with roses at a unit cost of R1.50 and also charged her a weekly fee of R150 for the right to be their distributor.	
1. April's goal was to save money each week for her dream of opening a florist shop of her own someday. How many roses did April need to sell in a week for a targeted profit of R300?	Formula: Target Profit Units = Total Fixed Costs + Target Profit / Unit Contribution Margin
2. Application: April always worked hard, and in one particularly good week she sold exactly twice as many roses as she needed for her targeted profit. How much profit did she make that week?	
3. Application: If the florist who April bought roses from increased the unit cost per rose to R1.75, what should April do in order to still achieve her weekly target profit of R300? Choose one option: A Nothing B Increase the selling price per rose by R0.25 C Keep the selling price the same but sell 60 more roses per week D She can do B or C	

Question 4: Margin of safety (Question 1 links to Question 4)	
The Branlove Cereal Company sells fancy gluten-free organic cereal for R4.00 per box. Branlove's forecasted sales are R400 000 for this month and its sales at break-even are R180 000.	
1. What is the company's margin of safety in Rands?	Formula: Margin of Safety in Rands = Actual or budgeted sales in Rands – Break-even Sales in Rands
2. What is the margin of safety as a percentage of sales?	Formula: Margin of Safety as a % of Sales = Margin of Safety in Rands X 100
3. What is the margin of safety in product units?	Formula: Margin of Safety Units = Actual or budgeted sales – Break-even Sales
4. Application: If Branlove increases the selling price per box to R4.40, and the number of boxes it forecasts to sell remains the same, and its sales at break-even are still R180 000, by how much could the rand amount of cereal sales drop before Branlove takes a net loss?	

3.5 RESULTS AND ANALYSIS

3.5.1 Statistical methods

Data were analysed using a two-way analysis of covariance (ANCOVA) model to examine the difference between the four experimental groups based on language and formula provision. Students' background variables were used as covariates in the statistical analysis. For all statistical tests, a significance level of .05 was applied. Partial eta-squared (ηp^2) is reported as the measure of effect size. The benchmark values of .01, .06, .14 suggested by Cohen (1988, pp. 280–287) are used to indicate small, medium or large effects respectively (Richardson, 2011). When analysing simple main effects, a Bonferroni correction was applied to the level of statistical significance, which was accepted at the p>.025 level. All pairwise comparisons were run for statistically significant simple main effects with reported 95% confidence intervals and p-values, Bonferroni adjusted. Reference was made to the Laerd Statistics (2017) online guide to assist in conducting the tests and reporting the results.

Before the statistical analysis was conducted, the following assumptions were tested:

The Cronbach's alpha of 0.712 for all 14 questions and 0.742 for the formula-facilitated questions is above the acceptable level of 0.7, indicating that the questions have a reliable level of internal consistency. However, the Cronbach's alpha of 0.305 for the application questions suggests that these problems were not measuring the same concepts or constructs (Tavakol and Dennick, 2011). This is in line with what would be expected, as the application questions are heterogeneous and case-based. The difference between the formula-facilitated and application scores in each of the four scenarios in the assessment were therefore analysed separately.

To test for the assumptions of the two-way ANOVA using IMB Statistics SPSS (version 25), residual analysis was performed. Inspection of a boxplot assessed outliers. The Shapiro-Wilk measure was used to test for normality for each cell of the design, and Levene's measure was used to test for homogeneity of variances.

All group score residuals were significantly non-normal (p<.05), except for the residuals of the total scores of the accounting language no formula group (p>.05). There were several outliers, assessed as being greater than 1.5 box-lengths from the edge of the box in a boxplot, in the majority of the group scores. Finally, while there was homogeneity of variances in the total and application scores, as assessed by Levene's test for equality of variances (p>.05), the assumption of homogeneity of variances was violated for the formula-facilitated scores (p=.022). The latter result was obtained because half of the students (58) scored full marks for the formula-facilitated questions.

Due to these assumption violations, it was decided to use robust ANOVA alternatives and to keep the outliers in the analysis. Data were analysed using three robust two-way ANOVA tests (t2way, med2way, pbad2way), using the WRS2 package (Mair, Schoenbrodt, and Wilcox, 2017) in R (version 3.4.4) (R Core Team, 2018). The results of the robust ANOVAs (not shown) were similar to those of the standard ANOVA, therefore the standard ANOVA functions in SPSS were used in the rest of the analysis.

The steps in the statistical analysis are as follows:

- The descriptive information for the background control variables, and the results of the tests performed to determine if there were significant differences between these variables for the four experimental groups, are reported in Table 3.3.
- The total, formula-facilitated and application test mean scores (dependent variables) and the results of a one-way ANOVA with simple contrasts (conducted to check for differences between the means of the four groups) are reported in Table 3.4.
- The correlation tests between the three dependent test result variables and the continuous control variables are reported in Table 3.5, and the comparison of the means of the dependent variables between the two categorical variables are reported in Table 3.6. The aim here was to determine which of the background variables to use in the ANCOVA analysis.
- The first two-way ANCOVA examining the effects of language, formula provision and their interaction on the total, formula-facilitated and application scores is provided in Table 3.7. The first-year management accounting and Grade 12 mathematics results of the participants are included as covariates, and the Grade 12 English language level is used as a fixed factor covariate. The additional assumptions required by the ANCOVA procedure were checked.
    - The effect of the covariates on the dependent variables is analysed.
    - To test Hypothesis 1a, the effect of accounting versus everyday language on student performance is analysed.

- The effect of formulas on student performance was analysed separately for the formula-facilitated and application questions, and for the transfer scores.
    - To test Hypothesis 2, the effect of formulas on formula-facilitated scores was analysed.
    - The effect of formulas on application scores is also analysed.
- The transfer of learning scores are provided in Table 3.8. In Table 3.9 a two-way ANCOVA on these scores is reported.
    - Hypotheses 1b and 3 are tested considering the effect of formulas and language on students' transfer of learning scores.
    - The five transfer of learning scores are analysed with examples provided.
- Hypothesis 4 is tested and considers the effect of formulas and accounting versus everyday language on cognitive load. The results of the cognitive load survey are provided in Table 3.10. The two-way ANCOVA on these scores is reported in Table 3.11.
- The total, formula-facilitated and application mean scores for students separated by Grade 12 English level are provided in Table 3.12, and briefly analysed. Due to insufficient numbers, no hypothesis was formed for the effect of the Grade 12 English level on student performance and cognitive load.
- Finally, the results of this study are compared to those of Johnson and Sargent (2014).

3.5.2 Control variables

Table 3.3 provides the background variables for the 116 participants split between the four experimental groups. The first step was to determine whether the four groups were similar on basic characteristics. One-way between-subjects ANOVA tests were used for the continuous variables, and chi-square tests for the categorical variables. There were no statistically significant differences between the background variables for the four groups.

Table 3.3: Participant information per experimental group

Experimental Group	No. of students	Gender		Home Language		Grade 12 English[2]		Grade 12 Acc[4]
		Male	Female	English	Other	Home Language	First additional Language	
Accounting language No formula (ALNF)	29	8	21	10	19	22	7	28
Accounting language With formula (ALWF)	29	12	17	8	21	21	8	28
Everyday language No formula (ELNF)	29	10	19	9	20	21	8	29
Everyday language With formula (ELWF)	29	14	15	7	22	21	8	26
Total	116	44	72	34	82	85	31	111
Df		3		3		3		3
X^2		2.929		.832		.132		3.971
p		.403		.842		.988		.265

Experimental Group	Admission Point Score[1]	Grade 12 English[2]	Grade 12 Maths[3]	Grade 12 Acc[4]	First-year Financial Accounting	First-year Management Accounting
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Accounting language No formula (ALNF)	38 (3)	75 (8)	81 (9)	83 (10)	65 (12)	60 (10)
Accounting language With formula (ALWF)	38 (3)	75 (9)	82 (7)	85 (10)	63 (13)	61 (11)
Everyday language No formula (ELNF)	38 (3)	77 (6)	82 (9)	87 (10)	64 (11)	62 (9)
Everyday language With formula (ELWF)	39 (3)	76 (7)	82 (8)	88 (5)	64 (10)	62 (9)
Total	38 (3)	76 (8)	82 (8)	86 (9)	64 (11)	61 (10)
Df	(3,112)	(3,112)	(3,112)	(3,107)	(3,112)	(3,112)
F	.140	.698	.209	1.490	.056	.273
p	.936	.555	.890	.222	.982	.845

[1] Grade 12 Admission Point Score (APS) used for entrance to the university. The highest APS that can be achieved is 42. The subminimum APS required for entrance to the B.Com (Accounting Sciences) degree for 2016 was 34.
[2] Grade 12 English result. English either taken at Home language (HL) or First additional language (FAL) level. If at FAL level, the student will have taken another South African language as their HL. A subminimum of 60% for English at HL or FAL level was required for entrance to the degree for 2016.
[3] Grade 12 Mathematics result. All students would have taken Mathematics. A subminimum of 70% was required for entrance to the degree for 2016.
[4] Grade 12 accounting result. Accounting was not compulsory to gain admission to the degree. However, 111 of the 116 participants had taken accounting as a school subject.

3.5.3 Test scores

The dependent variables were total, formula-facilitated and application scores (Table 3.4), as well as students transfer scores from the formula-facilitated to application questions (Table 3.8). These measures are explained in 3.4.6 above. All 116 students completed the test; however, two students each omitted one item. The results of these students were included in the analysis and the omitted items were marked as zero.

The unadjusted percentage total scores and the separate percentage scores for formula-facilitated and application questions for each of the four experimental groups are reported in Table 3.4. The estimated marginal means of the test scores, adjusted for the students' Grade 12 mathematics and first-year Financial Management results and the Grade 12 English level are also provided in Table 3.4. The discussion around the use of these particular covariates follows in the next section.

Table 3.4: Unadjusted and adjusted percentage of questions completed correctly by type

		Unadjusted		Adjusted#	
		No formula (NF)	With formula (WF)	No formula (NF)	With formula (WF)
Total scores (% out of 14)		**%**	**%**	**%**	**%**
Accounting language (AL)	Mean	60.59*	86.70	61.31	86.50
	SE	3.54	2.15	2.52	2.51
Everyday language (EL)	Mean	81.28	83.99	81.00	83.75
	SE	3.00	2.37	2.51	2.51
Formula-facilitated scores (% out of 9)					
Accounting language (AL)	Mean	63.60*	95.40**	63.88	95.29
	SE	4.23	1.87	2.85	2.84
Everyday language (EL)	Mean	87.36**	93.87	87.28	93.78
	SE	2.90	2.18	2.84	2.84
Application scores (% our of 5)					
Accounting language (AL)	Mean	55.17***	71.03***	56.70	70.67
	SE	4.40	4.16	3.76	3.75
Everyday language (EL)	Mean	70.34***	66.21	69.71	65.69
	SE	4.17	4.56	3.75	3.75

Adjusted percentages are estimated marginal means adjusted for covariates.
* The mean total and formula-facilitated scores of the ALNF group were significantly lower than those of the other three groups at the p<.001 level.
** The mean formula-facilitated scores of the ELNF group were significantly lower than those of the ALWF at the p<.05 level.
*** The mean application scores of the ALNF group were significantly lower than those of the ALWF and ELNF group at the p<.05 level.

A one-way ANOVA with simple contrasts was run to check for differences across the means of the four groups. There were significant differences between the total (F(3,112)=17.878, p<.001), formula-facilitated (F(3,112)=25.074, p<.001) and application (F(3,112)=2.870, p<.05) scores of the different groups. The results of the simple contrasts are provided in Table 3.4.

3.5.4 Correlations

Pearson's correlation was run to assess the relationship between each of the dependent variables: total, formula-facilitated and application percentage scores, and the continuous variables of interest. Due to the statistical assumption violations already mentioned, a non-parametric alternative, Kendall's tau was also used to minimise the effect of extreme scores. Kendall's tau was preferred over Spearman's as, according to Field (2013, p. 278), Kendall's tau provides a better estimate of the correlation in the population when the data set is relatively small and there are a large number of tied ranks. This was true for the population in this experiment as many students obtained the same scores. Both sets of correlation coefficients are provided in Table 3.5. There are no guidelines for determining how strong the association is between two values when using Kendall's tau (unlike with Pearson's correlation). However, Kendall's tau coefficients do tend to be smaller than Pearson correlation coefficients. Using the general guidelines provided by Cohen (1988, p. 109) an r-value less than 0.3 is considered as having a small correlation, between 0.3 and 0.5 as a medium correlation and above 0.5 as a large correlation (Faul, Erdfelder, Buchner and Lang, 2009).

The correlations among the dependent variables and the first-year management accounting results were all significant ($p<.05$). The Kendall's tau correlation was highest for the application scores ($r=.368$, $p<.01$). The first-year financial accounting result only correlated significantly with the application scores ($r=.155$, $p<.05$). The correlation between the two first-year courses was significant ($p<.01$), with a medium association ($r=.487$) using Kendall's and a strong association ($r=.692$) for Pearson. In order to improve the degrees of freedom of the ANCOVA model it was decided to use only one of the two first-year result variables. A multiple regression analysis (not shown) was conducted on total scores with the independent variables entered first and then the financial management result followed by the financial accounting result. The adjusted R squared of the model improved slightly from .400 to .402 when the financial accounting result was excluded. The financial management variable was therefore the only first-year result variable included in further analysis.

The Grade 12 English result did not correlate significantly with any of the dependent variables. It was therefore excluded from further analysis. The Grade 12 APS aggregate and mathematics and accounting grades all correlated significantly with the application scores ($p<.01$). The APS and mathematics scores were also significantly correlated at the $p<.01$ level to the total scores. Students' Grade 12 accounting results were significantly correlated to the Grade 12 APS ($p<.01$) with a strong association for both Kendall's tau ($r=.584$) and Pearson's ($r=.761$). As five of the students did not take accounting as a subject at school, this result was also omitted from further analysis. There was also a significant medium association for Kendall's tau (r=.433) and strong association for Pearson's (r=.577) between students' Grade 12 APS and mathematics results ($p<.01$). The correlation of students' mathematics results to the total and application scores was higher than for their APS, while the correlation of the mathematics and APS results to the formula-facilitated scores were similar. In order to reduce the number of Grade 12 result covariates and improve the degrees of freedom of the ANCOVA model, a multiple regression analysis was conducted (not shown) on the total scores with the independent and financial management variables, first including the Grade 12 Maths result only and then adding the APS result. The adjusted R squared value reduced from .414 to .410 when the APS result was included. The Grade 12 Maths result was therefore the only Grade 12 variable used in subsequent analysis.

To consider the effect of the experiment separately for students with EAL, either the Grade 12 English language level or the English primary (home) language dummy variables could have been used. An independent sample t-test and Mann-Whitney U test were run to determine if there were differences in the dependent variables between students with Grade 12 English home and first additional language, and students with English or another language as their primary language (refer Table 3.6). Even though they were not significant, the Grade 12 English home language variable had a higher relationship to all the dependent variables than the English primary language variable did; thus, the former was used as a variable in the analysis. In addition, when an ANCOVA was conducted, including all eight control variables (not shown), the Grade 12 English result and English primary language variable had low F values with no significant effect on students' achievements. The Grade 12 English language level had higher F values that reached significance at the $p>.05$ level. Therefore, this was the only dummy variable included in further analysis.

Table 3.5: Correlation coefficients between dependent and continuous independent variables

Pearson (above diagonal) / Kendall's tau (below diagonal)	% Total Correct	% Formula Correct	% Application Correct	Financial Accounting 1 result	Manage-ment Accounting 1 result	Gr 12 English result	Gr 12 Accounting result	Gr 12 Maths result	Gr 12 APS
% Total Correct	1.000	.904**	.758**	.168	.356**	.134	.194*	.299**	.264**
% Formula Correct	.769**	1.000	.406**	.101	.195*	.081	.104	.172	.151
% Application Correct	.708**	.359**	1.000	.204*	.463**	.163	.255**	.375**	.333**
Financial Accounting 1 result	.122	.068	.155*	1.000	.692**	.459**	.485**	.474**	.513**
Management Accounting 1 result	.279**	.151*	.368**	.487**	1.000	.437**	.418**	.456**	.478**
Gr 12 English result	.114	.102	.101	.319**	.304**	1.000	.528**	.256**	.687**
Gr 12 Accounting result	.156*	.070	.223**	.374**	.322**	.381**	1.000	.453**	.761**
Gr 12 Maths result	.268**	.147*	.297**	.320**	.311**	.178**	.297**	1.000	.577**
Gr 12 APS	.245**	.152*	.283**	.418**	.386**	.556**	.584**	.433**	1.000

**. Indicates p<.01 (2-tailed)
*. Indicates p<.05 (2-tailed)

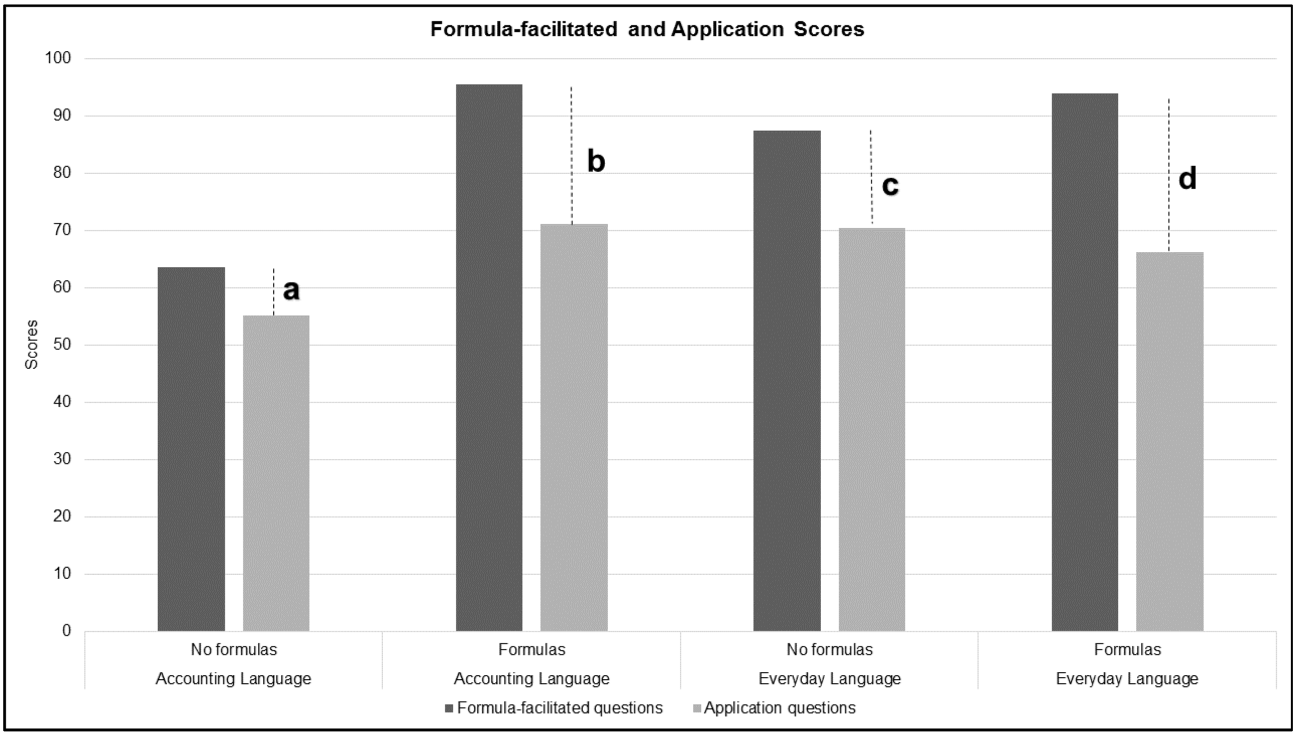
Table 3.6: Relations between dependent and categorical independent variables

	Gr 12 English HL				English Primary Language			
	t-test		Wilcoxon / Mann-Whitney		t-test		Wilcoxon / Mann-Whitney	
	Coeff.	p-value (2-tailed)	Coeff.	p-value (2-tailed)	Coeff.	p-value (2-tailed)	Coeff.	p-value (2-tailed)
% Total Correct	1.715	.094	1.418	.156	.723	.471	.735	.462
% Formula Correct	1.394	.171	1.025	.306	.081	.936	-.111	.912
% Application Correct	1.742	.084	1.540	.123	1.431	.155	1.269	.204

3.5.5 Effect of language and formulas on student performance

Figure 3.3 presents the formula-facilitated and application scores for the four experimental groups. The transfer scores are labelled as lines (a) to (d).

Figure 3.3: Formula-facilitated and application scores for the language and formula conditions



A two-way ANCOVA was conducted to examine the effects of language, formula provision and their interaction on the total, formula-facilitated and application scores. The first-year management accounting and Grade 12 mathematics results of the participants were included as covariates in the model and the Grade 12 English language level was used as a fixed factor covariate.

As the means of the covariates chosen were similar across the treatment groups, all the covariance assumptions were satisfied. There was a linear relationship between the two continuous variables and the dependent variables for each experimental group, as assessed by visual inspection of a scatterplot. There was homogeneity of regression slopes as the interaction terms between the experimental groups, and continuous covariates were not statistically significant, $F(3,104)<.70$, $p>.554$ (for all terms).

Table 3.7 provides the results of the standard two-way ANCOVA performed. After controlling for the covariates, both language and formula provision were significant in explaining the total and formula-facilitated scores of the participants (p≤.001), but not the application scores. The interaction variable was significant at the p<.001 level in explaining the total and formula-facilitated scores and at the p<.05 level in explaining the application scores. Comparing the results of the two-way ANCOVA (Table 3.7) to a two-way ANOVA without covariates (not shown) revealed that the adjusted R squared predictive values increased considerably for the ANCOVA. The adjusted R squared values for the total scores improved from .306 to .448; formula-facilitated scores from .386 to .429 and the application scores value showed the most significant increase from .047 to .284. Therefore, the prior knowledge control variables improved the predictive ability of the model.

Table 3.7: Two-way ANCOVA on total, formula-facilitated and application scores

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	% Total Correct	18166.594[a]	6	3027.766	16.564	.000	.477
	% Formula Correct	21537.372[b]	6	3589.562	15.403	.000	.459
	% Application Correct	21021.513[c]	6	3503.586	8.597	.000	.321
Intercept	% Total Correct	174.793	1	174.793	.956	.330	.009
	% Formula Correct	2088.209	1	2088.209	8.961	.003	.076
	% Application Correct	2046.273	1	2046.273	5.021	.027	.044
Covariates							
Management Accounting Result	% Total Correct	1046.324	1	1046.324	5.724	.018	.050
	% Formula Correct	148.929	1	148.929	.639	.426	.006
	% Application Correct	4706.549	1	4706.549	11.548	.001	.096
Grade 12 English HL or FAL	% Total Correct	1428.939	1	1428.939	7.817	.006	.067
	% Formula Correct	1425.895	1	1425.895	6.119	.015	.053
	% Application Correct	1434.451	1	1434.451	3.520	.063	.031
Grade 12 Maths Result	% Total Correct	1126.134	1	1126.134	6.161	.015	.053
	% Formula Correct	524.972	1	524.972	2.253	.136	.020
	% Application Correct	2779.427	1	2779.427	6.820	.010	.059
Main effects							
LanguageGroup	% Total Correct	2068.094	1	2068.094	11.314	.001	.094
	% Formula Correct	3454.025	1	3454.025	14.821	.000	.120
	% Application Correct	464.245	1	464.245	1.139	.288	.010
FormulaGroup	% Total Correct	5636.789	1	5636.789	30.838	.000	.221
	% Formula Correct	10389.948	1	10389.948	44.584	.000	.290
	% Application Correct	715.261	1	715.261	1.755	.188	.016
Interaction effect							
LanguageGroup X FormulaGroup	% Total Correct	3638.342	1	3638.342	19.905	.000	.154
	% Formula Correct	4484.376	1	4484.376	19.243	.000	.150
	% Application Correct	2338.115	1	2338.115	5.737	.018	.050
Residual	% Total Correct	19924.098	109	182.790			
	% Formula Correct	25401.751	109	233.044			
	% Application Correct	44423.314	109	407.553			

a. R Squared=.477 (Adjusted R Squared=.448)
b. R Squared=.459 (Adjusted R Squared=.429)
c. R Squared=.321 (Adjusted R Squared=.284)

3.5.6 Effect of covariates on total, formula-facilitated and application scores

In the ANCOVA (Table 3.7) the first-year management accounting covariate was significantly related to total scores: $F(1,109)=5.72$, $p=.018$, but with a small effect ($\eta p^2=.050$). The relation to application scores had a medium effect $F(1,109)=11.55$, $p=.001$, $\eta p^2=.096$. There was no significant relationship between students' first-year management accounting result and their formula-facilitated scores.

Taking English as a first language at school had a significant positive relation to total scores with a medium effect: $F(1,109)=7.82$, $p=.006$, $\eta p^2=.067$. The relationship to formula-facilitated scores had a significant small effect $F(1,109)=6.12$, $p=.015$, $\eta p^2=.053$. The relationship to application scores was not significant ($p=.063$).

Students' Grade 12 mathematics result was significantly related to total scores: $F(1,109)=6.16$, $p=.015$, but with a small effect ($\eta p^2=.053$). The relation to application scores also had a small effect $F(1,109)=6.82$, $p=.010$, $\eta p^2=.059$. There was no significant relation to the formula- facilitated scores.

All of the results discussed next are after adjusting for the covariates.

3.5.7 Effect of language on student performance

In the ANCOVA for formula-facilitated scores, both fixed factors and the interaction were statistically significant (Table 3.7). The language condition had a medium effect size: $F(1,109)=14.82$, $p<.001$, $\eta p^2=.120$. Formula provision had a large effect size: $F(1,109)=44.58$, $p<.001$, $\eta p^2=.290$. The interaction between language and formula provision had a large effect size: $F(1,109)=19.24$, $p<.001$, $\eta p^2=.150$. The interaction effect of formulas and language occurred because everyday language improved formula-facilitated scores when formulas were absent.

An analysis of simple main effects for language and formula was performed. For the no formula treatment, everyday language increased adjusted formula-facilitated scores by 23.40% (95% CI, 15.42 to 31.38) compared to accounting language. The effect was large ($F(1,109)=33.80$, $p<.001$, $\eta p^2=.237$). Everyday language compared to accounting language decreased the average adjusted formula-facilitated scores by 1.51% when formulas were provided, but the effect was not significant ($p=.707$).

In Table 3.7, both the language (p=.288) and formula (p=.188) conditions did not have a significant effect on application scores. The interaction between language and formula provision had a small effect size (F(1,109)=5.74, p=.018, ηp^2=.050). The interaction effect of formulas and language occurred because everyday language improved application scores when formulas were absent.

The analysis of simple main effects for language and formula established that without formulas everyday language increased adjusted application scores by 13.01% (95% CI, 2.46 to 23.56) compared to accounting language. The effect was small (F=5.97, p=.016 ηp^2=.052). Everyday language compared to accounting language decreased the adjusted application scores by 4.98% when formulas were provided, but the effect was not significant (p=.350).

H1a is therefore supported only for the no formula condition, where everyday language improved students' formula-facilitated and application scores. H1a is not supported for the provision of formulas, which had no significant effect for language.

3.5.8 Effect of formulas on student performance

3.5.8.1 Effect of formulas on formula-facilitated scores

Following from the discussion above on the effect of language, it was noted that formula provision (F(1,109)=44.58, p<.001, ηp^2=.290) and the interaction between language and formula provision (F(1,109)=19.24, p<.001, ηp^2=.150) had a large effect size on formula-facilitated scores (Table 3.7 refers). An alternative reason for the interaction effect of formulas and language is that formulas improved formula-facilitated scores for the accounting language condition.

An analysis of simple main effects for language and formula was performed. For questions phrased in accounting language, formulas increased the average adjusted score on formula-facilitated questions by 31.41% (95% CI, 23.44 to 39.38). This was a large effect (F(1,109)=61.04, p<.001, ηp^2=.359). The increase of 6.5% between no formula and with formula adjusted formula-facilitated scores for the everyday language condition was not significant (p=.108).

H2 is therefore supported, as the provision of formulas resulted in significantly better results for students on formula-facilitated questions with accounting language than for those provided with everyday language.

3.5.8.2 Effect of formulas on application scores

As mentioned, when discussing the effect of language, the main effect of language and formula provision on the application scores was not significant (refer Table 3.7). However, the interaction variable had a small effect on application scores, $F(1,109)=5.74$, $p=.018$, $\eta p^2=.050$. The alternative explanation for the interaction effect is that formulas improved application scores in the accounting language condition.

An analysis of simple main effects for language and formula was performed. Formulas increased the average mark on application questions by 13.97% (95% CI, 3.43 to 24.51) when presented together with accounting language. This increase was a statistically significant medium effect $F(1,109)=6.90$, $p=.010$, $\eta p^{2=}.060$. Application scores decreased by 4.02% when formulas were added to the everyday language condition, but this effect was not significant ($p=.450$).

3.5.9 Effect of formulas and language on transfer of learning scores

To test H1b and H3, the transfer scores for each experimental condition were analysed. The percentage of students per transfer score category (as described in Table 3.2) for each of the four experimental groups are provided in Table 3.8.

Table 3.8: Percentage of students per transfer score categories per experimental group

	Accounting Language		Everyday Language	
App Qu = Application question **FF Qu = Formula-facilitated question**	**No formula**	**With formula**	**No formula**	**With formula**
	%	**%**	**%**	**%**
Contribution Margin (CM)				
App Qu 4 incorrect and FF Qu 2 incorrect (-1)	27.6	3.5	0.0	0.0
App Qu 4 incorrect and FF Qu 2 correct (0)	17.2	37.9	31.0	31.0
App Qu 4 correct and FF Qu 2 incorrect (1)	41.4	6.9	3.5	0.0
App Qu 4 correct and FF Qu 2 correct (2)	13.8	51.7	65.5	69.0
Break-even (BE)				
App Qu 3 incorrect and FF Qu 2 incorrect (-1)	37.9	0.0	13.8	3.4
App Qu 3 incorrect and FF Qu 2 correct (0)	10.3	0.0	20.7	6.9
App Qu 3 correct and FF Qu 2 incorrect (1)	0.0	0.0	3.4	6.9
App Qu 3 correct and FF Qu 2 correct (2)	51.7	100.0	62.1	82.8
Target Profit 1 (TP 1)				
App Qu 2 incorrect and FF Qu 1 incorrect (-1)	20.7	0.0	10.3	10.4
App Qu 2 incorrect and FF Qu 1 correct (0)	10.3	24.1	0.0	31.0
App Qu 2 correct and FF Qu 1 incorrect (1)	0.0	0.0	0.0	0.0
App Qu 2 correct and FF Qu 1 correct (2)	69.0	75.9	89.7	58.6
Target Profit 2 (TP 2)				
App Qu 3 incorrect and FF Qu 1 incorrect (-1)	13.8	0.0	3.4	6.9
App Qu 3 incorrect and FF Qu 1 correct (0)	24.1	34.5	20.7	17.2
App Qu 3 correct and FF Qu 1 incorrect (1)	6.9	0	6.9	3.5
App Qu 3 correct and FF Qu 1 correct (2)	55.2	65.5	69.0	72.4
Margin of Safety (MS)				
App Qu 4 incorrect and FF Qu incorrect (-1)	20.7	3.4	10.3	3.5
App Qu 4 incorrect and FF Qu 1 correct (0)	41.4	41.4	38.0	58.5
App Qu 4 correct and FF Qu 1 incorrect (1)	13.8	0.0	10.3	3.5
App Qu 4 correct and FF Qu 1 correct (2)	24.1	55.2	41.4	34.5

A two-way ANCOVA (Table 3.9) was conducted to examine the effects of formula and language provision on the transfer scores. The interaction variable was not significant for the Contribution Margin (CM) and Target Profit 2 (TP2) transfer scores. Therefore, an analysis of main effects on these two transfer scores was performed. There was no main effect for language or formula provision for the TP2 transfer scores. The main effect of language showed a statistically significant difference in adjusted CM transfer scores (p=.001). Everyday language improved students' adjusted CM transfer scores by .601 points (95% CI, .240 to .962) compared to accounting language. The effect was medium (F=10.909, p=.001, ηp^2=.091). The main effect of formula provision was only significant at the p=.077 level for the CM transfer scores (F=3.194, ηp^2=.028). Formula provision increased the adjusted CM transfer scores by .325 points (95% CI, -.035 to .685). Further analysis of the simple main effects indicated that everyday language improved the adjusted CM transfer score in the no formula condition by .892 points (95% CI, .381 to 1.402) with a significant medium effect (F=11.970, p=.001, ηp^2=.099). In the accounting language condition, formulas improved the adjusted CM transfer score by .615 (95% CI, .105 to 1.126) with a significant small effect (F=5.713, p=.019, ηp^2=.050).

The interaction variable was significant at the $p<.05$ level in explaining the Break-even (BE) and Target Profit 1 (TP1) transfer scores and at the p=.051 level in explaining the Margin of Safety (MS) transfer scores. An analysis of simple main effects for these three transfer scores was performed.

Everyday language improved the adjusted BE transfer score in the no formula condition by .473 points (95% CI, -.056 to 1.001), but the effect was only significant at the p=.079 level ($F(1,109)$=3.412, ηp^2=.028). Formulas improved the adjusted BE transfer score in the everyday language condition by .547 points (95% CI, .021 to 1.074) with a small effect size ($F(1,109)$=4.245, p=.042, ηp^2=.037), and in the accounting language condition by 1.323 points (95% CI, .795 to 1.851) with a large effect size ($F(1,109)$=24.679, $p<.001$, ηp^2=.185).

Everyday language improved the adjusted TP1 transfer score in the no formula condition by .453 points (95% CI, -.071 to .977), but the effect was only significant at the p=.090 level ($F(1,109)$=2.934, ηp^2=.026). In the formula condition, everyday language had a negative effect on the adjusted TP1 transfer score of .468 points (95% CI, -.055 to .990), but only at a p=.079 level ($F(1,109)$=3.151, ηp^2=.028). Formulas had a significant negative effect on the adjusted TP1 transfer scores in the everyday language condition, decreasing scores by .607 points (95% CI, .085 to 1.130) with a small effect size ($F(1,109)$=5.312, p=.023, ηp^2=.046).

Formulas improved the adjusted MS transfer scores in the accounting language condition by .579 points (95% CI, .066 to 1.093) with a small effect size ($F(1,109)$=5.005, p=.027, ηp^2=.044).

H1b is not supported, as when formulas were provided, everyday language (compared to accounting language) did not improve students' transfer scores. Everyday language appeared to decrease students' TP1 transfer scores in the formula condition, but improved students' CM transfer scores significantly in the no formula condition. The BE and TP1 transfer scores also appeared to improve in the no formula condition when everyday language was provided.

Table 3.9: Two-way ANCOVA on Transfer Scores

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	CM Transfer	23.534	6	3.922	4.105	.001	.184
	BE Transfer	33.621	6	5.603	5.481	.000	.232
	TP Transfer 1	27.098	6	4.516	4.488	.000	.198
	TP Transfer 2	15.859	6	2.643	2.713	.017	.130
	MS Transfer	28.379	6	4.730	4.893	.000	.212
Intercept	CM Transfer	.083	1	.083	.086	.769	.001
	BE Transfer	.648	1	.648	.634	.428	.006
	TP Transfer 1	.073	1	.073	.072	.788	.001
	TP Transfer 2	.006	1	.006	.006	.937	.000
	MS Transfer	8.066	1	8.066	8.343	.005	.071
Covariates							
Management Accounting Result	CM Transfer	.906	1	.906	.948	.332	.009
	BE Transfer	.087	1	.087	.085	.771	.001
	TP Transfer 1	12.166	1	12.166	12.089	.001	.100
	TP Transfer 2	8.670	1	8.670	8.900	.004	.075
	MS Transfer	1.264	1	1.264	1.308	.255	.012
Grade 12 English HL or FAL	CM Transfer	.509	1	.509	.533	.467	.005
	BE Transfer	.546	1	.546	.534	.467	.005
	TP Transfer 1	2.534	1	2.534	2.518	.115	.023
	TP Transfer 2	.039	1	.039	.040	.842	.000
	MS Transfer	2.100	1	2.100	2.173	.143	.020
Grade 12 Maths Result	CM Transfer	2.068	1	2.068	2.164	.144	.019
	BE Transfer	2.294	1	2.294	2.244	.137	.020
	TP Transfer 1	.267	1	.267	.266	.607	.002
	TP Transfer 2	.082	1	.082	.085	.772	.001
	MS Transfer	10.749	1	10.749	11.119	.001	.093
Main effects							
LanguageGroup	CM Transfer	10.424	1	10.424	10.909	.001	.091
	BE Transfer	.206	1	.206	.202	.654	.002
	TP Transfer 1	.002	1	.002	.002	.968	.000
	TP Transfer 2	1.125	1	1.125	1.155	.285	.010
	MS Transfer	.005	1	.005	.005	.946	.000
FormulaGroup	CM Transfer	3.052	1	3.052	3.194	.077	.028
	BE Transfer	25.279	1	25.279	24.725	.000	.185
	TP Transfer 1	.624	1	.624	.620	.433	.006
	TP Transfer 2	.400	1	.400	.410	.523	.004
	MS Transfer	1.385	1	1.385	1.433	.234	.013
Interaction effect							
LanguageGroup X FormulaGroup	CM Transfer	2.439	1	2.439	2.552	.113	.023
	BE Transfer	4.350	1	4.350	4.255	.042	.038
	TP Transfer 1	6.128	1	6.128	6.090	.015	.053
	TP Transfer 2	.337	1	.337	.346	.558	.003
	MS Transfer	3.756	1	3.756	3.885	.051	.034
Residual	CM Transfer	104.156	109	.956			
	BE Transfer	111.440	109	1.022			
	TP Transfer 1	109.695	109	1.006			
	TP Transfer 2	106.176	109	.974			
	MS Transfer	105.371	109	.967			

a. R Squared = .184 (Adjusted R Squared = .139)
b. R Squared = .232 (Adjusted R Squared = .189)
c. R Squared = .198 (Adjusted R Squared = .154)
d. R Squared = .130 (Adjusted R Squared = .082)
e. R Squared = .212 (Adjusted R Squared = .169)

H3 is supported for the TP1 transfer score in the everyday language condition only, i.e. formulas appeared to hamper the transfer of learning. No support is found for H3 in any of the other transfer scores.

3.5.10 Analysis of transfer of learning scores

The effect of language and formulas on each of the transfer scores are now analysed. Two examples are provided that show the negative effect of formulas on student performance.

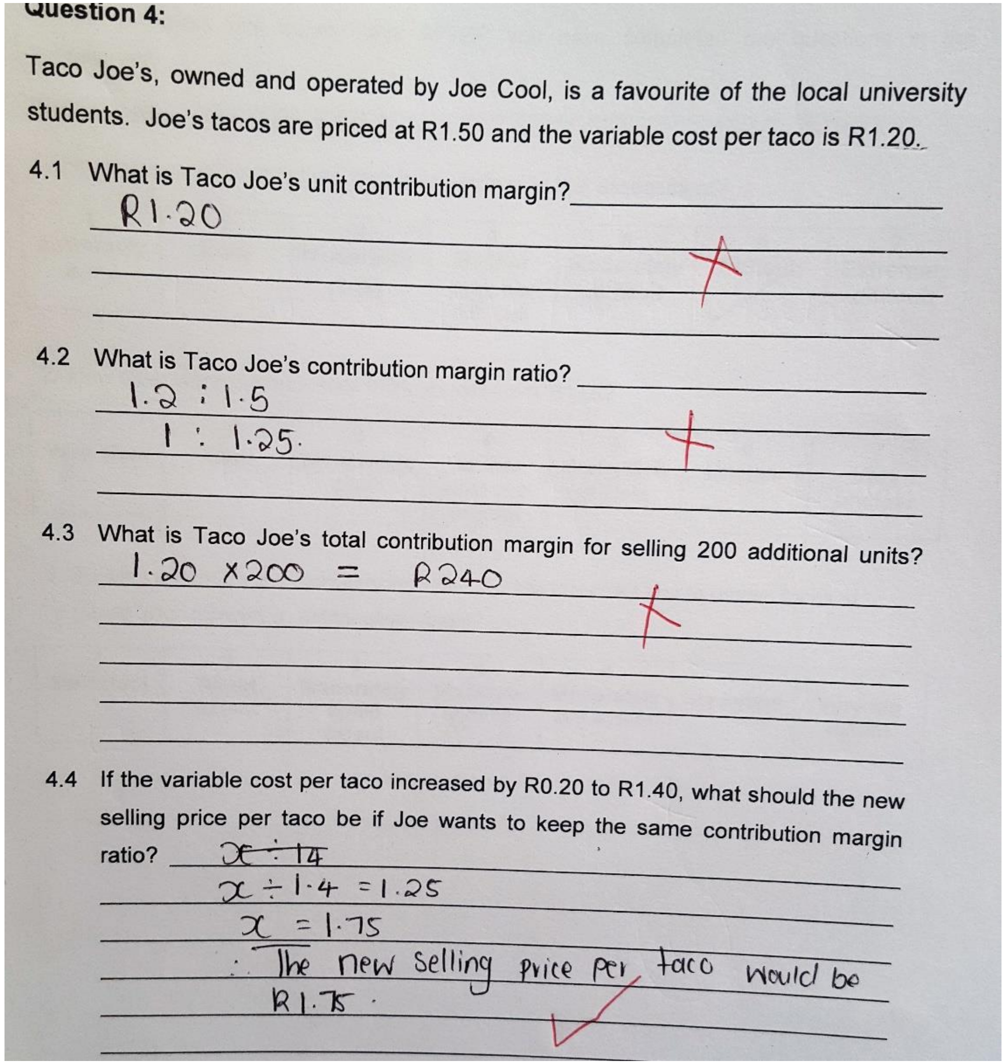
3.5.10.1 Contribution Margin (CM)

Everyday language improved students CM transfer scores in the no formula condition only. Formula provision appeared to improve the CM transfer scores when questions were phrased in accounting language. However, an interesting phenomenon was noticed in the accounting language condition. Without formulas, 41.4% of students were able to answer the application question correctly, but not the formula-facilitated questions. Only 6.9% of students who were given formulas achieved the same result. This effect can be seen when comparing Image 1 to Image 2. It must be noted however that significance was not established for this negative effect of formulas.

Image 1 is a picture of the answer sheet for the CM scenario for a student who received accounting language without formulas. This student had none of the formula-facilitated questions correct, but had the application question right. In question 4.1 the student mistakes the variable cost per taco for the contribution margin, which indicates he/she does not understand the meaning of the terminology. In question 4.2 the student compares the variable cost to the selling price and comes up with the ratio of 1:1.25 which although it is not the contribution margin ratio, is the correct calculation for comparing variable cost to selling price. In question 4.4 (the application question) the student then did an algebraic calculation using the new variable cost, and the ratio of 1:1.25 that they calculated in 4.2 to get to the correct new selling price of R1.75. In the formula-facilitated questions, the student appeared to be going through a thinking process, which while not giving the “correct” answers to the first three questions, assisted him/her in understanding the link between selling price and variable costs to answer the application question correctly.

On the other hand, the student whose answer sheet is provided in Image 2 also had accounting language but with formulas. This student used the formulas to get the three

Image 1: Contribution Margin - Accounting language No formula



Question 4:

Taco Joe's, owned and operated by Joe Cool, is a favourite of the local university students. Joe's tacos are priced at R1.50 and the variable cost per taco is R1.20.

4.1 What is Taco Joe's unit contribution margin?

R1.20

4.2 What is Taco Joe's contribution margin ratio?

1.2 : 1.5

1 : 1.25.

4.3 What is Taco Joe's total contribution margin for selling 200 additional units?

1.20 x200 = R240

4.4 If the variable cost per taco increased by R0.20 to R1.40, what should the new selling price per taco be if Joe wants to keep the same contribution margin ratio?

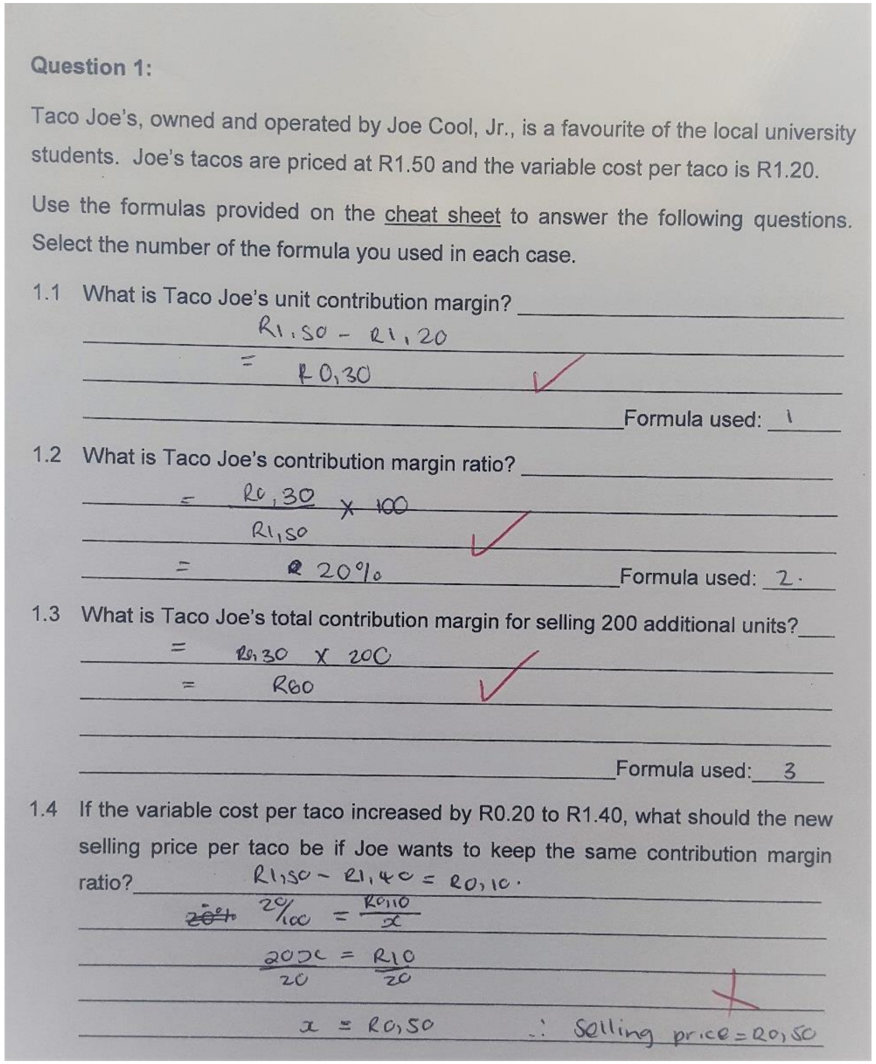
~~x ÷ 14~~

x ÷ 1.4 = 1.25

x = 1.75

∴ The new selling price per taco would be R1.75.

Image 2: Contribution Margin - Accounting language With formula



Question 1:

Taco Joe's, owned and operated by Joe Cool, Jr., is a favourite of the local university students. Joe's tacos are priced at R1.50 and the variable cost per taco is R1.20.

Use the formulas provided on the cheat sheet to answer the following questions. Select the number of the formula you used in each case.

1.1 What is Taco Joe's unit contribution margin?

R1,50 – R1,20

= R0,30

Formula used: 1

1.2 What is Taco Joe's contribution margin ratio?

= R0,30 / R1,50 x 100

= 20%

Formula used: 2.

1.3 What is Taco Joe's total contribution margin for selling 200 additional units?

= R0,30 x 200

= R60

Formula used: 3

1.4 If the variable cost per taco increased by R0.20 to R1.40, what should the new selling price per taco be if Joe wants to keep the same contribution margin ratio?

R1,50 – R1,40 = R0,10.

~~20%~~ 20/100 = R0,10 / x

20x / 20 = R10 / 20

x = R0,50 ∴ Selling price = R0,50

formula-facilitated questions correct but answered the application question incorrectly. It is evident from the student's workings that he/she tried to use formulas to solve the application question without understanding the links between the variables. The provision of formulas, therefore appeared to hamper the transfer of knowledge from the formula-facilitated questions to the application question for this student.

3.5.10.2 Break-even (BE)

In the break-even question, students provided with formulas were able to complete the application question without difficulty for both the accounting and everyday language conditions. Formulas assisted students when answering this question. The reason for this is that the application question was a multiple-choice question. Almost no students chose two of the four options, namely 'no change' and 'I'm not sure'. The question therefore only had two possible choices for the answer. Students were then able to eliminate the incorrect answer quite easily by using what they had learnt in the formula-facilitated questions and applying it to get the correct answer for the application question.

The only effect of language was that everyday language appeared to assist students in the no formula condition. Everyday language had a negative effect on BE transfer performance in the formula condition, but the effect was not significant.

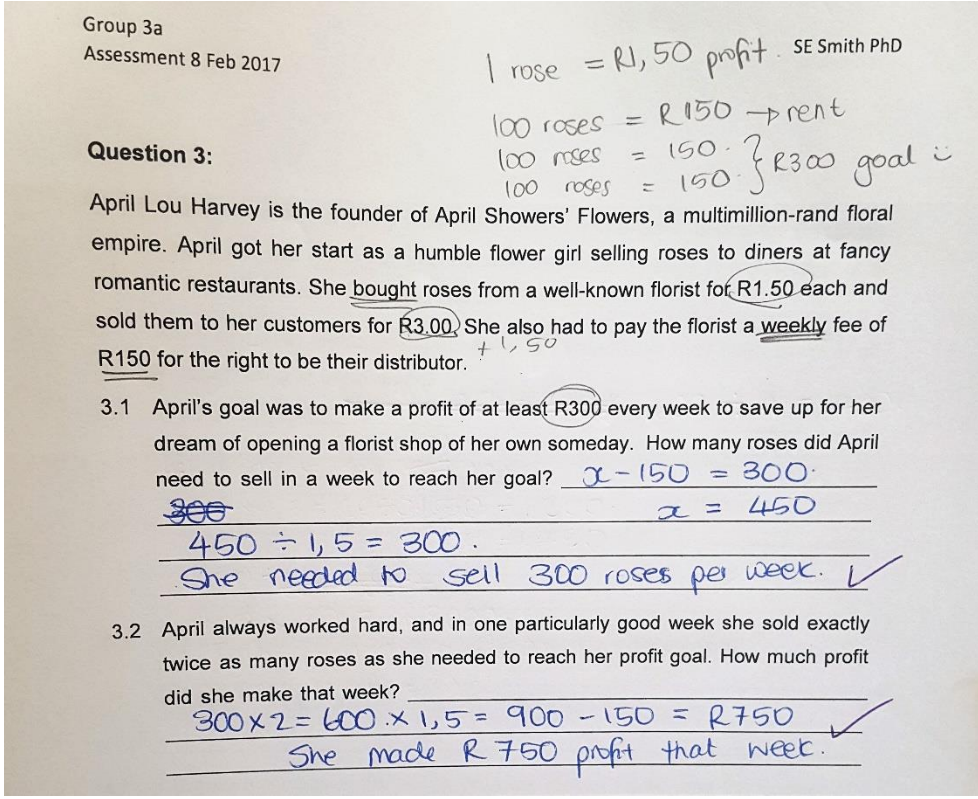
3.5.10.3 Target Profit 1 (TP1)

Everyday language appeared to positively influence the TP1 transfer scores in the no formula condition. Providing formulas had a significant negative effect in the everyday language condition only. Image 3 and 4 illustrate this difference.

Image 3 is the answer sheet of a student for the first two target profit questions. This student received questions phrased in everyday language and managed to get both question one (the formula-facilitated question) and question two (the application question) correct without formulas. Almost 90% of the students in this experimental condition answered both of these questions correctly.

The student whose answer sheet appears in Image 4 had the questions phrased in everyday language and received formulas. He/she answered the formula-facilitated

Image 3: Target Profit 1 - Everyday language No formula



Group 3a
Assessment 8 Feb 2017

SE Smith PhD

1 rose = R1,50 profit.
100 roses = R150 → rent
100 roses = 150 }
100 roses = 150 } R300 goal

Question 3:

April Lou Harvey is the founder of April Showers' Flowers, a multimillion-rand floral empire. April got her start as a humble flower girl selling roses to diners at fancy romantic restaurants. She bought roses from a well-known florist for R1.50 each and sold them to her customers for R3.00. She also had to pay the florist a weekly fee of R150 for the right to be their distributor.

+1,50

3.1 April's goal was to make a profit of at least R300 every week to save up for her dream of opening a florist shop of her own someday. How many roses did April need to sell in a week to reach her goal? $x - 150 = 300$

~~300~~ $x = 450$

$450 \div 1,5 = 300$.

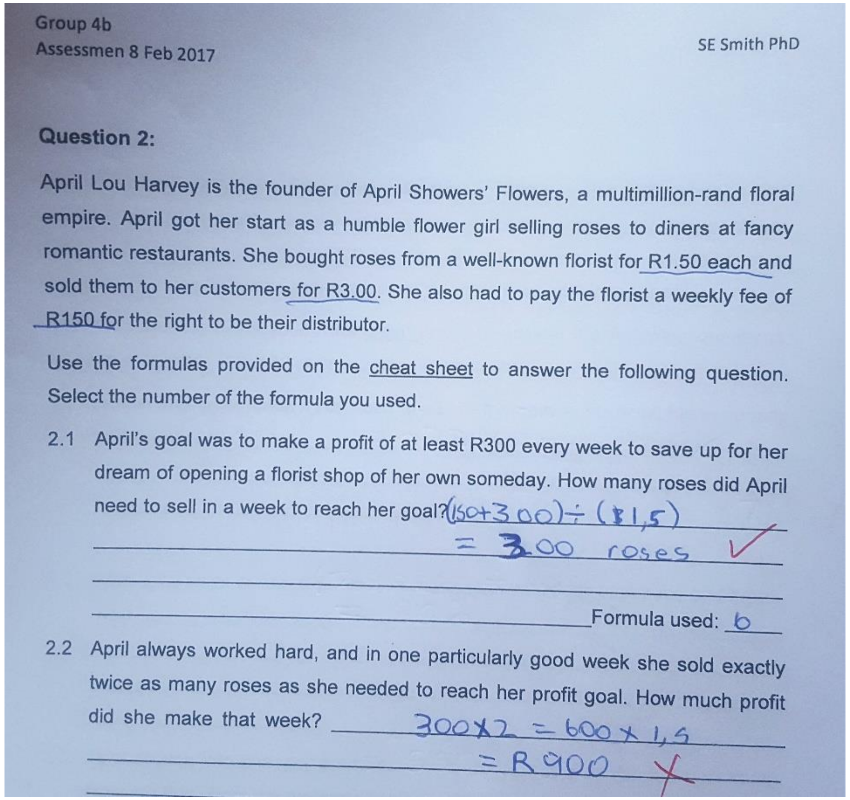
She needed to sell 300 roses per week. ✓

3.2 April always worked hard, and in one particularly good week she sold exactly twice as many roses as she needed to reach her profit goal. How much profit did she make that week?

$300 \times 2 = 600 \times 1,5 = 900 - 150 = R750$ ✓

She made R750 profit that week.

Image 4: Target Profit 1 - Everyday language With formula



Group 4b
Assessmen 8 Feb 2017

SE Smith PhD

Question 2:

April Lou Harvey is the founder of April Showers' Flowers, a multimillion-rand floral empire. April got her start as a humble flower girl selling roses to diners at fancy romantic restaurants. She bought roses from a well-known florist for R1.50 each and sold them to her customers for R3.00. She also had to pay the florist a weekly fee of R150 for the right to be their distributor.

Use the formulas provided on the cheat sheet to answer the following question. Select the number of the formula you used.

2.1 April's goal was to make a profit of at least R300 every week to save up for her dream of opening a florist shop of her own someday. How many roses did April need to sell in a week to reach her goal? $(150 + 300) \div (R1,5)$

$= 300$ roses ✓

Formula used: 6

2.2 April always worked hard, and in one particularly good week she sold exactly twice as many roses as she needed to reach her profit goal. How much profit did she make that week? $300 \times 2 = 600 \times 1,5$

$= R900$ ✗

fixed costs of R150. It could be that, because the student did not have to go through the thinking process in the first formula-facilitated question requiring them to work out how many roses to sell in order to break-even (as the student in Image 3 did), that they did not consider the impact of fixed costs on profit. Formula provision may therefore have hampered this student's learning.

3.5.10.4 Target Profit 2 (TP2)

As the second target profit question was a multiple-choice question with four possible answers, students already had an idea of what the answer should be. There was no significant effect for formulas or language in this question. Students may have found it more difficult to make a connection between the formula-facilitated and application question in this scenario, as the wording of these questions was not as similar as for the previous three transfer opportunities.

3.5.10.5 Margin of Safety (MS)

Formula provision improved the MS transfer scores for the accounting language condition only, but not in the everyday language condition. While there was no significant effect for language, students given everyday language in the no formula condition, appeared to do better than those who were given formulas. Similar to the TP2 question, students may have had difficulty connecting the wording in the formula-facilitated and application questions in this scenario as well.

3.5.11 Effect of language and formulas on cognitive load

Students were asked to rate the level of difficulty (a measure of intrinsic load) and clarity (a measure of extraneous load) of the assessment on a scale of 1 to 7. They also had to indicate on the same scale to what extent the monetary incentive motivated them to remain focused during their completion of the assessment. These results are supplied in Table 3.10. Two students did not complete the survey; thus the total number of students is 114.

The average rating for the monetary incentive was 3.5 ('moderately small extent' to 'moderate extent'). A one-way ANOVA with simple contrasts found no significant difference in this score between the four groups ($F(3,113)=.37$, $p=.774$), even without homogeneity of variances as assessed by Levene's test ($p=.008$).

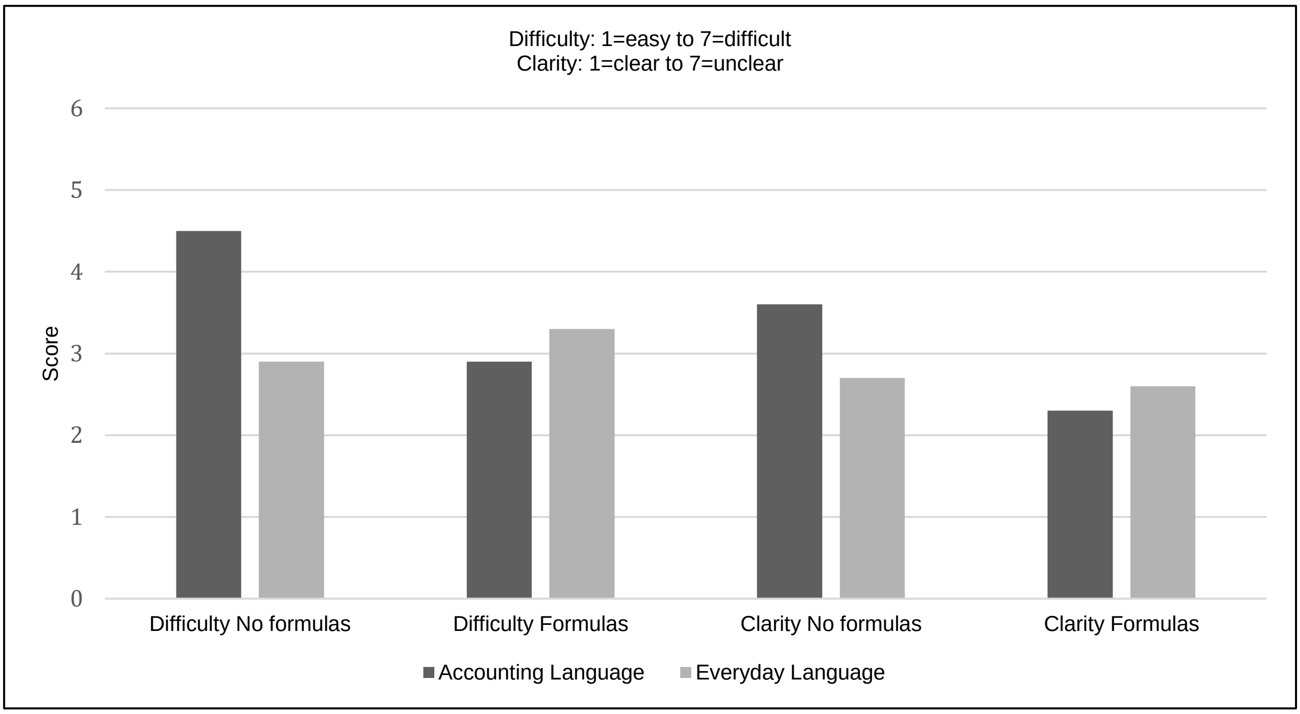
Table 3.10: Survey results

Experimental Group	Difficulty[a]	Clarity[b]	Monetary Incentive[c]
	Mean (SD)	Mean (SD)	Mean (SD)
Accounting language No formula	4.5 (1.1)	3.6 (1.4)	3.7 (1.5)
Accounting language With formula	2.9 (0.9)	2.3 (1.2)	3.8 (2.3)
Everyday language No formula	2.9 (1.3)	2.7 (0.9)	3.4 (1.8)
Everyday language With formula	3.3 (1.1)	2.6 (1.1)	3.3 (1.9)
Total	3.4 (1.3)	2.8 (1.2)	3.5 (1.9)
F(3,110)	11.85	6.22	.37
p	.000	.001	.774

[a] 1=Extremely easy, 4=Neither easy nor difficult, 7=Extremely difficult
[b] 1=Very clear, 4=Neither clear nor unclear, 7=Very unclear
[c] 1=No extent, 4=Moderate extent, 7=Very big extent

Overall, the difficulty of the test was rated 3.4 (moderately easy), while the clarity was rated 2.8 (moderately clear). As expected, the accounting language no formula group rated the test as the most difficult (4.5) and the least clear (3.6). The one-way ANOVA with simple

Figure 3.4: Perceived difficulty and clarity scores for the language and formula conditions



contrasts reported a significant difference between the four groups for the difficulty (F(3,113)=11.85, p<.001) and clarity (F(3,113)=6.22, p<.001) scores. There was homogeneity of variances, as assessed by Levene's test of homogeneity of variances for the difficulty scores only (p=.105), but not for the clarity scores (p=.017). The latter, however, still did not affect the significance of the difference in clarity scores. Figure 3.4 illustrates how the intrinsic (difficulty) and extraneous cognitive load (clarity) scores changed based on the language and formula conditions.

A two-way ANCOVA (Table 3.11) revealed a statistically significant interaction between formula provision and language on the difficulty $F(1,109)=19.78$, $p<.001$, $\eta p^2=.154$ and clarity ratings $F(1,109)=6.32$, $p=.013$, $\eta p^2=.055$. The first-year management accounting result and Grade 12 English level were excluded as covariates in the analysis, as they had no effect on the results, and had a negative impact on the R squared values.

Table 3.11: Two-way ANCOVA on cognitive load scores

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Difficulty	55.605[a]	4	13.901	11.872	.000	.303
	Clarity	25.491[b]	4	6.373	4.693	.002	.147
Intercept	Difficulty	46.662	1	46.662	39.850	.000	.268
	Clarity	12.040	1	12.040	8.866	.004	.075
Covariate							
Grade 12 Maths Result	Difficulty	10.845	1	10.845	9.261	.003	.078
	Clarity	.317	1	.317	.234	.630	.002
Main effects							
LanguageGroup	Difficulty	9.653	1	9.653	8.244	.005	.070
	Clarity	2.988	1	2.988	2.200	.141	.020
FormulaGroup	Difficulty	8.633	1	8.633	7.373	.008	.063
	Clarity	13.361	1	13.361	9.838	.002	.083
Interaction effect							
LanguageGroup X FormulaGroup	Difficulty	23.162	1	23.162	19.781	.000	.154
	Clarity	8.578	1	8.578	6.317	.013	.055
Residual	Difficulty	127.632	109	1.171			
	Clarity	148.026	109	1.358			

a. R Squared = .303 (Adjusted R Squared = .278)
b. R Squared = .147 (Adjusted R Squared = .116)

Students in the no formula condition who were provided with accounting language and no formula found the test more difficult and less clear than those given everyday language. The adjusted mean difficulty score for students given accounting language without formulas was 1.485 points (95% CI, 0.916 to 2.055) higher than for this given everyday language. This effect was large, $F(1,109)=26.76$, $p<.001$, $\eta p2=.197$. Everyday language students rated the clarity of the test as .874 points (95% CI, 0.261 to 1.486) better than accounting language students. This was a medium effect, $F(1,109)=7.98$, $p=.006$, $\eta p2=.068$.

Students provided with accounting language and no formula, found the test more difficult and less clear than those given accounting language with formula. The adjusted mean difficulty score for students in the accounting language without formulas condition was 1.455 points higher than for those given formulas (95% CI, 0.879 to 2.031). This effect was large, $F(1,109)=25.10$, $p<.001$, $\eta p2=.187$. Students in the no formula condition had an adjusted mean clarity score that was 1.236 points lower than for those given formulas (95% CI, 0.616 to 1.856), also with a large effect size (F(1,109)=15.623, p<.001, ηp2=.125).

Formulas appeared to increase the difficulty scores and worsen the clarity scores when everyday language was provided. However, the differences were not significant.

H4a and H4b are therefore both supported as students in the accounting language no formula group perceived the difficulty (intrinsic load) of the test as being higher and less clear (extraneous load) than for those given everyday language and/or formulas.

3.5.12 Effect of the Grade 12 English level on student performance and cognitive load

Student mean scores separated by whether they took English at home language (HL) or first additional language (FAL) level at school, are compared in Table 3.12. Students with EAL underperformed on formula-facilitated questions only in the ALNF Group.

Table 3.12: Comparison of means (standard deviation) for Grade 12 English HL and FAL students

	% Formula Correct		**% Application Correct**		**% Total Correct**	
Grade 12 English	**HL**	**FAL**	**HL**	**FAL**	**HL**	**FAL**
ALNF (7, 22))	68.2* (19.8)	49.2* (27.1)	59.1 (20.9)	42.9 (29.3)	64.9* (16.5)	46.9* (21.4)*
ALWF (8, 21))	95.8 (7.4)	94.4 (15.7)	76.2 (21.6)	57.5 (19.8)	88.8 (8.9)	81.3 (16.2)
ELNF (8, 21)	88.9 (13.1)	83.3 (21.4)	70.5 (21.6)	70.0 (26.2)	82.3 (13.7)	78.6 (22.3)
ELWF (8, 21)	95.8 (9.6)	88.9 (15.7)	66.7 (25.6)	65.0 (23.3)	85.4 (12.3)	80.4 (14.2)
Total (31, 85)	86.9 (17.5)	79.9 (25.9)	68.0 (22.9)	59.4 (25.6)	80.2 (15.9)	72.6 (22.7)

* The total and formula-facilitated scores of the students with EAL in the ALNF group were significantly lower than those of English HL students at the p<.05 level.

A two-way between-group ANOVA (not shown) was conducted to explore the impact of students' level of English taken in Grade 12 and the experiment group they were in, on the three dependent variables. The interaction effect between the Grade 12 English level and the experiment group was not statistically significant for any of the dependent variables (p>.05). There was a statistically significant main effect for the Grade 12 English level, with a medium effect size for total scores (F(1,108)=7.65, p=.007, ηp^2=.066) and formula-facilitated scores (F(1,108)=6.37, p=.013, ηp^2=.056). The effect for application scores was not significant (p=.058).

Pairwise comparisons revealed that students with EAL in the ALNF group had a statistically significant lower mean total score, 18.00 (95% CI, 5.31 to 30.68), p=.006, and formula-facilitated score, 18.98 (95% CI, 5.71 to 32.25), p=.005, than students with Grade 12 English HL in the same group.

A two-way between-group ANOVA (not shown) of the impact of students' level of English taken in Grade 12 and the experiment group they were in, on their transfer scores, resulted in a significant main effect for the Grade 12 English level for the TP1 transfer score ($F(1,108)=5.31$, $p=.023$, $\eta p^2=.047$) and a significant interaction effect for the CM transfer score at the p=.072 level ($F(1,108)=2.40$, $\eta p^2=.062$).

Pairwise comparisons revealed that students with EAL scored .918 points (95% CI, .072 to .954) less on the TP1 transfer score than Grade 12 English HL students. For the CM transfer score, students with EAL in the accounting language with formula condition scored .958 points (95% CI, .154 to 1.762) less than the Grade 12 English HL students in the same condition.

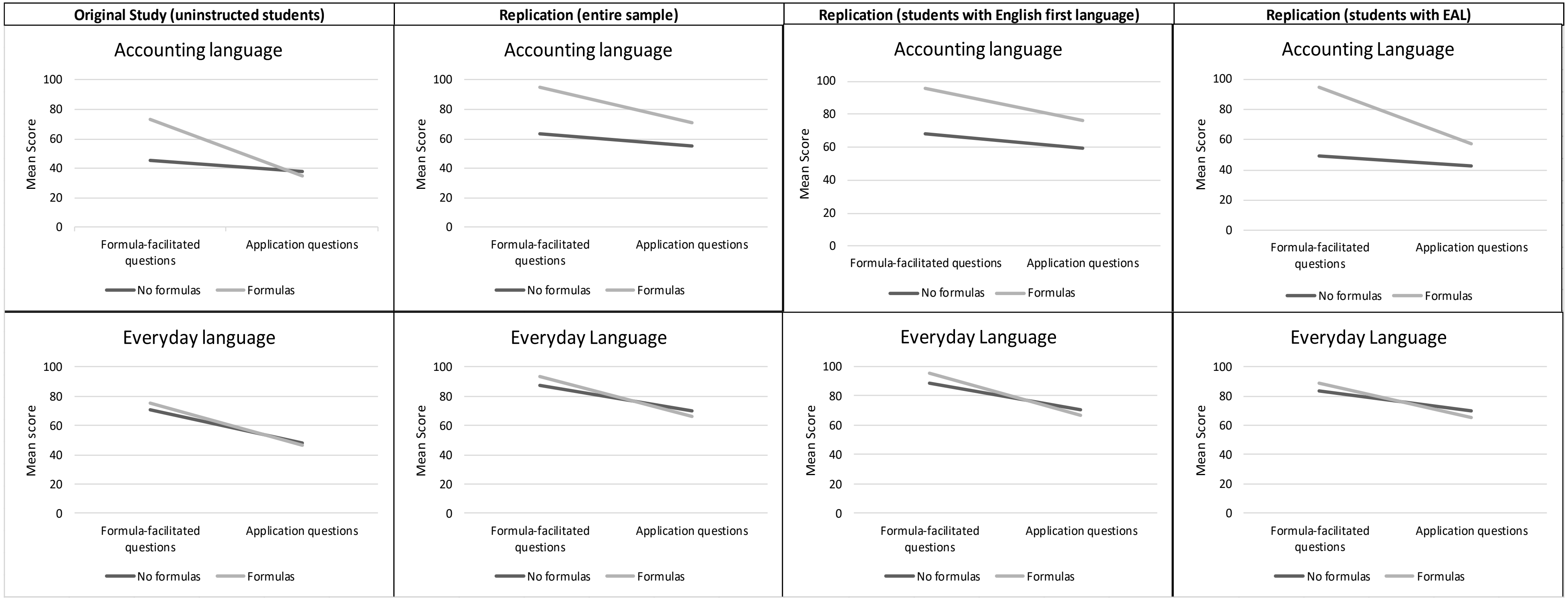
A further two-way between-group ANOVA (not shown) was conducted, which explored the impact of students' level of English taken in Grade 12 and the experimental group they were in, on the two cognitive load variables. The interaction effect between the Grade 12 English level and the experimental group was not statistically significant for either of the cognitive load variables (p>.05). There was also no statistically significant main effect for the Grade 12 English level (p>.05).

3.5.13 Results compared to Johnson and Sargent (2014) study

The results of this study are now compared to those of the prior study. The studies were not meant to be identical. All of the changes made in the execution of the current study and to the research instrument, were in order to improve the rigour of the experiment conducted. These differences are described in the research methodology section 3.4.

Figure 3.5 represents the results for the entire sample of 116 students, as well as for the 85 English HL students and the 31 students with EAL, compared to the uninstructed students in the Johnson and Sargent (2014) study. Overall, students' performance in this study surpassed that of students in the Johnson and Sargent (2014) research. This can be attributed to the high level of academic achievement of the students in this experiment in the year they completed high school compared to the overall cohort, and also to their exposure to costing concepts in their first year of study.

Figure 3.5: Results compared to Johnson and Sargent (2014)



For the everyday language condition, the pattern of the results was similar to those of Johnson and Sargent (2014), with formula-facilitated scores higher than application scores, and minimal difference between the formula and no-formula conditions. For questions phrased in accounting language, formulas appeared to assist students more in the application questions than they did in the Johnson and Sargent (2014) study. This may be due to the fact that the application questions in this study were adapted.

For students with EAL, the effect of providing questions in everyday language rather than accounting language improved their performance considerably. The test scores for those given accounting language without formulas were lower than for the English first-language students, but in the everyday language condition, the scores of students with EAL were similar to the scores of the first-language students. Students with EAL appeared to have an even greater decrease in transfer scores for accounting language questions with formulas provided than the English first-language students.

The perceived cognitive load measures of the students in this study were compared with those of the participants in the Johnson and Sargent (2014) study. Figures 3.2 and 3.4 refer. Both sets of participants found that without formulas, the accounting language condition was more difficult and less clear, than the everyday language condition. When formulas were provided, students in this study perceived the everyday language condition as more difficult and less clear than the accounting language condition, compared to the prior study where the difficult and clarity scores were similar.

3.6 DISCUSSION

Including students' prior knowledge variables in the analysis, revealed that students with higher school-leaving mathematics and first-year management accounting grades performed significantly better on the application questions, which required them to apply the knowledge they had learnt from the formula-facilitated questions. This result reinforces the necessity of controlling for prior knowledge variables in research of this nature.

Students who took English at first language level in high school achieved better scores on the formula-facilitated questions in the accounting language no formula condition than students with EAL. While the differences were not significant, the application scores of students with EAL were lower than for students with English HL in both formula conditions with accounting language. For the TP1 transfer score, students with English as a first language outperfomed students with EAL. In the accounting language with formula condition, students with EAL underperformed on the CM transfer score. The performance of students with EAL is discussed further at the end of this section.

The provision of formulas assisted students when answering the formula-facilitated questions phrased in accounting language. They could match the accounting terminology in the question to the same accounting terms appearing in the formulas provided. In the everyday language condition, the effect of formulas on formula-facilitated scores was however negligible. Formulas also assisted students given accounting language in improving their mean application scores. While not significant, providing formulas decreased students' scores on application question in the everyday language condition.

The results indicate that without formulas, everyday instead of technical language made the questions more accessible and improved students' results. The cognitive load perception of students who did not receive formulas supported this result. Those who received everyday language perceived the test as being easier (lower intrinsic load) and clearer (lower extraneous load) than those who received accounting language. Students with the everyday language version of the test did not have to deal with the unfamiliar technical terminology, and therefore had more working memory available for comprehension. Conversely, in the accounting language condition, the unfamiliar CVP terminology increased the extraneous cognitive load experienced by students.

However, when given formulas, students' perceptions of the difficulty and clarity of the test changed. While the difference was not significant students who received accounting language together with formulas found the test to be easier and clearer than those who received everyday language with formulas. This translates to a higher intrinsic and extraneous cognitive load in the everyday language with formula condition. The addition of formulas to everyday language was extraneous and made the task more difficult for students. Students found it easier to match the technical terms to the terms in the formulas when the latter also used technical language. The technical terms were easily recognisable and generally shorter than the everyday language terms. For example, in the first contribution margin question, the accounting version asked for Taco Joe's 'unit contribution margin', and the formula provided used exactly the same term. On the other hand, the everyday language version asked 'for each taco sold, how much profit does Taco Joe's make?' The everyday language formula used the term 'profit per product unit' that was not as easy to connect directly to what was asked in the question. This means that when using everyday language, also providing students with formulas in everyday language is counterproductive.

Students' ability to apply their knowledge gained in formula-facilitated questions to application questions was measured by means of five separate transfer scores. Everyday language had a positive effect on the transfer scores in the no formula condition. Conversely, when formulas were provided, everyday language students scored lower transfer scores than accounting language students did in three of the five instances. Everyday language students with and without formulas achieved similar results in the CM and TP2 transfer scores. Either students did not use the formulas in these two questions or if they did use them, it had no effect on their result. For the BE transfer score, formulas assisted everyday language students. This is because the application question was multiple choice and students could manipulate the formula provided to correctly answer the question. For the TP1 and MS transfer scores, everyday language students who received formulas underperformed compared to students without formulas.

Formulas therefore appeared to be extraneous to the transfer process when everyday language was provided and hampered student learning, as the high element interactivity (intrinsic load) of the application problem(s) together with the extraneous formulas would have exceeded students' working memory capacity. This provides further support for the conclusion that students should not be given formulas together with everyday language.

In the accounting language condition, the extraneous load of unfamiliar accounting language made it difficult for students to transfer their knowledge. Formulas assisted students given accounting language in mentally organising the material, relating it to their prior knowledge and therefore improving their germane load. The transfer scores of students in the accounting language no formula condition match up to their perceived higher levels of difficulty and uncertainty (lower clarity). The difficulty rating as a measure of intrinsic load for this group was directly related to the effect of the use of accounting terminology (which was an extraneous load when formulas were not provided). In both everyday language conditions (with and without formulas) and in the accounting language with formula condition students found the assessment easier and clearer.

To optimise the transfer of learning when teaching complex tasks, such as CVP analysis, it is important to avoid cognitive overload (van Merriënboer *et al.*, 2006). The first obvious solution is the use of everyday language when introducing a topic to students. A further suggestion is using a part-whole element interactivity approach. In this assessment, the formula-facilitated questions had fewer elements students needed to consider at the same time to solve the problems. Students could use the knowledge gained from the lower level of interactivity in these questions to build up their knowledge schemata required to solve the more interactive application type questions. This part-whole structure served to reduce the intrinsic load of the tasks and when given everyday language without formulas, extraneous load was reduced and the mental processing required to solve the problems was stimulated (van Merriënboer *et al.*, 2006), thereby improving students' transfer scores.

Van Merriënboer *et al.* (2006) warn against instructional methods, such as the provision of formulas, which facilitate the aspects of a task that are similar between situations. The reason is that these methods limit students' thinking, and make it more difficult for them to generate productive solutions or 'think outside the box'. The examples provided in the analysis are indicative of the constraints that formulas may place on students' cognitive processing.

Finally, it appeared that students with EAL were more negatively affected by the technical terminology than students with English as a first language. Reducing this extraneous cognitive load improved the learning outcomes of students with EAL, bringing them into line with those of English first-language students. The latter group of students may have more elaborate cognitive language schemata that lower the intrinsic cognitive load of a task involving technical language compared to students with EAL. In addition to the high level of interactivity in CVP analysis problems, the additional load imposed by accounting language can overload the working memory capacity of students with EAL. There did not however appear to be any difference in the perceived cognitive load experienced between the two groups of students.

As the number of students with EAL was relatively small, the results for students with EAL are not conclusive. However, they do indicate that everyday language facilitated the learning processes of students with EAL.

3.7 CONCLUSION

At the outset of this chapter, it was noted that accounting educators want their students to learn how to think. This study experimented with the concept of the transfer of learning using CLT to assist in determining effective instructional practices to achieve this. The conclusion reached is that when teaching introductory accounting topics, we as educators must consider students' prior knowledge including their English language experience. We need to identify when methods or materials provided to students are actually extraneous to their learning processes. If we have a stake in these it can be difficult to recognise that what we thought was a good idea might be doing more harm than good. In addition, the increasing language diversity in accounting classrooms makes the management of issues surrounding the learning processes of students with EAL essential. The results of this study indicate that introducing new technical concepts in everyday language instead of using accounting language may assist students with no prior experience of the CVP topic.

This study used a unique measure to test students' ability to apply what they had learnt in the formula-facilitated questions to the application questions. Comparing the transfer performance for the four experimental conditions in the study indicated that everyday language improved transfer performance in the no formula condition, and formulas improved transfer performance in the accounting language condition. The optimal condition for transfer performance appears to be providing everyday language without formulas. The extraneous load of accounting language is eliminated, and the intrinsic load allows students to transfer what they learn from lower interactivity questions to the application questions, thus optimising the use of germane resources.

The following instructional design guidelines are provided for accounting educators to use when teaching an accounting topic to students with no prior experience in the topic. These suggestions correspond to those supplied by Leppink (2017) to medical educators based on recent CLT research.

The first guideline is that specific learning goals, such as transfer of learning, should be set before instruction commences. Students' prior knowledge, together with the learning outcomes should then determine what is intrinsic to the specific instructional activity. Educators should structure the intrinsic load of the topic so that it does not overwhelm students limited cognitive resources, but rather enables them to build up the relevant schemata in their long-term memory in a progressive manner. Following on the suggestions of prior research (van Merriënboer *et al.*, 2006) the results of this study indicate that sequencing CVP tasks from low to high levels of interactivity together with reducing the extraneous load formulas provide, promotes students' learning processes. Encouraging germane load in this way allows students to structure the necessary schemata in long-term memory that allow them to apply their knowledge in transfer situations.

Secondly, cognitive activity that does not contribute to learning (extraneous load) should be minimised. When teaching the principles of CVP analysis for the first time, and to maximise transfer of learning, educators should avoid using technical terminology and should not provide students with formulas. Students' working memory resources consumed by technical terminology and their attempts to use the formulas, will not contribute to the intended learning outcome.

Finally, as occurred in this experiment, assessment for learning is an important instructional strategy. Even though students were unaware that they were learning while they were completing the test, those in the conditions that were optimal for the transfer of learning made significant progress in understanding the basic premises of CVP analysis and being able to apply that knowledge. If it had been possible to provide students with feedback on their progress while completing the assessment, it would have further assisted them in monitoring their own learning. Part of teaching students how to think is that we want them to reflect on what they have already learnt and to make the appropriate choice about what to study next (Leppink, 2017).

A concluding point to make regarding instructional design is that technical terminology and providing formulas are less likely to overload students' working memory resources as they become more proficient at the topic. What constitutes extraneous load at the beginning stages of learning may become part of intrinsic load in subsequent learning objectives (Leppink, 2017).

3.8 LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

The premise of this thesis is that students need to be socialised into the language of accounting. In order for student learning to be effective, accounting concepts should be introduced and explained in language that moves from everyday language that students already understand to the more technical language that they need to develop for full understanding of the concepts (Schleppegrell, 2007). Further work is needed in exploring ways of modifying the language features of accounting assessment tasks to try to make the meanings more accessible to students, in particular those with EAL.

To improve the validity of the results, future versions of the research instrument should only include calculation type questions and not multiple-choice questions, as students performed differently for the two types of questions. In future research, it would be useful to change the two multiple-choice application questions to calculation type questions. This would make all the application questions more comparable in order to determine the effect of language and formula provision.

The single-measures used for measuring cognitive load are inherently limited. Future studies should consider using the multiple-item psychometric instrument developed by Leppink, *et al.* (2013, 2014) to obtain a more reliable measure of intrinsic and extraneous cognitive load.

The same accounting topic (i.e. CVP) that Johnson and Sargent (2014) used was investigated. Research testing the effectiveness of formula and language use in the assessment of other accounting topics, (e.g. the use of patterns to teach students the double entry principle in accounting) should be conducted.

The effects of accounting versus everyday language provision on the performance of students with EAL in introductory accounting topics need further investigation. In South Africa, the classification of students with EAL is complicated. In this study, speaking another language besides English at home did not appear to make a difference to students' results, while taking English as an additional language in high school did. Repeating this study with a larger sample of students, including those who speak another primary language besides English and those who studied English as an additional language at school, would serve to clarify this issue.

3.9 REFERENCES

Brünken, R., Seufert, T. and Paas, F. (2010), "Measuring Cognitive Load", in Plass, J.L., Moreno, R. and Brünken, R. (Eds.), *Cognitive Load Theory*, Cambridge University Press, pp. 181–202.

Cohen, J. (1988), *Statistical Power Analysis for the Behavioral Sciences*, 2nd ed., Lawrence Erlbaum Associates, Inc., Hillsdale, N.J.

DeLeeuw, K.E. and Mayer, R.E. (2008), "A Comparison of Three Measures of Cognitive Load: Evidence for Separable Measures of Intrinsic, Extraneous, and Germane Load", *Journal of Educational Psychology*, Vol. 100 No. 1, pp. 223–234.

Department of Basic Education. (2015), *2015 National Senior Certificate Examination Diagnostic Report*, available at: https://www.education.gov.za/Portals/0/Documents/Reports/2015 NSC Diagnostic Report.pdf?ver=2016-01-05-001418-000.

Faul, F., Erdfelder, E., Buchner, A. and Lang, A.-G. (2009), "Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses.", *Behavior Research Methods*, Vol. 41 No. 4, pp. 1149–60.

Faul, F., Erdfelder, E., Lang, A.-G. and Buchner, A. (2007), "G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences", *Behavior Research Methods*, Vol. 39, pp. 175–191.

Field, A. (2013), *Discovering Statistics Using IBM SPSS Statistics*, 4th ed., SAGE Publications Inc.

Hwang, N.-C.R., Lui, G. and Tong, M.Y.J.W. (2005), "An Empirical Test of Cooperative Learning in a Passive Learning Environment", *Issues in Accounting Education*, Vol. 20 No. 2, pp. 151–165.

Hwang, N.-C.R., Lui, G. and Tong, M.Y.J.W. (2008), "Cooperative Learning in a Passive Learning Environment: a replication and extension", *Issues in Accounting Education*, Vol. 23 No. 1, pp. 67–75.

Johnson, B.G. and Sargent, C.S. (2014), "Impact of Formulas, Language and Instruction on Student Performance on Cost-Volume-Profit Problems", *Accounting Education: An International Journal*, Vol. 23 No. 1, pp. 22–41.

Kalyuga, S. (2011), "Cognitive Load Theory: How Many Types of Load Does It Really Need?", *Educational Psychology Review*, Vol. 23 No. 1, pp. 1–19.

Kalyuga, S. and Singh, A.-M. (2016), “Rethinking the Boundaries of Cognitive Load Theory in Complex Learning”, *Educational Psychology Review*, Vol. 28 No. 4, pp. 831–852.

Kirschner, P.A., Sweller, J. and Clark, R.E. (2006), “Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching”, *Educational Psychologist*, Vol. 41 No. 2, pp. 75–86.

Koedinger, K.R. and Roll, I. (2012), “Learning to Think: Cognitive Mechanisms of Knowledge Transfer”, in Holyoak, K.J. and Morrison, R.G. (Eds.), *The Oxford Handbook of Thinking and Reasoning*, Oxford University Press, New York, NY, US, pp. 699–716.

Krathwohl, D.R. (2002), “A Revision of Bloom’s Taxonomy: An Overview”, *Theory into Practice*, Vol. 41 No. 4, pp. 212–218.

Laerd Statistics. (2017), “Statistical tutorials and software guides”, available at: https://statistics.laerd.com/.

Leppink, J. (2017), “Cognitive load theory: Practical implications and an important challenge”, *Journal of Taibah University Medical Sciences*, Elsevier Ltd, Vol. 12 No. 5, pp. 385–391.

Leppink, J. and van den Heuvel, A. (2015), “The evolution of cognitive load theory and its application to medical education”, *Perspectives on Medical Education*, Vol. 4 No. 3, pp. 119–127.

Leppink, J., Paas, F., van Gog, T., van der Vleuten, C.P.M. and van Merriënboer, J.J.G. (2014), “Effects of pairs of problems and examples on task performance and different types of cognitive load”, *Learning and Instruction*, Elsevier Ltd, Vol. 30, pp. 32–42.

Leppink, J., Paas, F., van der Vleuten, C.P.M., van Gog, T. and van Merriënboer, J.J.G. (2013), “Development of an instrument for measuring different types of cognitive load”, *Behavior Research Methods*, Vol. 45 No. 4, pp. 1058–1072.

Mair, P., Schoenbrodt, F. and Wilcox, R.R. (2017), “WRS2: Wilcox robust estimation and testing”.

Mostyn, G.R. (2012), “Cognitive load theory: What it is, why it’s important for accounting instruction and research”, *Issues in Accounting Education*, Vol. 27 No. 1, pp. 227–245.

Paas, F. and van Merriënboer, J.J.G. (1994), “Variability of worked examples and transfer of geometric problem-solving skills: A cognitive load approach.”, *Journal of Educational Psychology,* Vol. 86 No. 1, pp. 122–133.

Paas, F., van Merriënboer, J.J.G. and Adam, J.J. (1994), “Measurement of Cognitive Load in Instructional Research”, *Perceptual and Motor Skills*, Vol. 79 No. 1, pp. 419–430.

Paas, F., Tuovinen, J.E., Tabbers, H. and van Gerven, P.W.M. (2003), “Cognitive Load Measurement as a Means to Advance Cognitive Load Theory”, *Educational Psychologist*, Vol. 38 No. 1, pp. 63–71.

R Core Team. (2018), “R: A Language and Environment for Statistical Computing”, R Foundation for Statistical Computing, Vienna, Austria, available at: https://www.r-project.org/.

Richardson, J.T.E. (2011), “Eta squared and partial eta squared as measures of effect size in educational research”, *Educational Research Review*, Elsevier Ltd, Vol. 6 No. 2, pp. 135–147.

Schleppegrell, M. (2007) "The linguistic challenges of mathematics teaching and learning: A research review", *Reading and Writing Quarterly*, Vol. 23 No. 2, pp. 139-159.

Sweller, J. (1988), “Cognitive Load During Problem Solving: Effects on Learning”, *Cognitive Science*, Vol. 12 No. 2, pp. 257–285.

Sweller, J. (1994), “Cognitive Load Theory, Learning Difficulty, and Instructional Design”, *Learning and Instruction*, Vol. 4, pp. 295–312.

Sweller, J. (2010a), “Element interactivity and intrinsic, extraneous, and germane cognitive load”, *Educational Psychology Review*, Vol. 22 No. 2, pp. 123–138.

Sweller, J. (2010b), “Cognitive Load Theory: Recent Theoretical Advances”, in Plass, J.L., Moreno, R. and Brünken, R. (Eds.), *Cognitive Load Theory*, Cambridge University Press, pp. 29–47.

Sweller, J. and Chandler, P. (1994), “Why Some Material Is Difficult to Learn”, *Cognition and Instruction*, Vol. 12 No. 3, pp. 185–233.

Tavakol, M. and Dennick, R. (2011), “Making sense of Cronbach’s alpha”, *International Journal of Medical Education*, Vol. 2, pp. 53–55.

van Merriënboer, J.J.G., de Croock, M.B.M. and Jelsma, O. (1997), “The Transfer Paradox: Effects of Contextual Interference on Retention and Transfer Performance of a Complex Cognitive Skill”, *Perceptual and Motor Skills*, Vol. 84 No. 3, pp. 784–786.

van Merriënboer, J.J.G., Kester, L. and Paas, F. (2006), “Teaching complex rather than simple tasks: Balancing intrinsic and germane load to enhance transfer of learning”, *Applied Cognitive Psychology*, Vol. 20 No. 3, pp. 343–352.

CHAPTER 4
THE INSTRUCTIONAL EFFICIENCY OF MULTIMEDIA PRESENTATIONS OF THE ACCOUNTING EQUATION FOR STUDENTS WITH ENGLISH AS AN ADDITIONAL LANGUAGE

4.1 INTRODUCTION

In addition to learning the language of accounting, students for whom English is an additional language (EAL) must also deal with learning the English language itself. If students with EAL need to concentrate on the meaning of discrete words and unfamiliar phrases in the English language they are hearing and reading it could detract from their comprehension of the subject matter (Mayer, Lee and Peebles, 2014). This potential additional load on the working memory capacity of students with EAL, means that the cognitive resources they have available to learn accounting content may be reduced compared to their counterparts who speak English as a first language.

So how can educators make the content of accounting more accessible to students with EAL, thereby relieving the constraints on their working memory capacity? One avenue to consider is how students assimilate non-academic information outside of the classroom context. Rapid advances in technology and students' exposure to visual and social media mean that today's student no longer learns and communicates through written and verbal text only. Multimedia learning uses the principle that students learn more authentically from words and images than from words alone (Mayer, 2005).

This first purpose of this study was therefore to investigate the effect of a multimedia presentation of the accounting equation, that uses visual images to represent unfamiliar words and phrases, on the quality of the learning outcomes of both students with English as a first language and students with EAL, as measured by their performance and cognitive load experiences. The animation was designed using the constructs of the cognitive theory for multimedia learning (CTML) (Mayer, 2005; Mayer and Moreno, 2002).

The second impetus for this study was to find an efficient way of teaching the accounting equation at the beginning of the introductory accounting course the researcher was lecturing. The decision to experiment with using an animation was an attempt to engage students, and thereby promote their learning. Finding ways to interest students in accounting from the start of a course is a common challenge for introductory accounting educators (Stice and Stice, 2006). If students do not understand the initial accounting concepts, their subsequent achievement is negatively affected (Stice and Stice, 2006; Turner, Holmes and Wiggins, 1997).

Third, the use of multimedia instruction to promote students with EAL's understanding of accounting concepts has not been explored in experimental studies. Wynder's (2018) account of the use of animations in two accounting courses is non-experimental, but indicates that visualisations may increase the learning efficiency of students with EAL. In other subject areas, multimedia research indicates that animations encourage learning (Berney and Bétrancourt, 2016). This study therefore tests the prediction of Wynder in a controlled experiment.

Finally, this study combines the CTML and CLT. Both theories consider the effect of teaching practices on students' cognitive capacities and processes. The CTML focuses on the role of three types of cognitive processing during multimedia learning and provides instructional design principles on which the animation developed for this study was based (Kalyuga, 2011). DeLeeuw and Mayer (2008) map the three types of cognitive processes onto the corresponding types of load in CLT, allowing for the measurement thereof, as was done in this study.

4.1.1 Teaching the accounting equation

Using the accounting equation to teach double-entry bookkeeping is a pedagogical choice made by many, but not all, financial accounting educators (Palm and Bisman, 2010; Phillips and Heiser, 2011; Sangster, 2010). While the intent of this study is not to justify the topic used for the task, it is the author's view that using the accounting equation to teach double entry bookkeeping is an essential step in helping students analyse transactions and prepare journal entries that are fundamental to the accounting process.

Phillips and Heiser (2011) support this teaching approach. They found that introductory accounting students who were required to document the accounting equation effect of transactions were able to prepare accurate journal entries from inception. They argue that using the accounting equation acts as a scaffold that assists student comprehension of each accounting transaction and alleviates demands on their working memory, thereby contributing to better performance (Phillips and Heiser, 2011). Even though the benefits of an accounting equation emphasis diminished as students became familiar with the process of preparing a journal entry, the authors maintained that the initial improvement in student performance helped to engage students and prevent negative perceptions towards accounting as a subject (Phillips and Heiser, 2011). This engagement with the subject matter at an early stage is an ideal, which every accounting educator would endorse.

4.1.2 Background variables

When studying the effect of any introductory accounting intervention, it is important to consider background variables that may influence student outcomes. The accounting equation task used in this experiment is similar to what students would have been exposed to if they took accounting as a subject in Grade 12. Research has shown that secondary school accounting improves the performance of first-year accounting students (Barnes, Dzansi, Wilkinson and Viljoen, 2009; Eskew and Faley, 1988; Naser and Peel, 1998; Rankin, Silvester, Vallely and Wyatt, 2003). To study a commerce degree at the university where this experiment took place, Grade 12 accounting is not a compulsory subject, although many students take it. One of the planned outcomes of this experiment was therefore to consider the effect of students' previous exposure to accounting.

This study also uses students' language backgrounds as an independent variable. The reason for this is twofold. Evidence from research conducted both in South Africa and abroad, that accounting students with EAL consistently underperform compared to students with English as their first language (Sartorius and Sartorius, 2013; Smith, Therry and Whale, 2012; Wagner and Huang, 2011) Furthermore, language plays a unique role in the South African education system. Students with EAL can be categorised in two ways, based on whether they speak another language besides English as their primary (home) language or whether they studied English as a first additional language at school. Both categorisations are considered in this work.

4.1.3 Testing instructional efficiency

The goal of the experiment was to test the instructional efficiency of a story-based whiteboard animation that used pictures together with narration to explain the accounting equation, compared to a voice-over PowerPoint (Microsoft, 2013) presentation. The latter presentation described the same scenario presented in the animation, but utilised the accounting equation table format, with the narrator's writing visible while completing the table during the explanation. As the same narration was provided for both presentations; it was only the visual element that was different between the two presentations. The use of

PowerPoint is the customary way in which the core lecture content is shared with students, embedded in the lecturer's live narration (oral instruction). The purpose of the experiment was to compare on-screen support making use of a combination of the written mode (text) and still pictures (PowerPoint using the accounting equation table) with animated visuals (combining the modes of still pictures and movement). The PowerPoint presentation was therefore used as a control.

The reason for testing instructional efficiency is that it measures the quality of student learning outcomes. It is calculated using the result of task performance and the cognitive load experienced by the students while undertaking a specific task (van Gog and Paas, 2008; Paas and van Merriënboer, 1993). By quantifying the mental effort expended by students in achieving their test grades, insight is provided into the cognitive consequences of the accounting equation assignment for students with diverse language backgrounds.

This study will be of interest to accounting educators who are looking for efficient ways of improving the learning outcomes of their novice accounting students by using multimedia presentations, especially animations, with a specific focus on students who are learning accounting in English as an additional language. The animation also provides instructional designers with an example of how to implement the design principles of the CTML.

The remainder of this chapter proceeds as follows: First relevant prior literature is reviewed. The next section describes the theoretical underpinnings for the study drawn from the CTML. The application of this theory to the two presentation tools designed for this study follows. The student performance, cognitive load and instructional efficiency measures used are then discussed. The subsequent section covers the development of the hypotheses. The results and analysis follow the description of the methodology used for the experiment. The implications of the outcomes of the experiment are then discussed, followed by the conclusion. Finally, the limitations of the study and suggestions for future research are presented.

4.2 LITERATURE REVIEW

Other disciplines, such as the natural and physical sciences, have reported the positive effect of animations on student learning (Barak, Ashkar and Dori, 2011; Lin and Atkinson, 2011; Stebner, Kühl, Höffler, Wirth and Ayres, 2017; Türkay, 2016). A meta-analysis of experimental studies conducted by Berney and Bétrancourt (2016) found that the use of animations had an overall positive effect on learning compared to static graphics.

However, Castro-Alonso, Ayres and Paas (2016) argue that the effect is not always positive and that the visualisations compared in many studies do not control for confounding variables, such as appeal, media, realism, size, and interaction. In this study, it is not the intention to contend that animations are conclusively better than a more traditional approach to teaching the accounting equation. The focus is on whether animation as an instructional design for teaching foundational accounting concepts is better aligned to the way that students think, and to overcoming the limitations on their cognitive resources, in particular for students with EAL. The aim was to find innovative ways to engage students while they learn foundational accounting concepts.

In accounting education, an early experimental study by Butler and Mautz (1996) found that the use of multimedia, including animations, elicited a more positive response from students than a text-based verbal approach. A multimedia presentation resulted in higher recall, mainly for students who preferred to represent information graphically, rather than verbally (Butler and Mautz, 1996). Since then the technology to produce multimedia learning opportunities for students has become far more diverse and accessible. Despite this, research on the effects of different types of instructional multimedia on student learning and performance is limited (Ilioudi, Giannakos and Chorianopoulos, 2013). In the field of accounting education, Wynder (2018) reported on the use of whiteboard animations as learning materials for both students with English as a first language and students with EAL. He based his research on cognitive load theory (CLT) and found that students with self-reported low English comprehension appeared to gain the most significant benefit from visualisation.

Wynder's (2018) paper was also a response to Mostyn (2012) who pointed out that CLT is widely used in research and instructional design in other disciplines, but is underused in accounting education. Mostyn (2012) argues that educators of first-year accounting students need to raise their awareness of the theory and the contribution it makes in identifying the cognitive constraints of novice learners when learning complex tasks and by providing specific methods for improving learning efficiency. This study responds to Mostyn (2012) and Wynder (2018) in testing the effect of animations on the efficiency of learning for introductory accounting students with EAL, using the CTML.

4.3 COGNITIVE THEORY OF MULTIMEDIA LEARNING (CTML)

Multimedia learning environments involve words (printed or spoken) and pictures (e.g. animation, video, illustrations or photos) (Mayer and Moreno, 2010). Animations are simulated motion pictures depicting the movement of drawn or simulated objects, whereas a video is a motion picture representing real objects in motion (Mayer and Moreno, 2002).

The multimedia principle argues that the combined presentation of corresponding words and pictures assists students in building mental connections between the two. Displaying either words or images on their own requires learners to use more working memory to mentally create the missing element (Mayer and Moreno, 2002).

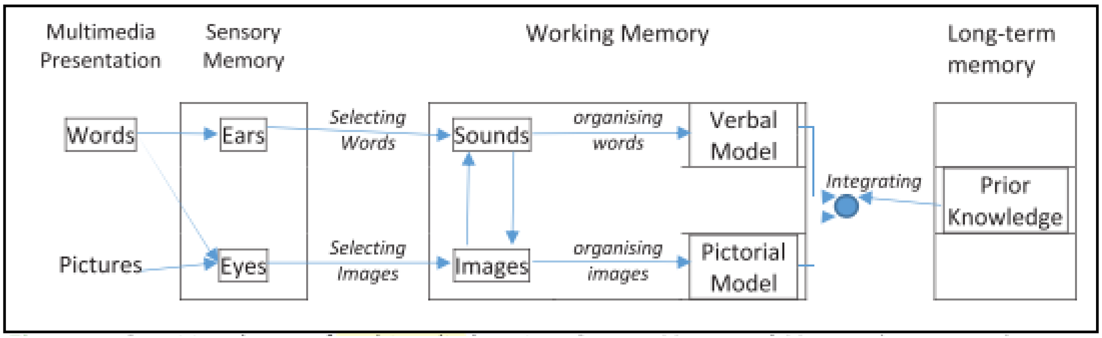
However, just adding pictures to words is not necessarily an efficient way to achieve multimedia learning. Mayer’s CTML aims to create instructional media (combining words and images) in light of how the human mind works (Mayer, 2005). The CTML is a specific version of CLT that was developed to explain the effects of instructional design on cognitive load and learning (Sweller, 1988, 2010b). The focus of both theories is on designing instruction that does not overload the learner’s cognitive system (Mayer and Moreno, 2010).

There are three central assumptions in the CTML (Mayer and Moreno, 2002, 2003):

1. Learners have two separate channels (auditory and visual) for processing information.
2. Each channel is limited regarding what it can actively process at any one time.
3. Meaningful learning is an active process of filtering information, selecting relevant material, organising it into a coherent mental representation and integrating it with prior knowledge.

The challenge of multimedia learning is that students can only actively process a finite amount of incoming material in their information processing channels at a time (Mayer and Moreno, 2010, p. 132). Mayer and Moreno's (2003, p. 44) pictorial representation of the CTML is provided in Figure 4.1. The vertical sequence starting with ‘Words’ and ‘Pictures’ is of the auditory and visual information processing channels respectively. The horizontal progression in the figure represents the three types of memory (sensory, working and long-term).

Figure 4.1: Cognitive theory of multimedia learning



Source: Mayer and Moreno (2003, *p*. 44)

The sensory memory receives stimuli through the ears and eyes and stores it for a brief period (Mayer and Moreno, 2003). The sounds and images selected by the learner in shallow working memory become verbal and pictorial models in deep working memory (Mayer and Moreno, 2003). Working memory has limited capacity. In contrast, the capacity of long-term memory is unlimited. The prior knowledge structures (schemata) stored in long-term memory are activated in different contexts to extract meaning from the information stored temporarily in working memory (Kalyuga, 2010). Learning takes place when the learner integrates prior knowledge stored in long-term memory with the models created in working memory to solve previously unseen problems (Mayer and Moreno, 2003). Working memory adds to existing schemata or creates new ones during the learning process (Kalyuga, 2010).

Cognitive load is the mental load that carrying out a specific task imposes on a learner's cognitive system (Paas and van Merriënboer, 1994). It may impose limitations on students' processing channels. There are three dimensions to the cognitive load imposed on working memory by instructional activities. The first is intrinsic cognitive load. The complexity of the learning task and having to hold a large number of elements in working memory at the same time determines the intrinsic load (Mayer and Moreno, 2010). Therefore students with little or no previous knowledge of the learning material experience higher levels of the intrinsic load than more knowledgeable students (Leppink, Paas, van Gog, van der Vleuten and van Merriënboer, 2014). Intrinsic cognitive load corresponds to essential processing in the CTML, where initial comprehension takes place by engaging in the cognitive process of attending to the relevant material (Mayer and Moreno, 2010), and is caused by the complexity of the material for the learner (Mayer and Estrella, 2014).

The second load is extraneous cognitive load which corresponds to the processing of extraneous material in the CTML that does not serve the objective of the instruction (Mayer and Estrella, 2014). It arises when instructional features are employed that provoke cognitive processes that do not contribute directly to the construction of schemata (Mayer and Moreno, 2010). Poorly designed layout or including non-essential material can hamper learning if the intrinsic load is high or can result in inadequate understanding when the intrinsic load is low (Leppink *et al.*, 2014).

Germane cognitive load arises from instructional features that contribute to learning. It encourages the learner to relate relevant information from long-term memory or the context to the new information elements. Germane load does not add to total cognitive load, but is rather a measure of the extent to which working memory resources are successfully allocated to dealing with intrinsic load (Leppink, 2017). Researchers now refer to this component as 'germane resources' or working memory resources rather than as germane cognitive load (Leppink, van Gog, Paas and Sweller, 2015). This allocation of germane resources corresponds to generative processing in the CTML. Generative processing occurs when the learner engages in mentally organising and integrating new material with the relevant prior knowledge to gain a deeper understanding (Mayer and Moreno, 2010).

When designing teaching and learning activities educators should optimise intrinsic load by selecting learning tasks based on learners' prior knowledge and minimise extraneous load by avoiding ineffective instructional features (Leppink, Paas, van der Vleuten, van Gog and van Merriënboer, 2013). Instruction should allow learners to engage in activities like self-explanation and argumentation that allow students to activate their germane resources, which are conducive to learning.

The extent to which instructional aspects influence extraneous load or the activation of students' germane resources depends on the amount of intrinsic load experienced by the individual learner (Leppink *et al.*, 2013). Research has shown that novice learners learn better from worked examples or from completing a partially solved problem, while more knowledgeable learners benefit most from independent problem-solving (Leppink *et al.*, 2013). Students in the latter category are more likely to find the information in worked examples redundant as they have the prior knowledge to solve the problem without direction. For these learners, processing unnecessary information leads to extraneous load (Leppink *et al.*, 2013). The same instructional feature could, therefore, be associated with a germane load for one learner (enhancing learning outcomes) and with an extraneous load for another (hindering learning outcomes). This incongruent result is known as the expertise reversal effect (Kalyuga, Ayres, Chandler and Sweller, 2003). A higher extraneous load is likewise experienced through the split-attention effect that occurs when explanations cause learners 'to split their attention between two or more mutually referring information sources' (Leppink *et al.*, 2013, p. 1058).

4.3.1 Measurement of cognitive load

Being able to measure cognitive load allows educational researchers and instructional designers to gain a better understanding of why the learning outcomes students achieve with instructional formats may differ between formats or between learners (Leppink *et al.*, 2013). When conducting experimental studies with different instructional designs, the measurement of cognitive load can contribute to a better understanding of the instructional effects for learners with similar or divergent levels of proficiency (Leppink *et al.*, 2013).

Both objective and subjective measures can be used to estimate cognitive load. Objective criteria can be direct, such as secondary task performance, or indirect physiological measures, such as heart rate. An example of a subjective measure is a self-reported mental effort (Martin, 2014). In this experiment, the time taken (Brünken, Seufert and Paas, 2010) to complete the experimental pre-test and post-test were used as an objective measure of total cognitive load. Time on task is a factor often overlooked in the measurement of cognitive load and the calculation of instructional efficiency (Paas, Tuovinen, Tabbers and van Gerven, 2003). Students may not consider the time they spent on a task when rating their cognitive load. For example, if two students give a cognitive load rating of 5 on a 9-point scale, but one took 5 minutes for the task, and the other took 10 minutes, the cognitive load of the second student can be assumed to be higher than for the first.

This study also considers the effects of the different types of cognitive load separately to evaluate the efficacy of the instructional task design. The measures used were based on indicators used in prior research to measure each kind of cognitive load (Leppink *et al.*, 2013, 2014).

A self-report questionnaire using questions adapted from the aforementioned studies was employed. It had a single indicator for overall cognitive load, as well as separate indicators for each of the distinct types of cognitive load. All of the questions were on a 7-point scale.

Question 1 asked students to rate the overall level of mental effort they invested in the activity (Paas *et al.*, 2003). This provided another measure of total cognitive load. The next three questions were taken from the study of Leppink *et al.* (2014). Question 2 dealt with the complexity of the subject matter itself and therefore measured intrinsic load. Question 3 asked about the clarity of the instructions and explanations and measured extraneous load. Question 4 asked students whether the instructions and explanations contributed to their learning. This question was used by Leppink *et al.* (2014) to measure germane load. However, they failed to find evidence supporting this measure, and suggested that it represented a subjective judgement of learning on the part of the student. In this study, this factor is referred to as germane load, but is interpreted on its own to determine its relationship to the other measures of cognitive load and student performance. The main reason for using single indicators for each type of cognitive load was to prevent survey exhaustion in the students (Türkay, 2016).

4.3.2 Instructional efficiency

To enable relevant comparison between the effects of the two different instructional approaches, Paas and van Merriënboer's (1993) instructional efficiency measure relates students' test performance to the mental effort expended to attain that result and calculates the 'quality' of the learning outcome. Mental effort refers to the cognitive capacity allocated to accommodate the demands imposed by the task (i.e. the actual cognitive load) (Paas *et al.*, 2003). The basic premise when interpreting this measure is that high (low) test performance and low (high) mental effort indicates that learning was more (less) efficient (van Gog and Paas, 2008). However, this interpretation of instructional efficiency cannot be applied indiscriminately. For example, the amount of intrinsic load experienced by students may be ascribed to higher levels of interactivity in more complex instructional tasks that require higher levels of cognitive processing (van Gog and Paas, 2008; van Merriënboer, Kester and Paas, 2006).

The equation that Paas and van Merriënboer (1993) introduced to calculate instructional efficiency (where P = standardised test performance scores and E = standardised test mental effort scores) is as follows:

Instructional efficiency = $\frac{Z_{Ptest} - Z_{Etest}}{\sqrt{2}}$

Using this formula, if performance and effort Z-scores are equal ($P = E$), then efficiency is zero; if the performance Z-score is higher than the effort Z-score ($P > E$), then instructional efficiency is positive; and if the performance Z-score is lower than the effort Z-score ($P < E$), then instructional efficiency is negative (Halabi, Tuovinen and Farley, 2005).

4.4 CREATION OF THE MULTIMEDIA LEARNING TOOLS

In terms of Bloom's revised taxonomy (Krathwohl, 2002), the outcomes of the accounting equation learning task set up for this experiment are at the 'conceptual' knowledge level and the 'analyse' cognitive dimension. Students needed to be able to comprehend the interrelationships among the basic elements of the accounting equation that enable them to function together. This comprehension is achieved by breaking the equation down into its constituent parts and detecting how the parts relate to one another and the overall structure and purpose of the equation (Krathwohl, 2002).

The element interactivity in accounting equation questions is part of the intrinsic cognitive load of the topic. Reducing the load placed on working memory by reducing the element interactivity of the topic, without changing what is learned, means that the load is extraneous (Sweller, 2010a). The animation was created with the intention of reducing the extraneous load on students' working memory. It depicted the interactivity of the accounting equation in a symbolic way with coloured blocks and pictures. In contrast, the video presentation used the accounting equation table, a format traditionally used to teach the topic. The motivation when preparing the animation was to assist students in concentrating their working memory resources on the essential elements that impose an intrinsic cognitive load, thereby allowing their germane cognitive load and learning to be maximised (Sweller, 2010a).

The discussion that follows explains how the animation and video presentations used for this study were created.

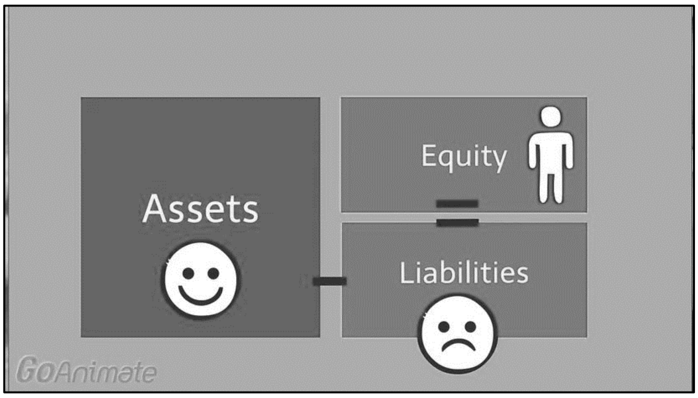
4.4.1 Test animation

Whiteboard animation is a process where the creator draws a storyboard with pictures on a simulated whiteboard (Türkay, 2016). The narrator takes the viewer through the story while constructing the images. The animation created for this experiment dynamically represented the accounting equation concepts as they build on each other. Systematic drawings were used that concluded with the main point represented by a completed picture. The next point then started on a blank board with a new sketch. The animation used appealing line drawings, as emotion-provoking design in multimedia instruction has been shown to foster learning (Mayer and Estrella, 2014).

The GoAnimate (Vyond, 2017) software was used to create an expository animation (Berney and Bétrancourt, 2016) intended to help learners with their conceptual understanding of the accounting equation. Using the functions of expository animations as detailed by Berney and Bétrancourt (2016), one can view the accounting equation as a dynamic system that changes over time.

The animation created depicts the integration of the three elements of the system, namely assets, equity and liabilities. The three elements were represented as three blocks, with assets colour-coded as one big blue block, and equity and liabilities colour coded as two matching red blocks that together equal the size of the blue block. Refer Figure 4.2. This idea came from a YouTube video uploaded by SwotSmart entitled: FAC1503 - Introduction to the accounting equation - Part 1 (https://www.youtube.com/watch?v=T2l9zvz5oAE). To explain each of the elements, a happy face was added for assets, a sad face for liabilities and the figure of a person to represent equity.

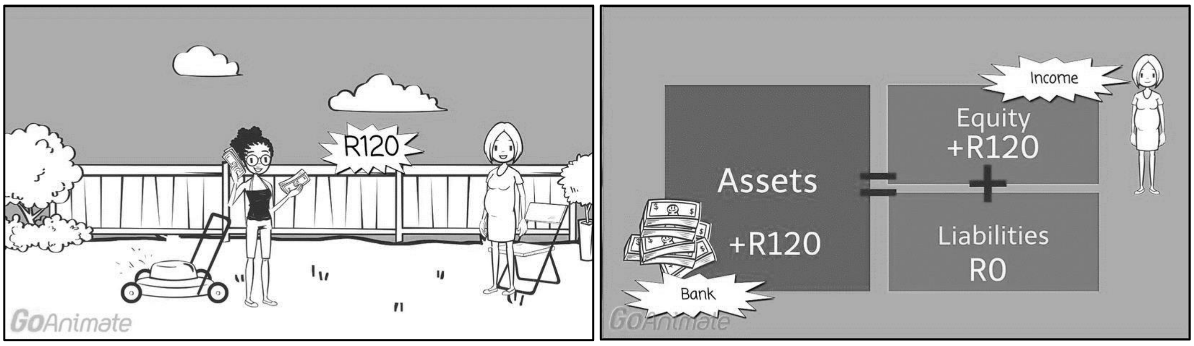
Figure 4.2: Animation representation of the accounting equation



The animation story conveys the dynamics of the accounting equation system by representing the behaviour of its components as different transactions take place. It explains the causal effect of the transactions on the functioning of the system (Berney and Bétrancourt, 2016). Figure 4.3 displays the protagonist in the story, Nandi, purchasing a lawnmower with her own money and the effect on the equation. Figure 4.4 presents Nandi receiving her first payment for mowing a lawn with the corresponding accounting equation result.

Figure 4.3: Animation representation of the purchase of an asset with capital

Figure 4.4: Animation representation of the receipt of money as income



In creating the animation, the theory-based principles for designing effective multimedia presentations, as recommended by Mayer and Moreno (2003), were applied. The first principle is to provide coherent verbal and pictorial information and to guide learners to select relevant words and images, thereby reducing the load for a single processing channel (Mayer and Moreno, 2003).

Next, the spatial contiguity principle was applied, with on-screen text placed close to the related animation for learners to build mental connections between them. If learners have to search for the animation corresponding to the text, they waste cognitive capacity (Mayer and Moreno, 2002). The temporal contiguity principle was easy to implement as it merely means that narration and animation should be presented concurrently rather than successively (Mayer and Moreno, 2002). The coherence principle required all the narrative, animation, sounds and text to be relevant to the intended learning outcome, as extraneous material overloads working memory capacity unnecessarily (Mayer and Moreno, 2002). Students are better able to transfer what they have learnt when the animation is accompanied by narration than by on-screen text. The use of animation and on-screen text together overloads the student's visual channel.

Regarding the modality and redundancy principles, on-screen text was limited and presented only words that were necessary to understand the concept together with the narration and animation (Mayer and Moreno, 2002). The conversational narrative personalised the animation. The young woman in the story was a figure to whom the students could relate (Mayer and Moreno, 2002). Colour and circles were used as a form of visual cueing. Lin and Atkinson (2011) found that the use of visual cueing improved the instructional efficiency outcomes of animations.

The animation is system-paced. In their meta-analysis, Berney and Bétrancourt (2016) observed that the positive effect of animation over static graphics was found only for system-paced instructional material, as opposed to when students controlled the pace.

The animation can be viewed at https://www.youtube.com/watch?v=Agba_veg3yU&t=69s.

4.4.2 Control video

The video was created using OfficeMix (a Microsoft add-in for PowerPoint (2013) designed to create and share interactive online presentations easily). The audio was a narrated voice-over using the same transcript as for the animation, but with minor adjustments for descriptions of visual items that were different or did not appear. The video explained the same scenario presented in the animation. The text of the transactions that occurred was provided on the slides. A tablet was used to complete the accounting equation entries manually. The narrator's writing was visible during the explanation.

The narrator's voice was the common element between the two media. As far as possible the length of the narration, the tone of voice and words used were identical. This was intentional to limit the focus of the experiment to the effect of the two different visual presentations, with no difference in the auditory input between the two presentations.

Figure's 4.5 and 4.6 represent the video version of the animation figure's 4.3 and 4.4 respectively.

Figure 4.5: PowerPoint representation of the purchase of an asset with capital

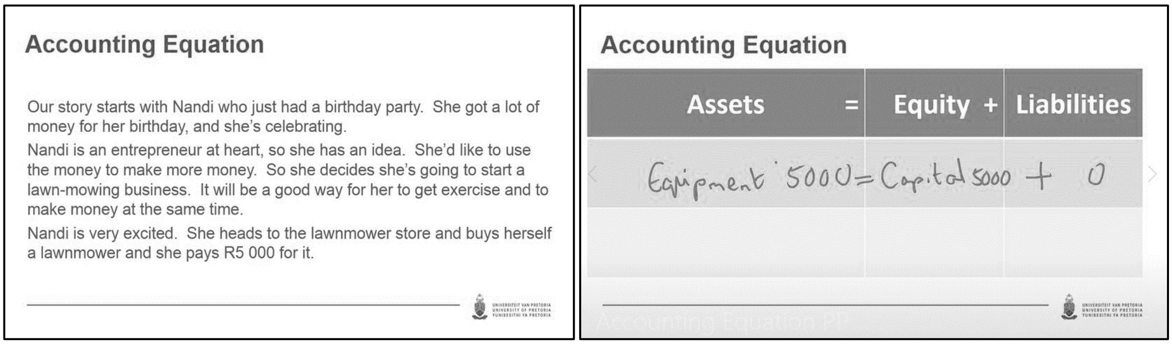
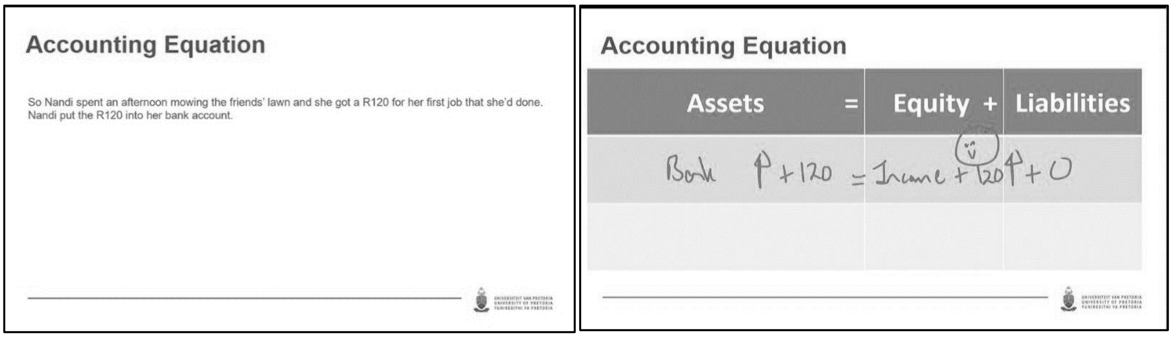


Figure 4.6: PowerPoint representation of the receipt of money as income



The control video is available for viewing at:
https://www.youtube.com/watch?v=eqj3tSc02M8&feature=youtu.be

4.5 HYPOTHESIS DEVELOPMENT

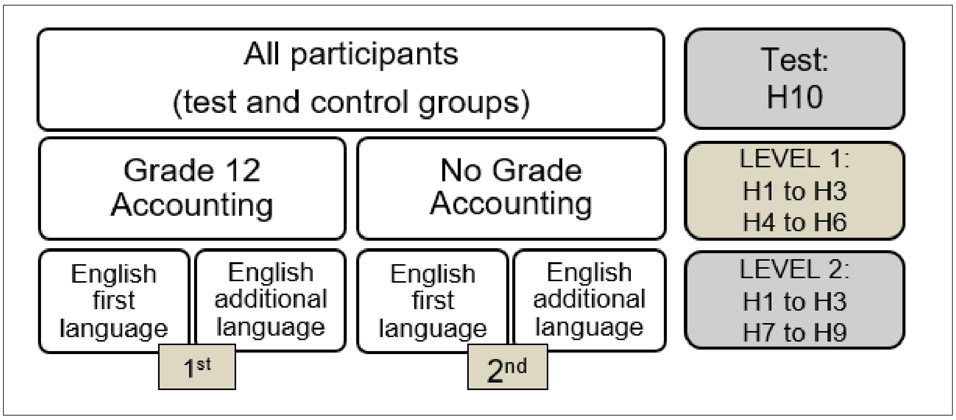
The primary purpose of this study was to explore the learning performance, cognitive load and instructional efficiency effects of using animations for an accounting equation instructional task in a controlled setting. The hypotheses that were tested relate to whether animations assisted the learning performance and improved the cognitive load and instructional efficiency of students with EAL, both with and without Grade 12 accounting. Figure 4.7 provides a pictorial representation of how the participants were split and which of the hypotheses (discussed below) are applicable at which level.

For the first level of analysis, the impact of students' previous experience with accounting and the experimental group is compared. Therefore, H1 to H3, and H4 to H6 are applicable to this level.

For the second level of analysis the impact of students' Grade 12 English level and the experimental group is compared separately for Grade 12 accounting and non-accounting students. H1 to H3 and H7 to H9 are tested at the second level.

The final hypothesis, H10, relating to student enjoyment and engagement, was tested between all students in the two experimental conditions.

Figure 4.7: Division of participants and hypotheses testing



4.5.1 Effect of animation

The hypotheses relating to the animation (H1 to H3) were tested three times, first between the Grade 12 accounting and non-accounting groups, secondly between the Grade 12 English levels for Grade 12 accounting students, and finally between the Grade 12 English levels for non-accounting students.

4.5.1.1 Test performance

In order to test the impact of the animation and control presentations on student performance, students completed an accounting equation pre-test (refer Appendix K) before they watched the animation or control presentation explaining the accounting equation. This provided a baseline measure of students' prior knowledge before participating in the intervention. After watching the presentations, students took a similar test (post-test), also on the accounting equation, but with different scenarios (Appendix L).

Research has provided evidence for the multimedia principle that animations are effective in promoting learner understanding (Barak *et al.*, 2011; Lin and Atkinson, 2011; Mayer and Moreno, 2002; Türkay, 2016). This is because students are better able to build mental connections between corresponding words and pictures when both are presented (Mayer and Moreno, 2002). Pictures and red and blue blocks were used in the animation to assist students to access unfamiliar word meanings (Mayer *et al.*, 2014). Also, the intention of using different colours for the building blocks of assets (blue), and equity and liabilities (red) was to improve students' understanding of the interconnection between the basic elements of the accounting equation. In contrast, students watching the control video had terminology without pictures and the accounting equation in a monochrome horizontal tabular format.

The hypothesis therefore was:

H1: Students in the test group (with the animation) will outperform students in the control group, based on the change in their test scores (pre-test to post-test).

4.5.1.2 Cognitive load

As discussed already for the performance hypothesis (H1), the intention of using pictures and red and blue blocks in the animation was to activate students' germane load and improve their learning outcomes as well as decrease their overall cognitive load. In contrast, because the control video used terminology without pictures and the accounting equation in a tabular format, it was expected that the extraneous cognitive processing demands on this group would be higher than for those in the animation group. In terms of CLT, there is a negative correlation between extraneous and germane load. The following hypotheses were therefore formulated:

H2a: The extraneous cognitive load (students' self-reported measure of clarity) will be lower for all students in the test group (with the animation) compared to the control group.

H2b: The germane cognitive load (students' self-reported measure of improvement in understanding) will be higher for students in the test group (with the animation) compared to those in the control group.

As the students in the test and control groups did the same pre- and post-tests, students' mental effort (total cognitive load) was measured using their time-on-task for the tests, thereby allowing for meaningful comparison of the instructional effect between the two groups.

Following on from H2a, an increase in extraneous cognitive load should increase overall cognitive load. Therefore, the hypothesis regarding students' time-on-task was:

H2c: Students in the test group (with the animation) will experience a more pronounced decrease in cognitive load than students in the control group based on the reduction in their time taken to complete the post-test compared to the pre-test.

No hypothesis was made about the intrinsic cognitive load, as this could not be affected by the experimental conditions. Students' prior knowledge of accounting and their Grade 12 English level were expected to contribute towards their intrinsic load, as discussed for Hypothesis 5a and 8a below.

4.5.1.3 Instructional efficiency

The hypothesis for instructional efficiency is based on H1 and H2c because it is calculated using the test performance and time-on-task measures. Instructional efficiency is measured for both tests, and the difference between the two is used for the hypothesis:

H3: The improvement in instructional efficiency will be higher for the test group (with the animation) than for the control group.

4.5.2 Effect of Grade 12 accounting

The hypotheses relating to the animation (H1 to H3) were tested together with the effect of Grade 12 accounting (H4 to H6).

4.5.2.1 Test performance

As the students participated in the experiment during the first week of their exposure to accounting at university, it was expected that their prior knowledge of school accounting would affect their performance (Barnes *et al.*, 2009). The next hypothesis therefore takes into account whether or not they had done accounting in Grade 12.

H4a: Students with accounting as a subject in Grade 12 will outperform students without accounting, based on their pre-test and post-test scores.

It was expected that the impact of the intervention would be higher for students without Grade 12 accounting. As the Grade 12 accounting students were already familiar with the accounting equation it was anticipated that the impact of the intervention on their increase in performance from the pre-test to the post-test would be less than for those with no prior experience of accounting.

H4b: The increase in test scores from pre-test to post-test will be higher for students who did not take accounting as a subject in Grade 12, compared to those who did.

4.5.2.2 Cognitive load

The expectation was that students who took accounting at school would have a lower intrinsic cognitive load than those who did not. Grade 12 accounting students' prior knowledge and more developed accounting schemata in long-term memory should reduce the intrinsic load that they experience due to any new elements and the element interactivity in a task (Leppink *et al.*, 2013). The next hypothesis was, therefore:

H5a: Students with accounting as a subject in Grade 12 will experience a lower intrinsic cognitive load (self-reported measure of difficulty) than students without.

Because of the lower intrinsic load expected to be experienced by Grade 12 accounting students, the hypothesis was that the overall cognitive load for these students would also be lower using the two measures available:

H5b: Students with accounting will report lower levels of self-reported mental effort used in completing the activity compared to those without.

H5c: Students with accounting as a subject in Grade 12 will complete both the pre- and post-tests faster than students without.

It was expected that the time taken from the pre-test to the post-test would decrease for all students. Partly due to their familiarity built up with the type of test, but also because of the presentation they watched. It could not be predicted whether students with or without Grade 12 accounting would have a more pronounced decrease in time taken. Therefore, the hypothesis was:

H5d: The cognitive load of both students with and without Grade 12 accounting will improve from the pre-test to the post-test with a decrease in the time taken to complete the post-test compared to the pre-test.

4.5.2.3 Instructional efficiency

The hypotheses for instructional efficiency are based on H4a and H5c, because it is calculated using the test performance and time-on-task measures. Based on the expectation that Grade 12 accounting students would have better test scores than non-accounting students, the hypothesis was:

H6a: Students who had taken accounting as a subject in Grade 12 will experience higher instructional efficiency levels than students who did not, based on the instructional efficiency scores for the pre-test and post-test.

As students without Grade 12 accounting were expected to improve their test scores more than for students with Grade 12 accounting (H4b), the hypothesis was as follows:

H6b: The instructional efficiency of students without Grade 12 accounting will improve from the pre-test to the post-test more than the improvement of students with Grade 12 accounting.

4.5.3 Effect of English as an additional language

The hypotheses relating to the animation (H1 to H3) were tested together with the hypotheses relating to the effect of EAL (H7 to H9). These hypotheses were first tested for Grade 12 accounting students and then for non-accounting students.

4.5.3.1 Test performance

Translating material received visually and verbally into their first language, and converting their existing mental schemata into English to make connections to the new content, may burden the working memory of students with EAL (Wynder, 2018). The next hypothesis was therefore as follows:

H7: Students with English as a first language will outperform students with EAL in both experimental groups, based on the pre-test and post-test scores, regardless of whether they took Grade 12 accounting or not.

4.5.3.2 Cognitive load

It was expected that students with English as a first language would have a lower intrinsic load than students with EAL. The prior language knowledge and more advanced language schemata in the long-term memory of students with English as a first language should reduce the intrinsic load that they may experience due to any new elements and the element interactivity in a task (Leppink *et al.*, 2013). The hypothesis therefore was:

H8a: After splitting students into whether they had taken Grade 12 accounting or not, students with English as a first language will experience a lower intrinsic cognitive load (self-reported measure of difficulty) than students with EAL.

As students with English as a first language were expected to have a lower intrinsic load, the hypothesis was that the overall cognitive load for these students would also be lower using the two measures available:

H8b: After being split into whether they had taken Grade 12 accounting or not, students with English as a first language will report lower levels of mental effort used in completing the activity compared to students with EAL.

H8c: After being split into whether they had taken Grade 12 accounting or not, students with English as a first language will complete both the pre-test and the post-test faster than students with EAL.

4.5.3.3 Instructional efficiency

The hypothesis for instructional efficiency is based on H7 and H8c because it is calculated using the test performance and time-on-task measures.

H9: After being split into whether they had taken Grade 12 accounting or not, English first-language students will have better instructional efficiency for both the pre-test and the post-test compared to students with EAL in both experimental groups.

4.5.4 Enjoyment and engagement experience of students

Based on the results of Türkay's (2016) study of the effects of whiteboard animations on students' subjective experiences when learning physics, it was expected that:

H10: Students in the test group (with the animation) will report higher enjoyment and engagement levels compared to students in the control group.

4.6 METHODOLOGY

4.6.1 Participants

Potential participants for this study were all the students enrolled in the introductory financial accounting course known as FRK111 in 2018 at a large residential university in South Africa.

FRK111 is a half-year course that is compulsory for all undergraduate Commerce and Consumer Science students who usually make up approximately 90% of the class. The remaining students choose the subject as an elective. The only exception is students studying towards the South African Institute of Chartered Accountants' professional qualification who take a different introductory accounting course. These students were excluded from the scope of this study. Students enrolling for FRK111 are not required to have taken accounting as a subject in Grade 12.

Students were stratified into groupings per Table 4.1 in order to test the results of students with English as a first language and students with EAL, with and without accounting as a school subject, separately. This improved the homogeneity between the test and control groups. Students who did not complete Grade 12 in 2017 were kept as a separate group in the initial stratification, as many would have been repeating the course. Students from groups A to E were randomly allocated to the test and control groups. The results of the students in group E are not reported in this study.

Table 4.1: Stratification of population

<table>
<tr><td></td><td colspan="5">Students registered for FRK111 in 2018</td></tr>
<tr><td>1</td><td colspan="4">Completed Grade 12 in 2017</td><td>Completed Grade 12 before 2017</td></tr>
<tr><td>2</td><td colspan="2">Grade 12 accounting</td><td colspan="2">No Grade 12 accounting</td><td rowspan="2"></td></tr>
<tr><td>3</td><td>English first language</td><td>English additional language</td><td>English first language</td><td>English additional language</td></tr>
<tr><td>Groups</td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td></tr>
</table>

Table 4.2 provides the details of the number of students who participated in this study. Only the data for those students who completed Grade 12 in 2017, completed both the pre- and post-tests under examination conditions, gave permission for their results to be used, and were still registered on 21 February 2018 when the experiment results were downloaded from the university online learning platform, were included in the present study.

Table 4.2: Population and sample

No. of students registered for FRK111 on 7 Feb 2018	1 550
No. of students who wrote	1 391
De-registered by 21 Feb 2018	-6
Did not write in labs	-5
Did not get permission to use results	-331
Did not complete pre- and post-test	-10
Students who wrote foreign school-leaving examinations	-22
Students completed Grade 12 before 2017	-310
Final sample of students who completed Grade 12 in 2017	707

In South Africa, Grade 12 students at government-funded schools write the NSC school-leaving examinations set by the Department of Basic Education. Grade 12 students at private schools can write either the NSC examination or the school-leaving examination set by the Independent Examination Board (IEB). The NSC and IEB examinations test the same curriculum, and the same quality assurance authority (UMALUSI) accredits both. The tertiary institution at which this study took place makes no distinction between the two examinations regarding admission. To provide further uniformity among the sample population, students who did not write the two aforementioned school-leaving examinations were excluded, as the curriculum for foreign examinations is different from the NSC and IEB examinations.

4.6.2 Experimental design and procedure

This study used a pre-test/post-test, 2 x 2 between-subjects experimental design. The two experimental conditions were the test (with animation) condition and control (with video) condition. For the first level of analysis, the students were divided into whether they had taken Grade 12 accounting or not (refer to Table 4.3).

Table 4.3: Level 1 analysis – Experimental group and Grade 12 accounting

	Grade 12 accounting		No Grade 12 accounting		Total	
	No.	**%**	**No.**	**%**	**No.**	**%**
Control	220	51.0	147	53.3	367	51.9
Test	211	49.0	129	46.7	340	48.1
Total	431	100.0	276	100.0	707	100.0
	61.0%		**39.0%**		**100%**	

After dividing students into the Grade 12 accounting and no accounting groups, the second level of analysis split subjects into whether they had taken English at the first or additional language level in Grade 12 (refer Table 4.4).

Table 4.4: Level 2 analysis – Experimental group and Grade 12 English level

	English Home Language		English additional language		Total
Grade 12 accounting	**No.**	**%**	**No.**	**%**	**No.**
Control	133	60.4	87	39.6	220
Test	142	68.8	69	31.2	211
Total	**275**	**63.8**	**156**	**36.2**	**431**
No Grade 12 accounting					
Control	104	58.6	43	41.4	147
Test	90	69.8	39	30.2	129
Total	**194**	**70.3**	**82**	**29.7**	**276**

The experiment was conducted at the end of the first week of the academic year. The rationale was that the lecturers needed to orientate first-year students to the hybrid-learning environment offered in the FRK111 course. Apart from face-to-face lectures and tutorials, FRK111 students are also required to complete online activities and tests, using the Blackboard learn+ 9.1 (2017) virtual learning environment and course management system adapted for use at this university.

Students signed up for the orientation activity/experiment in a time slot that suited them on the first Thursday and Friday of the term, 8 and 9 February 2018. The sessions were conducted in computer laboratories on the main campus, which are set up for test conditions with dividers between the workstations. The laboratories seat between 50 and 110 students. Over the two days, there were 12 slots available that students could sign up for, each lasting 50 minutes that ran on the half hour, for example, the first session was from 8.30 to 9.20, with the second session starting at 9.30.

The purpose of the orientation activity was to introduce students to the online learning environment in FRK111. It was set up as the first formative assessment for the course, for which students could achieve five participation ‘Beans’ for completing the activity. The lecturers use Beans as a form of reward for students who participate in the online activities of the course. Students could choose to convert these five Beans into marks making up half of one percentage of their final mark for the course.

Students received verbal and written instructions at the beginning of each session (refer Appendix J). Students indicated online if they were willing to participate in the study. They could choose not to have their results used in the research, and they suffered no negative consequences. They were still awarded the five Beans upon completion of the activity. The instructions made this clear to students.

The course lecturers, technical support staff and tutors were available during the sessions to assist students. The researcher supervised all sessions.

The sessions were set up electronically for each student to complete during his or her booked time slot. The session was not available to anyone who had not signed up for the particular time slot. It was possible that students could complete the session off-site, but this was controlled by asking students to sign a register when they arrived. The system allowed students to follow the ‘path’ that was set up in advance, as they were pre-allocated to one of the two experimental conditions. Students were unaware of the different conditions and the research questions included in the experiment. Student identification was via their log-on details to get onto the Blackboard learn+ system. All of the activities were automated, including the tests, time taken, presentations and the additional questions. Students completed all the activities electronically on the computers in the test laboratory.

The order of the experiment, with a maximum time of 50 minutes, was as follows:

1. First 10 minutes:
   Arrival of students and signing of the register
   Assist students with logging in
   Students read written instructions (Appendix J)
   Explanation of activity and request to keep it confidential
   Informed consent of students
2. Pre-test (10 minutes) (measure time-on-task) (Appendix K)
3. Students watch the animation OR video on the accounting equation (10 minutes)
4. Post-test (10 minutes) (measure time-on-task) (Appendix L)
5. Subjective experience questions (5 minutes) (Appendix M)
6. Questions regarding language spoken at home, and Grade 12 results (5 minutes) (Appendix N)

In the experience of the FRK111 lecturers, first-year students are more diligent about completing all the work allocated to them during the first week of lectures, as compared to later in the year, when some become more relaxed. Conducting this experiment as the year started therefore added to the reliability of the results. In addition, the lecturers and tutors walked around the laboratories during the experiment, to ensure that students were in fact watching the whole presentation, and not trying to take a short cut.

4.6.3 Ethics

Approval was obtained from the Faculty Ethics Committee (refer Appendix H). All participants completed a consent form that described the nature and purpose of the research, and assuring them of anonymity (refer Appendix I).

All students were required to complete the orientation activity as part of the normal assessment requirements for the course FRK111. However, students could choose not to have their results used in the research without being penalised. All students who completed the activity whether they gave their informed consent or not, still received the Beans, which they could later convert into marks for the course.

Both the animation and video presentations were made available to all students on the FRK111 Blackboard learn+ site immediately after the conclusion of the last test session. This was to avoid any potential disadvantage for students due to them watching either the animation or the video, but not both.

4.6.4 Measures and instruments

4.6.4.1 Pre-test and post-test

The pre-test consisted of 15 marks (refer Appendix K). The intention was to test the participants' prior knowledge of the accounting equation. The first question for six marks required students to match the elements of financial statements to the correct definition. The next three questions asked students to analyse the effect of a transaction on the accounting equation. The students needed to indicate the impact on assets, equity and liabilities for each of the three transactions, resulting in nine marks being allocated. All questions in the pre-test had enforced completion activated. The computer programme automatically scored 0 points for an incorrect answer or 1 point for a correct answer. Therefore, students could achieve a maximum of 15 points on the pre-test. Students only received the result of this test at the end of the activity in order not to de-motivate them for the rest of the experiment.

The post-test also consisted of 15 marks and measured participants' comprehension of the material after instruction (refer Appendix L). The post-test was similar to the pre-test, except that there was no match-the-term question. There were five accounting equation questions asking students to analyse the effect of transactions for a different type of service entity from that used in the pre-test and the presentation. The amounts also varied from those in the pre-test. The questions resembled the problem covered in the presentation and were aimed at testing students' ability to transfer what they learnt. The post-test also had enforced completion and was automatically scored using the same rules as the pre-test, with a total of 15 points. Students received their test results when the experiment was complete to provide them with a sense of achievement and to promote a positive attitude towards the activity.

Two scores for the pre-test, using the pre-test scores including and, excluding question 1 (match-the-term), and one score for the post-test were calculated. The difference in scores between the pre-test (including and excluding question 1) and the post-test were also calculated.

4.6.4.2 Time on task

During the experiment, students had a time limit of 10 minutes each for the pre-test and for the post-test. Before the experiment began, students received instructions telling them that the time they took on the tests would be measured, and encouraging them to complete the tests as quickly and as accurately as possible. Students were encouraged to focus on the primary task of watching the animation or video presentation due to the importance of the assessment following it. The time limit of 10 minutes was more than adequate to finish the five questions in each test and ensured that students did not run over the total time available for the experiment.

The actual time students took to complete the pre-test and post-test was used to estimate the total cognitive load experienced by students. The difference between the post- and pre-test time was also calculated.

4.6.4.3 Instructional efficiency

The instructional efficiency calculations were done as follows (Paas *et al.*, 2003):

The test scores and time taken scores were first standardised. Time taken was a proxy measure for the effort expended by students in taking the test. The mean standardised test performance (P) and test effort (E) scores attained by students were entered into the following formula:

Instructional efficiency = $\frac{Z_{Ptest} - Z_{Etest}}{\sqrt{2}}$

Two instructional efficiency scores using the pre-test grades (including and excluding question 1) and the time taken to complete the pre-test were calculated. For the post-test, only one instructional efficiency score was calculated, using the post-test scores and the time taken to complete the post-test.

The difference in instructional efficiency scores between the pre-test (including and excluding question 1) and the post-test was also calculated.

4.6.4.4 Questionnaire

After completing the activity, students rated their experience of the activity (refer Appendix M). All cognitive load scores used a 7-point Likert scale. Mental effort used on completing the pre-test, watching the presentation and completing the post-test, was scored from 1 = 'very low mental effort' to 7 = 'very high mental effort'. Difficulty was scored on a range from 1 = 'very easy' to 7 = 'very difficult'. The clarity of the explanations in the presentation watched were scored on a range from 1 = 'very clear' to 7 = 'very unclear'. Finally, students rated their improvement in understanding of the topic after watching the presentation on a score from 1 = 'very little' to 7 = 'very much'.

On the same questionnaire students were asked to rate their subjective experience of the activity regarding enjoyment ('How much did you enjoy the activity?') and engagement ('How much did you want to continue?') using a 5-level Likert scale, from 'not at all' to 'extremely.' Other multimedia researchers used similar single item questions to test subjective experiences (Mayer and Estrella, 2014; Türkay, 2016).

Appendix N provides the final background questions. To statistically control for the effect that students' prior knowledge might have on their results, they had to indicate which language they mainly speak at home, and provide their Grade 12 school results. Only the results of students who submitted their informed consent in the experiment were used. The school results they supplied were verified against those on the university student system.

4.6.4.5 Variables for analysis

The variables resulting from the measures discussed are provided in Table 4.5.

Table 4.5: Variable names and abbreviations

Variable Name	Type	Abbreviation
Dependent variables:		
Test results:		
Pre-test % (out of 15)	Continuous	Pre-test %
Pre-test % question 1 (out of 6)	Continuous	Pre-test % Qu 1
Pre-test % excluding question 1 (out of 9)	Continuous	Pre-test % ex. Qu 1
Post-test % (out of 15)	Continuous	
Increase pre-test to post-test	Continuous	
Increase pre-test excluding question 1 to post-test	Continuous	Increase pre-test ex. Qu 1 to post-test
Objective cognitive load measures:		
Time pre-test	Continuous	
Time post-test	Continuous	
Time change	Continuous	

Variable Name	Type	Abbreviation
Instructional efficiency scores (based on time taken):*		
Instructional efficiency pre-test	Continuous	
Instructional efficiency pre-test excluding question 1	Continuous	Instructional efficiency pre-test ex. Qu 1
Instructional efficiency post-test	Continuous	
Change instructional efficiency pre-test to post-test	Continuous	Change Inst. eff. pre-test to post-test
Change instructional efficiency pre-test excluding question 1 to post-test	Continuous	Change Inst. eff. pre-test ex. Qu 1 to post-test
Subjective cognitive load measures:		
Mental effort used (total cognitive load)	Ordinal	
Difficulty (intrinsic load)	Ordinal	
Clarity (extraneous load)	Ordinal	
Improved understanding (germane load)	Ordinal	
Subjective student experience:		
Engagement	Ordinal	
Enjoyment	Ordinal	
Independent Variables:		
Experimental group	Categorical	Test (animation) / Control (video)
Grade 12 accounting (Yes/No)	Categorical	Gr 12 acc.
Grade 12 English home language or first additional language	Categorical	Grade 12 English level: Gr 12 Eng HL / Gr 12 Eng FAL
Control variables:		
Grade 12 mathematics result	Continuous	Grade 12 maths result
Grade 12 English result	Continuous	
Grade 12 accounting result	Continuous	
Grade 12 admission point score (APS)	Continuous	Grade 12 APS

* Instructional efficiency scores were calculated for all students and then separately for students with and without Grade 12 accounting.

4.7 RESULTS

4.7.1 Student background variables

Table 4.6 represents descriptive statistics for all the students included in the sample. Out of the total sample of 707 students, 431 students took Grade 12 accounting, 339 (368) students spoke English (another language) at home and 469 (238) took English at the home (first additional) language level in Grade 12. There were no significant differences between the background variables for the two experimental groups.

Table 4.6: Participant information per experimental group

Experimental group	Total No. of students	Gender		Home Language		Gr 12 English[2]		Gr 12 maths[3]	Gr 12 acc.[4]
		Male	Female	English	Other	HL	FAL		
Control	367	143	224	174	193	237	130	365	220
Test	340	132	208	165	175	232	108	337	211
Total	707	275	432	339	368	469	238	702	431
	χ^2 (1,707)	.001		.088		1.057		.286	.331
	p	.969		.766		.354		.593	.565

Experimental group	Admission point score[1]	Grade 12 English result[2]		Grade 12 maths result[3]	Grade 12 maths literacy result[3]	Grade 12 accounting result[4]
		HL	FAL			
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**
Control	33.9 (3.2)	70.6 (6.2)	78.4 (6.7)	62.9 (9.3)	62.5 (10.6)	70.7 (10.7)
Test	33.9 (3.1)	70.7 (5.9)	77.4 (8.2)	63.3 (9.5)	65.0 (8.2)	70.3 (9.9)
Total	33.9 (3.1)	70.6 (6.0)	77.9 (7.4)	63.1 (9.4)	64.0 (8.0)	70.5 (10.3)
F	(1,705) .010	(1,467) .007	(1,236) .966	(1,700) .277	(1,3) .091	(1,429) .139
p	.921	.932	.327	.599	.782	.710

1 Grade 12 admission point score (APS) used for entrance to the university. The highest APS that can be achieved is 42. The subminimum APS required for entrance to a B.Com degree in 2018 was 30.

2 Grade 12 English. English is either taken at home language (HL) or first additional language (FAL) level. If at FAL level, the student will have taken another South African language as their HL. A subminimum of 60% for English at HL or FAL level was required for entrance to a B.Com degree for 2018.

3 Grade 12 mathematics. Compulsory for all B.Com degrees with a subminimum of 50% required for 2018. Students taking mathematics literacy were mainly registered for a B.Ed. Degree.

4 Grade 12 accounting. This subject was not compulsory to gain admission to the degree. However, 431 of the participants had taken accounting as a school subject.

4.7.2 Test results

Tables 4.7 to 4.11 provide the pre- and post-test results and the change in results for the two experimental groups split between those who had done Grade 12 accounting at school and those who had not, and then between students with Grade 12 English home language (HL) and first additional language (FAL). One-way ANOVA tests conducted found no significant differences between the results of the two experimental groups.

Table 4.7: Pre-test (percentage out of 15)

Experimental group		Grade 12 accounting			No Grade 12 accounting		
		Total	**Gr 12 Eng. HL**	**Gr 12 Eng. FAL**	**Total**	**Gr 12 Eng. HL**	**Gr 12 Eng. FAL**
Control	**No.**	220	133	87	147	104	43
	Mean (SD)	67.4 (22.2)	69.3 (20.4)	64.6 (24.4)	42.9 (19.9)	44.2 (18.6)	39.5 (22.6)
Test	**No.**	211	142	69	129	90	39
	Mean (SD)	66.4 (21.9)	70.3 (19.9)	58.4 (23.8)	45.2 (22.2)	47.2 (21.8)	40.7 (22.8)
Total	**No.**	431	275	156	276	194	82
	Mean (SD)	66.9 (22.0)	69.8 (20.1)	61.8 (24.3)	44.0 (21.0)	45.6 (20.2)	40.1 (22.6)
	F	(1,429) .241	(1,273) .172	(1,154) 2.566	(1,274) .869	(1,192) 1.037	(1,80) .052
	P	.624	.679	.111	.352	.310	.819

Table 4.8: Pre-test (percentage out of 9, excluding question 1)

Experimental group		Grade 12 accounting			No Grade 12 accounting		
		Total	Eng. HL	Eng. FAL	Total	Eng. HL	Eng. FAL
Control	Mean (SD)	53.3 (31.9)	55.1 (30.4)	50.6 (34.0)	21.8 (27.2)	21.8 (27.0)	21.7 (28.1)
Test	Mean (SD)	52.8 (33.0)	56.6 (31.3)	44.9 (35.2)	24.5 (28.7)	25.9 (29.0)	21.4 (28.1)
Total	Mean (SD)	53.1 (32.4)	55.9 (30.8)	48.1 (34.5)	23.1 (27.9)	23.7 (28.0)	21.5 (27.9)
	F	(1,429) .033	(1,273) .148	(1,154) 1.028	(1,274) .680	(1,192) 1.053	(1,80) .003
	P	.856	.700	.312	.410	.306	.957

Table 4.9: Post-test (percentage out of 15)

Experimental group		Grade 12 accounting			No Grade 12 accounting		
		Total	Eng. HL	Eng. FAL	Total	Eng. HL	Eng. FAL
Control	Mean (SD)	83.9 (16.0)	85.4 (14.2)	81.6 (18.4)	62.2 (24.8)	62.1 (24.1)	62.3 (26.6)
Test	Mean (SD)	81.3 (18.8)	83.0 (18.1)	78.0 (19.7)	61.7 (25.9)	63.8 (24.7)	56.9 (28.1)
Total	Mean (SD)	82.6 (17.5)	84.1 (16.4)	80.0 (19.0)	62.0 (25.3)	62.9 (24.3)	59.8 (27.3)
	F	(1,429) 2.365	(1,273) 1.552	(1,154) 1.414	(1,274) .024	(1,192) .224	(1,80) .799
	p	.125	.214	.236	.877	.636	.374

Table 4.10: Percentage increase from pre-test (out of 15) to post-test

Experimental group		Grade 12 accounting			No Grade 12 accounting		
		Total	Eng. HL	Eng. FAL	Total	Eng. HL	Eng. FAL
Control	Mean (SD)	16.5 (24.8)	16.1 (23.7)	17.0 (26.5)	19.3 (27.6)	17.9 (28.7)	22.8 (24.7)
Test	Mean (SD)	14.9 (23.7)	12.7 (23.3)	19.6 (23.9)	16.5 (27.1)	16.6 (24.7)	16.2 (32.2)
Total	Mean (SD)	15.7 (24.3)	14.4 (23.6)	18.2 (25.3)	18.0 (27.3)	17.3 (26.9)	19.7 (28.5)
	F	(1,429) .434	(1,273) 1.488	(1,154) .405	(1,274) .738	(1,192) .111	(1,80) 1.081
	p	.511	.224	.526	.391	.739	.302

Table 4.11: Percentage increase from pre-test (out of 9) to post-test

Experimental group		Grade 12 accounting			No Grade 12 accounting		
		Total	Eng. HL	Eng. FAL	Total	Eng. HL	Eng. FAL
Control	Mean (SD)	30.6 (33.3)	30.3 (32.2)	31.0 (35.2)	40.4 (33.1)	40.3 (34.6)	40.6 (29.5)
Test	Mean (SD)	28.6 (32.6)	26.4 (32.4)	33.0 (33.0)	37.2 (32.5)	37.9 (30.0)	35.6 (38.0)
Total	Mean (SD)	29.6 (33.0)	28.3 (32.2)	31.9 (34.2)	38.9 (32.8)	39.2 (32.5)	38.2 (33.7)
	F	(1,429) .401	(1,273) 1.000	(1,154) .132	(1,275) .674	(1,192) .277	(1,80) .459
	p	.527	.318	.717	.412	.599	.500

4.7.3 Cognitive load measures

Tables 4.12 to 4.14 provide the time taken for the pre-test, post-test and the change in time between the two tests, for the two experimental groups split between students with and without Grade 12 accounting, and then between students with English HL and FAL in Grade 12. One-way ANOVA tests found no significant differences between the two groups.

Table 4.12: Time pre-test

Experimental group		Grade 12 accounting			No Grade 12 accounting		
		Total	Gr 12 Eng. HL	Gr 12 Eng. FAL	Total	Gr 12 Eng. HL	Gr 12 Eng. FAL
Control	No.	220	133	87	147	104	43
	Mean (SD)	5.06 (1.40)	4.70 (1.26)	5.61 (1.43)	5.35 (1.76)	5.14 (1.61)	5.87 (2.00)
Test	No.	211	142	69	129	90	39
	Mean (SD)	5.15 (1.65)	4.92 (1.52)	5.62 (1.81)	5.19 (1.74)	4.95 (1.63)	5.74 (1.87)
Total	No.	431	275	156	276	194	82
	Mean (SD)	5.10 (1.53)	4.82 (1.40)	5.61 (1.60)	5.28 (1.75)	5.05 (1.62)	5.81 (1.92)
	F	(1,429) .354	(1,273) 1.698	(1,154) .000	(1,275) .613	(1,192) .668	(1,80) .092
	P	.552	.194	.985	.434	.415	.763

Table 4.13: Time post-test

Experimental group		Grade 12 accounting			No Grade 12 accounting		
		Total	Eng. HL	Eng. FAL	Total	Eng. HL	Eng. FAL
Control	Mean (SD)	3.71 (1.29)	3.65 (1.33)	3.82 (1.22)	4.56 (1.88)	4.53 (1.81)	4.63 (2.05)
Test	Mean (SD)	3.98 (1.58)	3.96 (1.57)	4.01 (1.60)	4.46 (1.86)	4.45 (1.85)	4.48 (1.91)
Total	Mean (SD)	3.84 (1.44)	3.81 (1.47)	3.90 (1.40)	4.51 (1.87)	4.49 (1.82)	4.55 (1.98)
	F	(1,429) 3.589	(1,273) 3.210	(1,154) .702	(1,275) .191	(1,192) .088	(1,80) .116
	P	.059	.074	.404	.662	.767	.735

Table 4.14: Time change from pre-test to post-test

Experimental group		Grade 12 accounting			No Grade 12 accounting		
		Total	Eng. HL	Eng. FAL	Total	Eng. HL	Eng. FAL
Control	Mean (SD)	-1.35 (1.51)	-1.06 (1.44)	-1.79 (1.51)	-.79 (1.85)	-0.61 (1.74)	-1.24 (2.04)
Test	Mean (SD)	-1.17 (1.67)	-.96 (1.70)	-1.61 (1.52)	-.73 (1.97)	-0.50 (1.83)	-1.26 (2.19)
Total	Mean (SD)	-1.26 (1.59)	-1.01 (1.58)	-1.71 (1.51)	-.76 (1.90)	-0.56 (1.78)	-1.25 (2.10)
	F	(1,429) 1.307	(1,273) .254	(1,154) .568	(1,275) .084	(1,192) .193	(1,80) .002
	P	.254	.615	.452	.772	.661	.966

Tables 4.15 to 4.18 provide students' subjective cognitive load scores. Only 649 of the 707 students completed the mental effort, difficulty and improved understanding questions, and 491 completed the clarity question. Per Table 4.17, the clarity scores of the test group were significantly better than those of the control group for Grade 12 accounting students with EAL (p=.040). This was supported by the result of the two-way ANCOVA (Table 4.36), which found a significant interaction effect for the Grade 12 English level and the experiment group on Grade 12 accounting students' clarity scores (p=.045). There were no other significant differences between the results of the two experimental groups.

Table 4.15: Experience of mental effort (total cognitive load) [1=least to 7=most effort]

Experimental group		Grade 12 accounting			No Grade 12 accounting		
		Total	Gr 12 Eng. HL	Gr 12 Eng. FAL	Total	Gr 12 Eng. HL	Gr 12 Eng. FAL
Control	No.	208	125	83	132	95	37
	Mean (SD)	3.78 (1.27)	3.66 (1.19)	3.96 (1.36)	4.61 (1.20)	4.55 (1.19)	4.78 (1.23)
Test	No.	188	126	62	121	85	36
	Mean (SD)	3.86 (1.40)	3.73 (1.37)	4.11 (1.44)	4.44 (1.20)	4.39 (1.14)	4.56 (1.36)
Total	No.	396	251	145	253	180	73
	Mean (SD)	3.82 (1.33)	3.69 (1.28)	4.03 (1.39)	4.53 (1.20)	4.47 (1.17)	4.67 (1.29)
	F	(1,394) .335	(1, 249) .209	(1,143) .407	(1,251) 1.346	(1,178) .837	(1,71) .566
	P	.563	.648	.525	.247	.362	.454

Table 4.16: Experience of difficulty (intrinsic load) [1=least difficult to 7=most difficult]

Experimental group		Grade 12 accounting			No Grade 12 accounting		
		Total	Eng. HL	Eng. FAL	Total	Eng. HL	Eng. FAL
Control	Mean (SD)	2.40 (1.18)	2.33 (1.09)	2.52 (1.29)	3.50 (1.34)	3.54 (1.26)	3.41 (1.54)
Test	Mean (SD)	2.46 (1.07)	2.47 (1.06)	2.44 (1.10)	3.43 (1.33)	3.48 (1.36)	3.31 (1.26)
Total	Mean (SD)	2.43 (1.13)	2.40 (1.08)	2.48 (1.21)	3.47 (1.33)	3.51 (1.31)	3.36 (1.40)
	F	(1,394) .223	(1,249) 1.064	(1,143) .165	(1,251) .175	(1,178) .078	(1,71) .092
	P	.637	.303	.685	.676	.781	.763

Table 4.17: Experience of clarity (extraneous load) [1=clear to 7=very unclear]

Experimental group		Grade 12 accounting			No Grade 12 accounting		
		Total	Eng. HL	Eng. FAL	Total	Eng. HL	Eng. FAL
Control	No.	151	92	59	105	79	26
	Mean (SD)	1.56 (1.10)	1.46 (.84)	1.71 (1.41)	1.87 (1.11)	1.81 (.89)	2.04 (1.61)
Test	No.	140	94	46	95	67	28
	Mean (SD)	1.41 (.79)	1.48 (.89)	1.26 (.49)	1.77 (.95)	1.82 (1.01)	1.64 (.78)
Total	No.	291	186	105	200	146	54
	Mean (SD)	1.48 (.96)	1.47 (.87)	1.51 (1.12)	1.82 (1.04)	1.82 (.95)	1.83 (1.26)
	F	(1,289) 1.749	(1,184) .030	(1,103) 4.333	(1,198) .447	(1,144) .005	(1,52) 1.348
	P	.187	.862	.040*	.504	.946	.251

* Significant at .05 level

Table 4.18: Experience of improved understanding (germane load) [1=least to 7=most]

Experimental group		Grade 12 accounting			No Grade 12 accounting		
		Total	Eng. HL	Eng. FAL	Total	Eng. HL	Eng. FAL
Control	Mean (SD)	4.86 (1.82)	4.76 (1.80)	5.01 (1.86)	5.55 (1.37)	5.67 (1.28)	5.22 (1.57)
Test	Mean (SD)	4.62 (1.88)	4.51 (1.88)	4.85 (1.85)	5.52 (1.40)	5.55 (1.50)	5.44 (1.16)
Total	Mean (SD)	4.75 (1.85)	4.63 (1.84)	4.94 (1.85)	5.53 (1.38)	5.62 (1.38)	5.33 (1.38)
	F	(1,394) 1.639	(1,249) 1.173	(1,143) .255	(1,251) .020	(1,178) .367	(1,71) .499
	P	.201	.280	.615	.887	.545	.482

4.7.4 Instructional efficiency measures

During the first level of analysis, instructional efficiency scores for all 707 students were calculated, based on their test results and time taken. Tables 4.19 to 4.23 provide the preand post-test instructional efficiency scores and the change in scores between the two tests for the two experimental groups split between those who had done Grade 12 accounting at school and those who had not. As per Table 4.21 a one-way ANOVA found that the post-test instructional efficiency scores of the Grade 12 accounting students in the control group were significantly higher than for those in the test group (p=.030). This was not supported by the result of the two-way ANCOVA (Table 4.34), which did not find an interaction between Grade 12 accounting and the experimental group on students' post-test instructional efficiency scores (p=.290). There were no other significant differences between the results of the two experimental groups.

Table 4.19: Instructional efficiency (all students): Pre-test (out of 15)

Experimental group		**Total**	**Gr 12 Accounting**	**No Grade 12 accounting**
Control	**No.**	367	220	147
	Mean (SD)	-.014 (1.05)	.323 (.94)	-.518 (1.00)
Test	**No.**	340	211	129
	Mean (SD)	.015 (1.09)	.255 (1.02)	-.377 (1.09)
Total	**No.**	707	431	276
	Mean (SD)	.000 (1.06)	.290 (.98)	-.452 (1.04)
	F	(1,705) .127	(1,429) .525	(1,275) 1.253
	p	.722	.469	.264

Table 4.20: Instructional efficiency (all students): Pre-test (out of 9)

Experimental group		**Total**	**Grade 12 accounting**	**No Grade 12 accounting**
Control	**Mean (SD)**	-.017 (1.02)	.297 (.95)	-.487 (.95)
Test	**Mean (SD)**	.018 (1.08)	.247 (1.05)	-.356 (1.02)
Total	**Mean (SD)**	.000 (1.05)	.273 (1.00)	-.426 (.99)
	F	(1,705) .193	(1,429) .270	(1,275) 1.193
	p	.660	.604	.276

Table 4.21: Instructional efficiency (all students): Post-test

Experimental group		**Total**	**Grade 12 accounting**	**No Grade 12 accounting**
Control	**Mean (SD)**	.042 (1.15)	.452 (.84)	-.573 (1.28)
Test	**Mean (SD)**	-.045 (1.16)	.261 (.98)	-.545 (1.24)
Total	**Mean (SD)**	.000 (1.15)	.359 (.92)	-.560 (1.26)
	F	(1,705) .990	(1,429) 4.736	(1,275) .033
	p	.320	.030*	.855

* Significant at .05 level

Table 4.22: Change in instructional efficiency (all students): Pre-test (out of 15) to post-test

Experimental group		Total	Grade 12 accounting	No Grade 12 accounting
Control	**Mean (SD)**	.055 (1.11)	.129 (1.02)	-.055 (1.22)
Test	**Mean (SD)**	-.060 (1.11)	.007 (1.02)	-.168 (1.24)
Total	**Mean (SD)**	.000 (1.11)	.069 (1.02)	-.108 (1.23)
	F	(1,705) 1.907	(1,429) 1.560	(1,275) .852
	p	.168	.212	.446

Table 4.23: Change in instructional efficiency (all students): Pre-test (out of 9) to post-test

Experimental group		Total	Grade 12 accounting	No Grade 12 accounting
Control	**Mean (SD)**	.058 (1.12)	.155 (1.04)	-.087 (1.22)
Test	**Mean (SD)**	-.063 (1.12)	.014 (1.03)	-.189 (1.25)
Total	**Mean (SD)**	.000 (1.12)	.086 (1.04)	-.134 (1.23)
	F	(1,705) 2.071	(1,429) 2.002	(1,275) .474
	p	.151	.158	.492

After splitting the students into those with Grade 12 accounting and those without, the instructional efficiency scores were calculated separately for the two groups. Tables 4.24 to 4.28 provide the pre- and post-test instructional efficiency scores and the change in scores between the two tests, for the two experimental groups split between those who had done Grade 12 accounting at school and those who had not and then between students with Grade 12 English HL and FAL. As per Table 4.26, one-way ANOVA tests found the post-test instructional efficiency scores of Grade 12 accounting students in the control group were significantly higher than for those in the test group (p=.036). This result was supported by the two-way ANCOVA (Table 4.38), which found a main effect for the experimental group on the post-test instructional efficiency scores of Grade 12 accounting students (p=.027). There were no other significant differences between the results of the two groups.

Table 4.24: Instructional efficiency (Grade 12 accounting groups): Pre-test (out of 15)

Experimental group		Grade 12 accounting			No Grade 12 accounting		
		Total	Gr 12 Eng. HL	Gr 12 Eng. FAL	Total	Gr 12 Eng. HL	Gr 12 Eng. FAL
Control	**No.**	220	133	87	147	104	43
	Mean (SD)	.043 (1.26)	.294 (1.14)	-.340 (1.36)	-.084 (1.23)	.068 (1.08)	-.451 (1.49)
Test	**No.**	211	142	69	129	90	39
	Mean (SD)	-.045 (1.33)	.237 (1.20)	-.626 (1.41)	.096 (1.38)	.286 (1.30)	-.343 (1.46)
Total	**No.**	431	275	156	276	194	82
	Mean (SD)	.000 (1.30)	.499 (.88)	-.466 (1.38)	.000 (1.30)	.169 (1.19)	-.400 (1.47)
	F	(1,429) .495	(1,273) .159	(1,154) 1.651	(1,275) 1.300	(1,192) 1.619	(1,80) .107
	p	.482	.690	.201	.255	.205	.744

Table 4.25: Instructional efficiency (Grade 12 accounting groups): Pre-test (out of 9)

Experimental group		Grade 12 accounting			No Grade 12 accounting		
		Total	Gr 12 Eng. HL	Gr 12 Eng. FAL	Total	Gr 12 Eng. HL	Gr 12 Eng. FAL
Control	Mean (SD)	.029 (1.23)	.251 (1.14)	-.312 (1.30)	-.078 (1.21)	.009 (1.11)	-.289 (1.40)
Test	Mean (SD)	-.030 (1.34)	.193 (1.24)	-.488 (1.43)	.089 (1.32)	.235 (1.29)	-.248 (1.34)
Total	Mean (SD)	.000 (1.29)	.221 (1.20)	-.390 (1.36)	.000 (1.26)	.114 (1.20)	-.270 (1.37)
	F	(1,429) .219	(1,273) .160	(1,154) .652	(1,275) 1.201	(1,192) 1.715	(1,80) .018
	p	.640	.690	.421	.274	.192	.895

Table 4.26: Instructional efficiency (Grade 12 accounting groups): Post-test

Experimental group		Grade 12 accounting			No Grade 12 accounting		
		Total	Eng. HL	Eng. FAL	Total	Eng. HL	Eng. FAL
Control	Mean (SD)	.135 (1.26)	.256 (1.16)	-.049 (1.38)	-.009 (1.40)	-.001 (1.34)	-.028 (1.54)
Test	Mean (SD)	-.141 (1.46)	-.040 (1.40)	-.350 (1.57)	.010 (1.37)	.095 (1.26)	-.186 (1.59)
Total	Mean (SD)	.000 (1.37)	.103 (1.30)	-.182 (1.47)	.000 (1.38)	.044 (1.30)	-.103 (1.56)
	F	(1,429) 4.437	(1,273) 3.607	(1,154) 1.613	(1,275) .013	(1,192) .258	(1,80) .207
	p	.036*	.059	.206	.911	.612	.650

* Significant at .05 level

Table 4.27: Change in instructional efficiency (Grade 12 accounting groups): Pre-test (out of 15) to post-test

Experimental group		Grade 12 accounting			No Grade 12 accounting		
		Total	Eng. HL	Eng. FAL	Total	Eng. HL	Eng. FAL
Control	Mean (SD)	.092 (1.48)	-.038 (1.42)	.291 (1.56)	.075 (1.44)	-.068 (1.46)	.422 (1.35)
Test	Mean (SD)	-.096 (1.46)	-.277 (1.48)	.276 (1.35)	-.086 (1.46)	-.191 (1.36)	.158 (1.65)
Total	Mean (SD)	.000 (1.47)	-.161 (1.45)	.285 (1.47)	.000 (1.45)	-.125 (1.41)	.296 (1.50)
	F	(1,429) 1.773	(1,273) 1.873	(1,154) .004	(1,275) .847	(1,192) .364	(1,80) .634
	p	.184	.172	.948	.358	.547	.428

Table 4.28: Change in instructional efficiency (Grade 12 accounting groups): Pre-test (out of 9) to post-test

Experimental group		Grade 12 accounting			No Grade 12 accounting		
		Total	Eng. HL	Eng. FAL	Total	Eng. HL	Eng. FAL
Control	Mean (SD)	.107 (1.48)	.005 (1.40)	.263 (1.59)	.069 (1.46)	-.010 (1.49)	.260 (1.39)
Test	Mean (SD)	-.112 (1.47)	-.233 (1.50)	.138 (1.40)	-.079 (1.48)	-.140 (1.38)	.063 (1.71)
Total	Mean (SD)	.000 (1.48)	-.118 (1.46)	.208 (1.51)	.000 (1.47)	-.070 (1.44)	.166 (1.54)
	F	(1,429) 2.354	(1,273) 1.842	(1,154) .262	(1,275) .691	(1,192) .391	(1,80) .334
	p	.126	.176	.610	.406	.532	.565

4.7.5 Relationships between variables

4.7.5.1 Selection of categorical (independent) variables

As discussed in the introduction, for the purposes of this study, students with EAL could be classified using two different methods. One was to identify whether they spoke a language besides English at home; the other was to determine whether they took English at the first additional language level at school. Therefore, an independent sample t-test was run to check for differences in the dependent variables between the two different English groupings (Table 4.29). The instructional efficiency scores used were as calculated for all 707 students.

Table 4.29: Relations between the dependent and categorical variables

	English home language		Grade 12 English home language	
	t-test		t-test	
	Coeff.	p-value (2-tailed)	Coeff.	p-value (2-tailed)
Pre-test %	.681	.496	2.824	.005
Pre-test % ex. Qu 1	.036	.971	1.344	.179
Post-test %	.914	.361	1.263	.207
Time pre-test	-6.417	.000	-6.112	.000
Time post-test	-3.393	.001	-.279	.780
Instructional efficiency pre-test	4.649	.000	5.944	.000
Instructional efficiency pre-test ex. Qu 1	4.275	.000	4.996	.000
Instructional efficiency post-test	2.637	.009	.945	.345

There was no significant difference between the test results of English and other home language students. However, students who spoke English at home completed the tests in significantly less time than students who did not speak English at home. This meant that the instructional efficiency of students with English as their home language was significantly better as well.

Taking English as a home language at school had a significant positive effect on students' pre-test results, including question 1. These students also took significantly less time to complete the pre-test than students who took English as an additional language at school. As a result, the instructional efficiency on the pre-test for Grade 12 English home language students was significantly better than for Grade 12 students with EAL.

The Grade 12 English level was used to categorise students as English first language or EAL. The reason for this was that the Grade 12 English level affected the pre-test and not the post-test. This indicates that the experimental intervention may have assisted the Grade 12 students with EAL more in improving their test scores, the time taken and instructional efficiency from the pre-test to the post-test, than it did the Grade 12 students with English at the home language level.

4.7.5.2 Selection of continuous (independent) variables to use as covariates in the analysis

To increase the probability of detecting differences between the experimental groups, students' Grade 12 mathematics, English, accounting and admission point scores (APS) were all available to be used as covariates in the analysis. Pearson's product-moment correlation was run to assess the relationship between each of the dependent variables and the continuous variables of interest (Table 4.30). Using Cohen's (1988, p. 109) guidelines, a coefficient greater than 0.5 is considered a strong correlation. Students' Grade 12 APS aggregates are positively correlated to their Grade 12 English, mathematics and accounting grades ($p>.01$). Multi-collinearity between these variables was tested for in the ANCOVA analysis conducted on the test results (Table 4.31).

Students' Grade 12 accounting grades had a small but significant positive correlation with their test results. As this was the students' first accounting test at university, it was expected that students who had done accounting at school would outperform those who had not. The analysis was therefore started by testing the differences in the results of students who had taken accounting in Grade 12 and those who had not.

When considering the effect of the other Grade 12 results on students' test scores, the time taken and instructional efficiency measures, the Grade 12 APS had a significant positive correlation with the test scores as well as with the instructional efficiency measures. There was a significant positive correlation between the Grade 12 math grades and the test scores, the time taken and the instructional efficiency measures. The correlation between Grade 12 English grades and the post-test results, post-test time, the pre-test (excluding question 1) instructional efficiency and the post-test instructional efficiency was also significant in a positive direction. All three of these Grade 12 grades were therefore included as covariates in the ANCOVA tests. The Grade 12 accounting grades were only used for the analysis of the results of students who took Grade 12 Accounting at school.

Table 4.30: Pearson correlation coefficients between the dependent and continuous independent variables

		Gr 12 maths	Gr 12 English	Gr 12 acc. (431)	Gr 12 APS	Pre-test %	Pre-test % ex. Qu 1	Post-test %	Time pre-test	Time post-test	Inst. eff. pre-test	Inst. eff. pre-test ex. Qu 1	Inst. eff. post-test
Gr 12 maths	Corr.	1	.191**	.333**	.521**	.090*	.085*	.160**	-.077*	-.104**	.111**	.109**	.162**
	Sig.		.000	.000	.000	.017	.024	.000	.040	.006	.003	.004	.000
Gr 12 English	Corr.		1	.186**	.589**	.045	.067	.093*	-.065	-.090*	.072	.088*	.112**
	Sig.			.000	.000	.236	.077	.014	.086	.017	.055	.019	.003
Gr 12 acc. (431)	Corr.			1	.622**	.177**	.169**	.159**	.039	-.037	.089	.087	.117*
	Sig.				.000	.000	.000	.000	.413	.447	.066	.070	.015
Gr 12 APS	Corr.				1	.130**	.115**	.125**	-.071	-.071	.133**	.125**	.120**
	Sig.					.001	.002	.001	.059	.060	.000	.001	.001
Pre-test %	Corr.					1	.940**	.424**	-.141**	-.252**	.755**	.727**	.415**
	Sig.						.000	.000	.000	.000	.000	.000	.000
Pre-test % ex. Qu 1	Corr.						1	.376**	-.105**	-.238**	.691**	.743**	.376**
	Sig.							.000	.005	.000	.000	.000	.000
Post-test %	Corr.							1	-.130**	-.330**	.367**	.340**	.815**
	Sig.								.001	.000	.000	.000	.000
Time pre-test	Corr.								1	.438**	-.755**	-.743**	-.348**
	Sig.									.000	.000	.000	.000
Time post-test	Corr.									1	-.457**	-.454**	-.815**
	Sig.										.000	.000	.000
Instructional efficiency pre-test	Corr.										1	.973**	.505**
	Sig.											.000	.000
Instructional efficiency pre-test ex. Qu 1	Corr.											1	.487**
	Sig.												.000
Instructional efficiency post-test	Corr.												1
	Sig.												

**. Correlation is significant at the 0.01 level (2-tailed)
*. Correlation is significant at the 0.05 level (2-tailed)

4.8 ANALYSIS

The analysis is separated into two levels (as per Figure 4.7). At the first level, the effect of Grade 12 accounting and the experimental group on students' results is tested. The instructional efficiency scores calculated at this level were for all 707 students (refer Tables 4.19 to 4.23). The population was then split into those who had taken accounting in Grade 12 (431) and those who had not (276). The second level analysis tested the effect of the Grade 12 English level and the experimental condition on students' results separately for the Grade 12 accounting and non-accounting groups. At this level, the students' instructional efficiency scores were calculated separately for the accounting and non-accounting groups (refer Tables 4.24 to 4.28).

For hypotheses 1, 2c, 3, 4b, 5d and 6b the differences between the means of the experimental groups for the pre-test and post-test, and then the difference between the differences in means from the pre-test to post-test (except for H5d), were analysed. For the remaining hypotheses, the differences between the means of the actual scores and time measures were analysed.

How to analyse differences between groups from a pre-test to a post-test is not always clear. The most popular methods to compare independent groups are an ANOVA of the difference in scores between the pre-test and the post-test, or an ANCOVA where the post-test score is the dependent variable and the pre-test score a predictor variable (Jennings and Cribbie, 2016).

The main factor that should influence the choice between the two (ANOVA of difference scores and ANCOVA), relates to the research question (Kisbu-Sakarya, MacKinnon and Aiken, 2013). The ANOVA of difference scores tests the null hypothesis of no difference across groups in the *raw change from pre-test to post-test*. The ANCOVA model tests the null hypothesis of no difference between the treatment and control groups' *post-test* scores, *conditional on* the *pre-test* scores (Kisbu-Sakarya *et al.*, 2013).

In this study the ANOVA of differences test was used, and not the ANCOVA on post-test scores, as the latter approach assumes equivalence of groups for the pre-test (Jennings and Cribbie, 2016). In this study, pre-test differences were expected for the Grade 12 accounting and Grade 12 English level conditions (i.e. different pre-existing abilities between groups). If these differences had been controlled for, it would have biased the results

(Jennings and Cribbie, 2016). The difference score analysis is also easier to interpret than ANCOVA, especially if groups differ on pre-test scores (Smolkowski, 2013).

When there are only two assessments per participant, as in this study, the results from an ANOVA of difference scores is the same as for a repeated measures ANOVA (Smolkowski, 2013). Repeated measure ANOVAs were conducted, but are not shown, as they duplicated the ANOVA on the difference scores used in the analysis. As students' Grade 12 results are included as covariates in the ANOVA of difference scores, the wording 'ANCOVA' (of difference scores) is used in the analysis that follows. This was so that the effect of the independent variables could be examined after first controlling for the impact of the covariates on the difference between the pre-test and post-test dependent variables.

For the Likert scale dependent variables, parametric statistics were used, as research has shown that they are robust with respect to violations of assumptions of normality for ordinal data (Norman, 2010).

The analysis was conducted using IBM Statistics SPSS (version 25). As the various group sample sizes were unequal, the Type III option for determining the sum of squares for the model was used. This approach adjusts for the different number of participants in each group, by weighting the mean scores for each group equally, enabling the estimation of the interaction and main effects as though the sample sizes were equal (Becker, 2016). The Laerd Statistics (2017) online guide was used as a reference to conduct the tests and report the results.

4.8.1 Effect of Grade 12 accounting and the experimental group

A two-way analysis of covariance (ANCOVA) was run to determine the effect of Grade 12 accounting (yes/no), and the experimental group (test/control) on the students' test scores (Table 4.31), subjective experiences of cognitive load (Table 4.32), the time taken (Table 4.33) and instructional efficiency (Table 4.34) after controlling for students' Grade 12 aggregate and mathematics and English grades. Pairwise comparisons were run for statistically significant simple main effects, and are reported with 95% confidence intervals and p-values Bonferroni adjusted.

4.8.1.1 Test scores

As per Table 4.31, students' APS was significantly related to question 1 (p=.001), the match-the-term question; the pre-test, including question 1 (p=.003); and the increase in test scores from the pre-test, including question 1, to the post-test (p=.031). Students' Grade 12 English result, was significantly related to the pre-test question 1 result only (p=.008). It therefore appears that students with better APS and English results found question 1 easier. To test for multi-collinearity, variance inflation factors (VIFs) were calculated for students Grade 12 APS and English, accounting and mathematics grades against their post-test scores. For the 431 students who took Grade 12 accounting, all of the VIFs were less than or equal to 3.121. For the total 707 students, all of the VIF's were less than or equal to 2.083. These values are well below the generally accepted rule of thumb that multi-collinearity is not indicated if the VIF is less than 10 (O'Brien, 2007). The remaining results discussed in this section are after adjusting for students' Grade 12 results.

The interaction effect between Grade 12 accounting and the experimental group was not significant for any of the test scores. The main effect of the experimental group was not significant for any of the test scores or differences in test scores. Hypothesis 1 was therefore not supported.

The main effect for Grade 12 accounting was analysed next. It was expected that Grade 12 accounting students would outperform non-accounting students because their background knowledge would assist them in the tests. This proved to be the case for both the pre-test and post-test. The main effect of Grade 12 accounting on students' pre-test and post-test results was significant at the p<.001 level. Grade 12 accounting students' pre-test scores, including question 1, were 23.1% (95% CI, 19.9% to 26.4%) higher; pre-test scores, excluding question 1, were 30.4% (95% CI, 25.7% to 35.0%) higher; and post-test scores were 21.1% (95% CI, 18.0% to 24.2%) higher than those of students without Grade 12 accounting. This result supports Hypothesis 4a.

The effect of Grade 12 accounting on students' pre-test results was higher for the accounting equation questions (partial η^2=.192) compared to the match-the-term question 1 (partial η^2=.078). This result could be attributed to the matching question being easier, as it provided students with elements and definitions, which many were able to match correctly based on their background knowledge, even though they had not done Grade 12 accounting.

Table 4.31: ANCOVA between Gr 12 accounting and experiment group for test results

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial eta squared
Corrected Model							
	Pre-test % (out of 15)	98567.980[a]	6	16427.997	35.933	.000	.235
	Pre-test % ex. Qu 1 (out of 9)	167175.823[b]	6	27862.637	30.023	.000	.205
	Pre-test % Qu 1 (out of 6)	86726.327[c]	6	14454.388	34.696	.000	.229
	Post-test % (out of 15)	6681.624[d]	6	1113.604	1.722	.113	.015
	Increase pre-test to post-test	18761.864[e]	6	3126.977	2.885	.009	.024
	Increase pre-test ex. Qu 1 to post-test	23.902[f]	6	3.984	1.532	.165	.013
Intercept	Pre-test % (out of 15)	1527.494	1	1527.494	3.341	.068	.005
	Pre-test % ex. Qu 1 (out of 9)	1178.272	1	1178.272	1.270	.260	.002
	Pre-test % Qu 1 (out of 6)	3509.951	1	3509.951	8.425	.004	.012
	Post-test % (out of 15)	406.493	1	406.493	.629	.428	.001
	Increase pre-test to post-test	8755.496	1	8755.496	8.077	.005	.011
	Increase pre-test ex. Qu 1 to post-test	232.564	1	232.564	89.448	.000	.113
Covariates							
Grade 12 APS	Pre-test % (out of 15)	4040.420	1	4040.420	8.838	.003	.012
	Pre-test % ex. Qu 1 (out of 9)	3331.259	1	3331.259	3.590	.059	.005
	Pre-test % Qu 1 (out of 6)	5232.375	1	5232.375	12.180	.001	.017
	Post-test % (out of 15)	73.813	1	73.813	.177	.674	.000
	Increase pre-test to post-test	3022.016	1	3022.016	4.674	.031	.007
	Increase pre-test ex. Qu 1 to post-test	2413.327	1	2413.327	2.226	.136	.003
Grade 12 maths result	Pre-test % (out of 15)	262.662	1	262.662	.575	.449	.001
	Pre-test % ex. Qu 1 (out of 9)	978.628	1	978.628	1.055	.305	.002
	Pre-test % Qu 1 (out of 6)	41.055	1	41.055	.096	.757	.000
	Post-test % (out of 15)	5747.677	1	5747.677	13.797	.000	.019
	Increase pre-test to post-test	3552.945	1	3552.945	5.495	.019	.008
	Increase pre-test ex. Qu 1 to post-test	1982.957	1	1982.957	1.829	.177	.003
Grade 12 English result	Pre-test % (out of 15)	79.671	1	79.671	.174	.676	.000
	Pre-test % ex. Qu 1 (out of 9)	474.888	1	474.888	.512	.475	.001
	Pre-test % Qu 1 (out of 6)	3025.285	1	3025.285	7.042	.008	.010
	Post-test % (out of 15)	1434.575	1	1434.575	3.444	.064	.005
	Increase pre-test to post-test	2190.396	1	2190.396	3.387	.066	.005
	Increase pre-test ex. Qu 1 to post-test	258.691	1	258.691	.239	.625	.000
Main effects							
Grade 12 accounting	Pre-test % (out of 15)	89564.082	1	89564.082	195.905	.000	.219
	Pre-test % ex. Qu 1 (out of 9)	154098.362	1	154098.362	166.047	.000	.192
	Pre-test % Qu 1 (out of 6)	25392.743	1	25392.743	59.108	.000	.078
	Post-test % (out of 15)	74631.237	1	74631.237	179.145	.000	.204
	Increase pre-test to post-test	680.448	1	680.448	1.052	.305	.002
	Increase pre-test ex. Qu 1 to post-test	14248.352	1	14248.352	13.144	.000	.018
Experimental group	Pre-test % (out of 15)	46.704	1	46.704	.102	.749	.000
	Pre-test % ex. Qu 1 (out of 9)	176.253	1	176.253	.190	.663	.000
	Pre-test % Qu 1 (out of 6)	8.003	1	8.003	.019	.891	.000
	Post-test % (out of 15)	450.136	1	450.136	1.081	.299	.002
	Increase pre-test to post-test	786.827	1	786.827	1.217	.270	.002
	Increase pre-test ex. Qu 1 to post-test	1189.729	1	1189.729	1.097	.295	.002
Interaction effect							
Grade 12 accounting X Experimental group	Pre-test % (out of 15)	279.822	1	279.822	.612	.434	.001
	Pre-test % ex. Qu 1 (out of 9)	228.675	1	228.675	.246	.620	.000
	Pre-test % Qu 1 (out of 6)	366.211	1	366.211	.852	.356	.001
	Post-test % (out of 15)	60.736	1	60.736	.146	.703	.000
	Increase pre-test to post-test	79.826	1	79.826	.123	.725	.000
	Increase pre-test ex. Qu 1 to post-test	53.710	1	53.710	.050	.824	.000
Residual	Pre-test % (out of 15)	320027.399	700	457.182			
	Pre-test % ex. Qu 1 (out of 9)	649627.572	700	928.039			
	Pre-test % Qu 1 (out of 6)	300721.874	700	429.603			
	Post-test % (out of 15)	291617.096	700	416.596			
	Increase pre-test to post-test	452638.697	700	646.627			
	Increase pre-test ex. Qu 1 to post-test	758829.084	700	1084.042			

a. R Squared = .235 (Adjusted R Squared = .229)
b. R Squared = .205 (Adjusted R Squared = .198)
c. R Squared = .099 (Adjusted R Squared = .091)
d. R Squared = .229 (Adjusted R Squared = .223)
e. R Squared = .015 (Adjusted R Squared = .006)
f. R Squared = .024 (Adjusted R Squared = .016)

While there was a significant increase in the mean test scores of all students, students without Grade 12 accounting had a more significant increase in the test scores for accounting equation questions than for students who took Grade 12 accounting (p<.001). The increase in scores of students without Grade 12 accounting was 9.2% (95% CI, 4.2% to 14.2%) higher than for students with Grade 12 accounting. It therefore appeared that the intervention was more beneficial to students without Grade 12 accounting in improving their performance. This result supported Hypothesis 4b.

4.8.1.2 Cognitive load

Only 491 students answered all four of the subjective experience questions (Table 4.32). The interaction effect between Grade 12 accounting and the experimental group was not significant for any of the cognitive load subjective measures. The main effect of the experimental group was also not significant. Therefore, Hypotheses 2a and 2b are not supported.

As expected, Grade 12 accounting students exhibited lower levels of intrinsic load compared to non-accounting students. This was measured by asking students about their perceptions of difficulty of the activity. The main effect of Grade 12 accounting on students' level of difficulty experienced was significant (p<.001). On a scale of 1 to 7, the level of difficulty of students with Grade 12 accounting was 1.203 (95% CI, 1.002 to 1.404) lower than for students without Grade 12 accounting. Hypothesis 5a is therefore supported.

Students' experience of total cognitive load was measured by their perception of the effort they used on the task. Following from the result of lower intrinsic load, Grade 12 accounting students also professed to having used lower levels of mental effort (total cognitive load) compared to non-accounting students. The main effect of Grade 12 accounting on students' level of mental effort used was significant (p<.001). On a scale of 1 to 7, the mental effort used by students with Grade 12 accounting was 0.673 (95% CI, 0.444 to 0.902) lower than for students without Grade 12 accounting. Hypothesis 5b is therefore also supported.

Table 4.32: ANCOVA between Gr 12 accounting and experiment group for cognitive load

Source of Variance	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial eta squared
Corrected Model							
	Mental effort used	60.346[a]	6	10.058	6.307	.000	.073
	Difficulty	174.598[b]	6	29.100	23.728	.000	.227
	Clarity	15.696[c]	6	2.616	2.639	.016	.032
	Improved understanding	71.399[d]	6	11.900	4.302	.000	.051
Intercept							
	Mental effort used	92.384	1	92.384	57.933	.000	.107
	Difficulty	69.743	1	69.743	56.868	.000	.105
	Clarity	8.327	1	8.327	8.400	.004	.017
	Improved understanding	139.760	1	139.760	50.524	.000	.095
Covariates							
Grade 12 APS	Mental effort used	.215	1	.215	.135	.714	.000
	Difficulty	.434	1	.434	.354	.552	.001
	Clarity	.118	1	.118	.119	.730	.000
	Improved understanding	.007	1	.007	.003	.960	.000
Grade 12 maths result	Mental effort used	1.460	1	1.460	.915	.339	.002
	Difficulty	1.324	1	1.324	1.080	.299	.002
	Clarity	.233	1	.233	.235	.628	.000
	Improved understanding	9.460	1	9.460	3.420	.065	.007
Grade 12 English result	Mental effort used	.275	1	.275	.173	.678	.000
	Difficulty	.646	1	.646	.527	.468	.001
	Clarity	.065	1	.065	.065	.798	.000
	Improved understanding	.007	1	.007	.003	.960	.000
Main effects							
Grade 12 accounting	Mental effort used	53.086	1	53.086	33.290	.000	.064
	Difficulty	169.828	1	169.828	138.478	.000	.222
	Clarity	13.046	1	13.046	13.159	.000	.026
	Improved understanding	59.307	1	59.307	21.440	.000	.042
Experimental group	Mental effort used	.317	1	.317	.199	.656	.000
	Difficulty	.057	1	.057	.046	.830	.000
	Clarity	1.843	1	1.843	1.859	.173	.004
	Improved understanding	.405	1	.405	.146	.702	.000
Interaction effect							
Grade 12 accounting X Experimental group	Mental effort used	2.798	1	2.798	1.754	.186	.004
	Difficulty	.657	1	.657	.536	.465	.001
	Clarity	.064	1	.064	.065	.799	.000
	Improved understanding	.127	1	.127	.046	.830	.000
Residual	Mental effort used	771.825	484	1.595			
	Difficulty	593.573	484	1.226			
	Clarity	479.844	484	.991			
	Improved understanding	1338.837	484	2.766			

R Squared = .073 (Adjusted R Squared = .061)
R Squared = .227 (Adjusted R Squared = .218)
R Squared = .032 (Adjusted R Squared = .020)
R Squared = .051 (Adjusted R Squared = .039)

The measures for clarity (extraneous load) and improved understanding (germane load) were only hypothesised to differ with the experimental group; however, there was a significant difference between these scores for Grade 12 accounting and non-accounting students ($p<.001$). On a scale of 1 to 7, Grade 12 accounting students measured the instructions as .333 (95% CI, 0.153 to .514) points clearer than for students without Grade 12 accounting. However, non-accounting students found their understanding improved by .711 (95% CI, 0.409 to 1.013) points more than for Grade 12 accounting students.

4.8.1.3 Time taken

Students' Grade 12 mathematics result (p=.012) and English result (p=.025) were significantly related to the time they took on the post-test (Table 4.33). The interaction effect between Grade 12 accounting and the experimental group was not significant for the time taken to complete the tests or the decrease in time taken. The main effect of the experimental group was also not significant for the time taken or for the reduction in time. Therefore, Hypothesis 2c is not supported.

Table 4.33: ANCOVA between Gr 12 accounting and experiment group for time-on-task

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial eta squared
Corrected Model	Time pre-test	120.074[a]	6	20.012	7.753	.000	.062
	Time post-test	51.465[b]	6	8.577	2.902	.008	.024
	Time change	113.356[c]	6	18.893	19.102	.000	.141
Intercept	Time pre-test	200.883	1	200.883	77.820	.000	.100
	Time post-test	1.159	1	1.159	.392	.531	.001
	Time change	18.015	1	18.015	18.214	.000	.025
Covariates							
Grade 12 APS	Time pre-test	.085	1	.085	.033	.857	.000
	Time post-test	1.632	1	1.632	.632	.427	.001
	Time change	2.461	1	2.461	.832	.362	.001
Grade 12 maths Result	Time pre-test	5.100	1	5.100	1.962	.162	.003
	Time post-test	16.504	1	16.504	6.394	.012	.009
	Time change	3.255	1	3.255	1.101	.294	.002
Grade 12 English Result	Time pre-test	2.877	1	2.877	1.107	.293	.002
	Time post-test	13.083	1	13.083	5.068	.025	.007
	Time change	3.690	1	3.690	1.248	.264	.002
Main effects							
Grade 12 Accounting	Time pre-test	5.530	1	5.530	2.127	.145	.003
	Time post-test	79.449	1	79.449	30.778	.000	.042
	Time change	43.058	1	43.058	14.568	.000	.020
Experiment group	Time pre-test	.231	1	.231	.089	.766	.000
	Time post-test	1.114	1	1.114	.432	.511	.001
	Time change	2.358	1	2.358	.798	.372	.001
Interaction effect							
Grade 12 Accounting X Experimental group	Time pre-test	2.077	1	2.077	.799	.372	.001
	Time post-test	4.425	1	4.425	1.714	.191	.002
	Time change	.4393	1	.439	.148	.700	.000
Residual	Time pre-test	1819.998	700	2.600			
	Time post-test	1806.958	700	2.581			
	Time change	2068.902	700	2.956			

a. R Squared = .013 (Adjusted R Squared = .005)
b. R Squared = .062 (Adjusted R Squared = .054)
c. R Squared = .024 (Adjusted R Squared = .016)

Grade 12 accounting students were expected to complete the tests in a faster time than non-accounting students. This was for the same reason that the former students' test performance was predicted to be better. However, an interesting result was that there appeared to be no significant difference in the pre-test time between students with and without Grade 12 accounting (p=.145). In contrast, the main effect of Grade 12 accounting on students' post-test time was significant (p<.001). The post-test time of students with Grade 12 accounting was 0.689 minutes (95% CI, 0.445 to 0.933 minutes) quicker than for students without Grade 12 accounting. Hypothesis 5c is therefore supported for the post-test time only, and not for the pre-test time.

There was a significant decrease in the time taken to complete the tests for all students. This supports Hypothesis 5d. However, the decline in test time was significantly higher for students with Grade 12 accounting compared to those without (p<.001). Grade 12 accounting students decreased the time taken from the pre-test to the post-test by 0.508 minutes (95% CI, 0.246 to 0.769 minutes) more than for those without Grade 12 accounting.

4.8.1.4 Instructional efficiency

Table 4.34 shows that students' Grade 12 English and mathematics results were both significantly related to the instructional efficiency for the post-test (p<.01). There was also a significant association between APS and instructional efficiency for the pre-test, including question 1 (p=.048). The English, mathematics and APS results all had a significant relationship with the change in instructional efficiency from the pre-test, including question 1, to the post-test at the p<.05 level. Students' Grade 12 mathematics results were also significantly related to the change in instructional efficiency from the pre-test, excluding question 1, to the post-test – that is for the accounting equation questions (p=.030).

The interaction effect between Grade 12 accounting and the experimental group was not significant for the instructional efficiency scores or change in scores. As the main effect of the experimental group was also not significant, Hypothesis 3 is not supported.

The main effect of Grade 12 accounting on students' instructional efficiency scores was significant at the p<.001 level. Grade 12 accounting students' scores were higher than for students without Grade 12 accounting. Pre-test scores, including question 1, were 0.752 (95% CI, 0.601 to 0.903) higher; pre-test scores, excluding question 1, were 0.711 (95% CI, 0.561 to 0.860) higher; and post-test scores were 0.941 (95% CI, 0.783 to 1.098) higher. This result supports Hypothesis 6a.

Grade 12 accounting students had positive instructional efficiency scores that improved from the pre-test to the post-test. This improvement was due to their higher post-test scores and the reduction in time taken to complete the post-test. These students performed better than

Table 4.34: ANCOVA between Gr 12 accounting and experiment group for instructional efficiency

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial eta squared
Corrected Model							
	Instructional efficiency pre-test	101.511[a]	6	16.918	17.457	.000	.130
	Instructional efficiency pre-test ex. Qu 1	183.337[b]	6	30.556	28.304	.000	.195
	Instructional efficiency post-test	17.807[c]	6	2.968	2.448	.024	.021
	Change Inst. eff. pre-test to post-test	18.203[d]	6	3.034	2.449	.024	.021
	Change Inst. eff. pre-test ex. Qu 1 to post-test	167175.823[e]	6	27862.637	30.023	.000	.205
Intercept	Instructional efficiency pre-test	18.117	1	18.117	18.694	.000	.026
	Instructional efficiency pre-test ex. Qu 1	29.362	1	29.362	27.198	.000	.037
	Instructional efficiency post-test	1.379	1	1.379	1.137	.287	.002
	Change Inst. eff. pre-test to post-test	1.351	1	1.351	1.090	.297	.002
	Change Inst. eff. pre-test ex. Qu 1 to post-test	1527.494	1	1527.494	3.341	.068	.005
Covariates							
Grade 12 APS	Instructional efficiency pre-test	3.894	1	3.894	3.937	.048	.006
	Instructional efficiency pre-test ex. Qu 1	1.762	1	1.762	1.818	.178	.003
	Instructional efficiency post-test	.081	1	.081	.075	.784	.000
	Change Inst. eff. pre-test to post-test	5.097	1	5.097	4.204	.041	.006
	Change Inst. eff. pre-test ex. Qu 1 to post-test	2.597	1	2.597	2.097	.148	.003
Grade 12 maths result	Instructional efficiency pre-test	2.128	1	2.128	2.151	.143	.003
	Instructional efficiency pre-test ex. Qu 1	2.684	1	2.684	2.770	.096	.004
	Instructional efficiency post-test	16.439	1	16.439	15.228	.000	.021
	Change Inst. eff. pre-test to post-test	6.738	1	6.738	5.557	.019	.008
	Change Inst. eff. pre-test ex. Qu 1 to post-test	5.837	1	5.837	4.712	.030	.007
Grade 12 English Result	Instructional efficiency pre-test	.233	1	.233	.236	.627	.000
	Instructional efficiency pre-test ex. Qu 1	1.428	1	1.428	1.474	.225	.002
	Instructional efficiency post-test	7.317	1	7.317	6.778	.009	.010
	Change Inst. eff. pre-test to post-test	4.938	1	4.938	4.073	.044	.006
	Change Inst. eff. pre-test ex. Qu 1 to post-test	2.280	1	2.280	1.840	.175	.003
Main effects							
Grade 12 Accounting	Instructional efficiency pre-test	94.472	1	94.472	95.517	.000	.120
	Instructional efficiency pre-test ex. Qu 1	84.449	1	84.449	87.137	.000	.111
	Instructional efficiency post-test	147.854	1	147.854	136.957	.000	.164
	Change Inst. eff. pre-test to post-test	5.953	1	5.953	4.910	.027	.007
	Change Inst. eff. pre-test ex. Qu 1 to post-test	8.820	1	8.820	7.120	.008	.010
Experiment group	Instructional efficiency pre-test	.167	1	.167	.169	.681	.000
	Instructional efficiency pre-test ex. Qu 1	.236	1	.236	.244	.622	.000
	Instructional efficiency post-test	1.210	1	1.210	1.121	.290	.002
	Change Inst. eff. pre-test to post-test	2.275	1	2.275	1.877	.171	.003
	Change Inst. eff. pre-test ex. Qu 1 to post-test	2.515	1	2.515	2.030	.155	.003
Interaction effect							
Grade 12 Accounting X Experiment group	Instructional efficiency pre-test	1.246	1	1.246	1.260	.262	.002
	Instructional efficiency pre-test ex. Qu 1	.893	1	.893	.921	.337	.001
	Instructional efficiency post-test	1.296	1	1.296	1.200	.274	.002
	Change Inst. eff. pre-test to post-test	.000	1	.000	.000	.984	.000
	Change Inst. eff. pre-test ex. Qu 1 to post-test	.037	1	.037	.030	.862	.000
Residual	Instructional efficiency pre-test	692.338	700	.989			
	Instructional efficiency pre-test ex. Qu 1	678.404	700	.969			
	Instructional efficiency post-test	755.693	700	1.080			
	Change Inst. eff. pre-test to post-test	848.690	700	1.212			
	Change Inst. eff. pre-test ex. Qu 1 to post-test	867.152	700	1.239			

a. R Squared = .141 (Adjusted R Squared = .133)
b. R Squared = .130 (Adjusted R Squared = .123)
c. R Squared = .195 (Adjusted R Squared = .188)
d. R Squared = .021 (Adjusted R Squared = .012)
e. R Squared = .021 (Adjusted R Squared = .012)

expected, based on their invested mental effort; in other words, their invested mental effort was lower than might be expected to achieve their performance (Paas and van Merriënboer, 1993).

Students without Grade 12 accounting had negative instructional efficiency scores for both the pre-test and the post-test. The instructional efficiency scores for the post-test deteriorated, compared to the pre-test scores. This deterioration is due to the increase in test scores not matching up with an equivalent improvement in the time taken to complete the post-test. This means that students achieved higher post-test scores by increased mental effort; in other words, their increased mental effort was higher than might be expected to achieve their post-test scores.

There was a significant difference between students who had done Grade 12 accounting and those who had not, for the change in instructional efficiency from the pre-test (excluding question 1) to the post-test (p=.008). Students with Grade 12 accounting improved their instructional efficiency scores by 0.230 (95% CI, 0.061 to 0.399) more than for students without Grade 12 accounting. This significant difference was also evident using the pre-test measuring, including question 1 (p=.027). Students with Grade 12 accounting improved their instructional efficiency scores by 0.189 (95% CI, 0.022 to 0.356) more than students without Grade 12 accounting. This suggests that the intervention decreased the mental effort required by Grade 12 accounting students to complete the post-test. Conversely, the mental effort required of students without Grade 12 accounting to improve their post-test scores, was increased. Hypothesis 6b is therefore not supported.

Due to the differences in performance, effort and instructional efficiency between students with and without Grade 12 accounting, the students were separated into accounting and non-accounting groups, and the effect of the Grade 12 English level was analysed separately for each group.

4.8.2 Effect of the Grade 12 English level and the experimental group

4.8.2.1 Students with Grade 12 accounting

A two-way ANCOVA was run to determine the impact of the Grade 12 English level (HL/FAL) and the experiment group (test/control) on the students' test scores (Table 4.35), subjective experiences of cognitive load (Table 4.36), time taken (Table 4.37) and instructional efficiency (Table 4.38) after controlling for students' Grade 12 APS aggregate and for their mathematics, English and accounting grades. Pairwise comparisons were run for statistically significant simple main effects, and are reported with 95% confidence intervals and p-values Bonferroni adjusted.

4.8.2.1.1 Test scores

The results in Table 4.35 show that the covariates APS (p=.001) and mathematics grade (p<.001) were significantly related to the post-test score only. There was a significant relationship between students' accounting grades and all the test scores (p<.05). Students' English grades were significantly related to all the test scores (p<.05) except for question 1 of the pre-test (p=.50).

The interaction effect between the Grade 12 English level and the experiment group was not significant for any of the test scores or for the increase in scores. The main effect of the experiment group showed no significant difference in mean test scores and the improvement in scores between the two experiment groups. Hypothesis 1 was therefore still not supported.

An analysis of the main effect for the Grade 12 English level indicated that the main effect on the pre-test and post-test scores was significant (p<.001). Grade 12 English HL students' scores were higher than for Grade 12 students with EAL. Pre-test scores, including question 1, were 12.9% (95% CI, 8.0% to 17.8%) higher; pre-test scores, excluding question 1, were 14.9% (95% CI, 7.6% to 22.2%) higher; and post-test scores were 7.8% (95% CI, 3.9% to 11.7%) higher. This supports Hypothesis 7 for Grade 12 accounting students.

The improvement in results from the pre-test to the post-test was higher for students with EAL, but the difference was only significant at the p>.1 level.

Table 4.35: **ANCOVA between Grade 12 English level and experiment group for test results (Gr 12 accounting students only)**

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model							
	Pre-test % (out of 15)	20285.733	7	2897.962	6.510	.000	.097
	Pre-test % Qu 1 (out of 6)	10801.181	7	1543.026	4.931	.000	.075
	Pre-test % ex. Qu 1 (out of 9)	34262.962	7	4894.709	4.965	.000	.076
	Post-test % (out of 15)	13166.759	7	1880.966	6.753	.000	.101
	Increase pre-test to post-test	6639.184	7	948.455	1.629	.125	.026
	Increase pre-test ex. Qu 1 to post-test	12582.826	7	1797.547	1.673	.114	.027
Intercept	Pre-test % (out of 15)	39.105	1	39.105	.088	.767	.000
	Pre-test % Qu 1 (out of 6)	14660.127	1	14660.127	46.852	.000	.100
	Pre-test % ex. Qu 1 (out of 9)	4941.661	1	4941.661	5.013	.026	.012
	Post-test % (out of 15)	4382.258	1	4382.258	15.734	.000	.036
	Increase pre-test to post-test	3593.426	1	3593.426	6.171	.013	.014
	Increase pre-test ex. Qu 1 to post-test	18631.042	1	18631.042	17.335	.000	.039
Co-variates							
Grade 12 APS	Pre-test % (out of 15)	114.607	1	114.607	.257	.612	.001
	Pre-test % Qu 1 (out of 6)	247.744	1	247.744	.792	.374	.002
	Pre-test % ex. Qu 1 (out of 9)	54.011	1	54.011	.055	.815	.000
	Post-test % (out of 15)	3025.581	1	3025.581	10.863	.001	.025
	Increase pre-test to post-test	1962.473	1	1962.473	3.370	.067	.008
	Increase pre-test ex. Qu 1 to post-test	2271.101	1	2271.101	2.113	.147	.005
Grade 12 maths result	Pre-test % (out of 15)	212.565	1	212.565	.477	.490	.001
	Pre-test % Qu 1 (out of 6)	32.605	1	32.605	.104	.747	.000
	Pre-test % ex. Qu 1 (out of 9)	789.953	1	789.953	.801	.371	.002
	Post-test % (out of 15)	3463.991	1	3463.991	12.437	.000	.029
	Increase pre-test to post-test	1960.370	1	1960.370	3.367	.067	.008
	Increase pre-test ex. Qu 1 to post-test	945.536	1	945.536	.880	.349	.002
Grade 12 English result	Pre-test % (out of 15)	2656.816	1	2656.816	5.968	.015	.014
	Pre-test % Qu 1 (out of 6)	142.371	1	142.371	.455	.500	.001
	Pre-test % ex. Qu 1 (out of 9)	6076.602	1	6076.602	6.164	.013	.014
	Post-test % (out of 15)	3235.878	1	3235.878	11.618	.001	.027
	Increase pre-test to post-test	28.521	1	28.521	.049	.825	.000
	Increase pre-test ex. Qu 1 to post-test	443.851	1	443.851	.413	.521	.001
Grade 12 accounting result	Pre-test % (out of 15)	4307.498	1	4307.498	9.676	.002	.022
	Pre-test % Qu 1 (out of 6)	1931.243	1	1931.243	6.172	.013	.014
	Pre-test % ex. Qu 1 (out of 9)	6414.186	1	6414.186	6.507	.011	.015
	Post-test % (out of 15)	4463.859	1	4463.859	16.027	.000	.037
	Increase pre-test to post-test	1.394	1	1.394	.002	.961	.000
	Increase pre-test ex. Qu 1 to post-test	176.265	1	176.265	.164	.686	.000
Main effects							
Grade 12 English Level	Pre-test % (out of 15)	11805.704	1	11805.704	26.519	.000	.059
	Pre-test % Qu 1 (out of 6)	6912.028	1	6912.028	22.090	.000	.050
	Pre-test % ex. Qu 1 (out of 9)	15791.530	1	15791.530	16.019	.000	.036
	Post-test % (out of 15)	4268.057	1	4268.057	15.324	.000	.035
	Increase pre-test to post-test	1876.942	1	1876.942	3.223	.073	.008
	Increase pre-test ex. Qu 1 to post-test	3640.190	1	3640.190	3.387	.066	.008
Experimental group	Pre-test % (out of 15)	482.804	1	482.804	1.085	.298	.003
	Pre-test % Qu 1 (out of 6)	1074.312	1	1074.312	3.433	.065	.008
	Pre-test % ex. Qu 1 (out of 9)	218.159	1	218.159	.221	.638	.001
	Post-test % (out of 15)	859.649	1	859.649	3.086	.080	.007
	Increase pre-test to post-test	53.978	1	53.978	.093	.761	.000
	Increase pre-test ex. Qu 1 to post-test	211.690	1	211.690	.197	.657	.000
Interaction effect							
Grade 12 English level X Experimental group	Pre-test % (out of 15)	770.057	1	770.057	1.730	.189	.004
	Pre-test % Qu 1 (out of 6)	1124.377	1	1124.377	3.593	.059	.008
	Pre-test % ex. Qu 1 (out of 9)	570.987	1	570.987	.579	.447	.001
	Post-test % (out of 15)	18.825	1	18.825	.068	.795	.000
	Increase pre-test to post-test	548.080	1	548.080	.941	.333	.002

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
	Increase pre-test ex. Qu 1 to post-test	382.459	1	382.459	.356	.551	.001
Residual	Pre-test % (out of 15)	188310.091	423	445.178			
	Pre-test % Qu 1 (out of 6)	132358.138	423	312.903			
	Pre-test % ex. Qu 1 (out of 9)	416992.516	423	985.798			
	Post-test % (out of 15)	117817.928	423	278.529			
	Increase pre-test to post-test	246305.595	423	582.283			
	Increase pre-test ex. Qu 1 to post-test	454622.537	423	1074.758			

a. R Squared = .097 (Adjusted R Squared = .082)
b. R Squared = .075 (Adjusted R Squared = .060)
c. R Squared = .076 (Adjusted R Squared = .061)
d. R Squared = .101 (Adjusted R Squared = .086)
e. R Squared = .026 (Adjusted R Squared = .010)
f. R Squared = .027 (Adjusted R Squared = .011)

4.8.2.1.2 Cognitive load

Only 291 students answered all four of the subjective cognitive load questions (Table 4.36). The covariate, students' Grade 12 English results, was significantly related to students' subjective experience of mental effort used (p=.021). The remaining results discussed in this section are after adjustment for students' Grade 12 results.

There was a significant interaction between the Grade 12 English level and the experiment group for students' perceived clarity (extraneous load) score (p =.045). Therefore, an analysis of simple main effects for the experiment group was performed. The mean clarity score of students with EAL was 0.449 (95% CI, .075 to .823) points better for the test group, compared to the control group (p = .019). Hypothesis 2a is therefore supported only for Grade 12 accounting students with EAL, and not for students with Grade 12 English HL.

There was no significant interaction between the Grade 12 English level and the experiment group for the mental effort, difficulty and improved understanding scores. The main effect of the experiment group was also not significant for any of the subjective cognitive load measures. Therefore, Hypothesis 2b is not supported for Grade 12 accounting students.

The main effect of the Grade 12 English level on students' mental effort scores was significant (p <.001). On a scale of 1 to 7, Grade 12 English HL students' mental effort scores (total cognitive load) were .684 (95% CI, .325 to 1.043) less than for students with EAL. Hypothesis 8b is therefore supported for Grade 12 accounting students. The main effect of the Grade 12 English level on the mean difficulty score was 0.292 (95% CI, -.005 to .590) points higher for students with EAL, but the difference was only significant at the p=.054 level. Hypothesis 8a is therefore not supported for Grade 12 accounting students.

Table 4.36: ANCOVA between Gr 12 English level and experiment group for cognitive load (Gr 12 accounting students only)

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model							
	Mental effort used	37.535[a]	7	5.362	3.268	.002	.075
	Difficulty	16.543[b]	7	2.363	2.101	.044	.049
	Clarity	7.447[c]	7	1.064	1.153	.330	.028
	Improved understanding	35.713[d]	7	5.102	1.516	.162	.036
Intercept	Mental effort used	97.973	1	97.973	59.703	.000	.174
	Difficulty	44.426	1	44.426	39.500	.000	.122
	Clarity	3.251	1	3.251	3.521	.062	.012
	Improved understanding	108.515	1	108.515	32.238	.000	.102
Co-variates							
Grade 12 APS	Mental effort used	.075	1	.075	.046	.831	.000
	Difficulty	.018	1	.018	.016	.899	.000
	Clarity	1.222	1	1.222	1.324	.251	.005
	Improved understanding	.012	1	.012	.003	.953	.000
Grade 12 maths result	Mental effort used	1.905	1	1.905	1.161	.282	.004
	Difficulty	.410	1	.410	.365	.546	.001
	Clarity	.000	1	.000	.000	.989	.000
	Improved understanding	10.919	1	10.919	3.244	.073	.011
Grade 12 English result	Mental effort used	8.826	1	8.826	5.378	.021	.019
	Difficulty	1.233	1	1.233	1.096	.296	.004
	Clarity	.183	1	.183	.198	.657	.001
	Improved understanding	.717	1	.717	.213	.645	.001
Grade 12 accounting result	Mental effort used	1.306	1	1.306	.796	.373	.003
	Difficulty	2.782	1	2.782	2.473	.117	.009
	Clarity	1.797	1	1.797	1.946	.164	.007
	Improved understanding	.991	1	.991	.295	.588	.001
Main effects							
Grade 12 English Level	Mental effort used	23.042	1	23.042	14.041	.000	.047
	Difficulty	4.208	1	4.208	3.742	.054	.013
	Clarity	.101	1	.101	.109	.741	.000
	Improved understanding	7.905	1	7.905	2.349	.127	.008
Experimental group	Mental effort used	.931	1	.931	.567	.452	.002
	Difficulty	.260	1	.260	.231	.631	.001
	Clarity	2.915	1	2.915	3.158	.077	.011
	Improved understanding	.080	1	.080	.024	.878	.000
Interaction effect							
Grade 12 English Level X Experimental group	Mental effort used	.007	1	.007	.004	.949	.000
	Difficulty	1.557	1	1.557	1.385	.240	.005
	Clarity	3.748	1	3.748	4.060	.045	.014
	Improved understanding	2.227	1	2.227	.662	.417	.002
Residual	Mental effort used	464.403	283	1.641			
	Difficulty	318.289	283	1.125			
	Clarity	261.233	283	.923			
	Improved understanding	952.583	283	3.366			

a. R Squared = .075 (Adjusted R Squared = .052)
b. R Squared = .049 (Adjusted R Squared = .026)
c. R Squared = .028 (Adjusted R Squared = .004)
d. R Squared = .036 (Adjusted R Squared = .012)

4.8.2.1.3 Time taken

As per Table 4.37, the covariate, students' Grade 12 English result, was significantly related to the time taken for both tests and also to the decrease in the time taken to complete the post-test compared to the pre-test ($p<.05$). There was a significant relationship between students' Grade 12 mathematics result and their post-test time taken (p=.035). The interaction effect between the Grade 12 English level and the experiment group was not significant for the time taken to complete the tests or the decrease in time taken. The main effect of the experiment group was also not significant for the time taken or for the reduction in time. Support for Hypothesis 2c was therefore still not found.

Table 4.37: ANCOVA between Gr 12 English level and experiment group for time-on-task (Gr 12 accounting students only)

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model							
	Time pre-test	132.346[a]	7	18.907	9.217	.000	.132
	Time post-test	38.806[b]	7	5.544	2.745	.008	.043
	Time change	69.151[c]	7	9.879	4.120	.000	.064
Intercept	Time pre-test	204.775	1	204.775	99.827	.000	.191
	Time post-test	107.373	1	107.373	53.171	.000	.112
	Time change	15.586	1	15.586	6.499	.011	.015
Co-variates							
Grade 12 APS	Time pre-test	6.904	1	6.904	3.366	.067	.008
	Time post-test	5.213	1	5.213	2.581	.109	.006
	Time change	.119	1	.119	.049	.824	.000
Grade 12 maths result	Time pre-test	1.389	1	1.389	.677	.411	.002
	Time post-test	9.065	1	9.065	4.489	.035	.011
	Time change	3.358	1	3.358	1.400	.237	.003
Grade 12 English result	Time pre-test	55.191	1	55.191	26.905	.000	.060
	Time post-test	17.235	1	17.235	8.535	.004	.020
	Time change	10.742	1	10.742	4.480	.035	.010
Grade 12 accounting result	Time pre-test	.793	1	.793	.386	.535	.001
	Time post-test	1.883	1	1.883	.933	.335	.002
	Time change	.232	1	.232	.097	.756	.000
Main effects							
Grade 12 English level	Time pre-test	111.670	1	111.670	54.439	.000	.114
	Time post-test	8.544	1	8.544	4.231	.040	.010
	Time change	58.436	1	58.436	24.368	.000	.054
Experimental group	Time pre-test	1.132	1	1.132	.552	.458	.001
	Time post-test	6.047	1	6.047	2.994	.084	.007
	Time change	1.946	1	1.946	.812	.368	.002
Interaction effect							
Gr 12 English level X Experimental group	Time pre-test	.828	1	.828	.404	.526	.001
	Time post-test	.296	1	.296	.147	.702	.000
	Time change	.134	1	.134	.056	.813	.000
Residual	Time pre-test	867.699	423	2.051			
	Time post-test	854.200	423	2.019			
	Time change	1014.369	423	2.398			

a. R Squared = .132 (Adjusted R Squared = .118)
b. R Squared = .043 (Adjusted R Squared = .028)
c. R Squared = .064 (Adjusted R Squared = .048)

An analysis of the main effect for the Grade 12 English level indicated that the main effect on the time taken for both tests was significant. Grade 12 English HL students completed the pre-test 1.26 minutes (95% CI, 0.92 to 1.59 minutes) faster than Grade 12 students with EAL, and their post-test time was .35 minutes (95% CI, 0.02 to 0.65 minutes) faster. Support was therefore found for Hypothesis 8c for Grade 12 accounting students. The intervention appeared to be more beneficial to Grade 12 students with EAL, as they decreased their cognitive load (time taken) from the pre-test to the post-test by 0.91 minutes (95% CI, 0.55 to 1.27 minutes) more than for Grade 12 English HL students. This difference was significant at the p<.001 level.

4.8.2.1.4 Instructional efficiency

There was a significant relationship between students' Grade 12 English (p<.001) and accounting results (p<.05) and the instructional efficiency scores for the pre-tests and the post-test (Table 4.38). Grade 12 math scores were significantly related to the instructional efficiency for the post-test (p<.001) and the change in instructional efficiency from the pre-test to the post-test (p<.05). Students' Grade 12 APS was significantly related to the post-test instructional efficiency scores only (p=.001). The interaction effect between the Grade 12 English level and the experiment group was not significant for the instructional efficiency scores for any of the tests, or for the changes in instructional efficiency scores.

Per Table 4.38, the main effect of the experiment group was significant for the post-test instructional efficiency (p=.027). Students in the control group had an instructional efficiency score that was 0.291 (95% CI, 0.033 to 0.550) better than for students in the test group. This was because students in the control group obtained higher post-test results, but the difference was only significant at the p=.080 level (Table 4.35). Per Table 4.37, they also completed the post-test more quickly than those in the test group did (p=.084), which translated into their higher instructional efficiency scores. This was opposite to what was expected in Hypothesis 3. No support was therefore found for this hypothesis for Grade 12 accounting students.

An analysis of the main effect for the Grade 12 English level indicated that the main effect on the instructional efficiency scores for both tests (p<.001), and the change in instructional efficiency was significant (p<.05). Grade 12 English HL students' scores were 1.167 (95% CI, 0.889 to 1.446) higher on the pre-test, including Qu 1; 1.042 (95% CI, 0.762 to 1.323) higher on the pre-test, excluding question 1; and 0.615 (95% CI, 0.310 to 0.919) better on the post-test. Hypothesis 9 is therefore supported for Grade 12 accounting students.

However, Grade 12 students with EAL instructional efficiency scores improved from the pre-test, including question 1, to the post-test by 0.553 (95% CI, 0.214 to 0.891) more than for

Table 4.38: ANCOVA between Gr 12 English level and experiment group for instructional efficiency (Gr 12 accounting students only)

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model							
	Instructional efficiency pre-test	117.862	7	16.837	11.795	.000	.163
	Instructional efficiency pre-test ex. Qu 1	101.902	7	14.557	10.074	.000	.143
	Instructional efficiency post-test	85.960	7	12.280	7.222	.000	.107
	Change Inst. eff. pre-test to post-test	43.058	7	6.151	2.925	.005	.046
	Change Inst. eff. pre-test ex. Qu 1 to post-test	35.833	7	5.119	2.388	.021	.038
Intercept	Instructional efficiency pre-test	55.312	1	55.312	38.748	.000	.084
	Instructional efficiency pre-test ex. Qu 1	58.147	1	58.147	40.239	.000	.087
	Instructional efficiency post-test	34.834	1	34.834	20.487	.000	.046
	Change Inst. eff. pre-test to post-test	2.357	1	2.357	1.121	.290	.003
	Change Inst. eff. pre-test ex. Qu 1 to post-test	2.970	1	2.970	1.386	.240	.003
Co-variates							
Grade 12 APS	Instructional efficiency pre-test	2.905	1	2.905	2.035	.154	.005
	Instructional efficiency pre-test ex. Qu 1	2.089	1	2.089	1.445	.230	.003
	Instructional efficiency post-test	18.249	1	18.249	10.732	.001	.025
	Change Inst. eff. pre-test to post-test	6.592	1	6.592	3.134	.077	.007
	Change Inst. eff. pre-test ex. Qu 1 to post-test	7.990	1	7.990	3.728	.054	.009
Grade 12 maths result	Instructional efficiency pre-test	1.460	1	1.460	1.023	.312	.002
	Instructional efficiency pre-test ex. Qu 1	1.999	1	1.999	1.384	.240	.003
	Instructional efficiency post-test	23.518	1	23.518	13.831	.000	.032
	Change Inst. eff. pre-test to post-test	13.258	1	13.258	6.304	.012	.015
	Change Inst. eff. pre-test ex. Qu 1 to post-test	11.803	1	11.803	5.507	.019	.013
Grade 12 English result	Instructional efficiency pre-test	33.465	1	33.465	23.444	.000	.053
	Instructional efficiency pre-test ex. Qu 1	34.234	1	34.234	23.690	.000	.053
	Instructional efficiency post-test	28.051	1	28.051	16.497	.000	.038
	Change Inst. eff. pre-test to post-test	.239	1	.239	.114	.736	.000
	Change Inst. eff. pre-test ex. Qu 1 to post-test	.308	1	.308	.144	.705	.000
Grade 12 accounting result	Instructional efficiency pre-test	11.510	1	11.510	8.063	.005	.019
	Instructional efficiency pre-test ex. Qu 1	8.323	1	8.323	5.760	.017	.013
	Instructional efficiency post-test	20.263	1	20.263	11.917	.001	.027
	Change Inst. eff. pre-test to post-test	1.229	1	1.229	.585	.445	.001
	Change Inst. eff. pre-test ex. Qu 1 to post-test	2.613	1	2.613	1.219	.270	.003
Main effects							
Grade 12 English level	Instructional efficiency pre-test	96.687	1	96.687	67.734	.000	.138
	Instructional efficiency pre-test ex. Qu 1	77.070	1	77.070	53.333	.000	.112
	Instructional efficiency post-test	26.806	1	26.806	15.765	.000	.036
	Change Inst. eff. pre-test to post-test	21.674	1	21.674	10.306	.001	.024
	Change Inst. eff. pre-test ex. Qu 1 to post-test	12.971	1	12.971	6.052	.014	.014
Experimental group	Instructional efficiency pre-test	2.223	1	2.223	1.557	.213	.004
	Instructional efficiency pre-test ex. Qu 1	.901	1	.901	.624	.430	.001
	Instructional efficiency post-test	8.332	1	8.332	4.900	.027	.011
	Change Inst. eff. pre-test to post-test	1.948	1	1.948	.926	.336	.002
	Change Inst. eff. pre-test ex. Qu 1 to post-test	3.753	1	3.753	1.751	.186	.004
Interaction effect							
Grade 12 English level X Experimental group	Instructional efficiency pre-test	.702	1	.702	.492	.483	.001
	Instructional efficiency pre-test ex. Qu 1	.100	1	.100	.069	.793	.000
	Instructional efficiency post-test	.000	1	.000	.000	.989	.000
	Change Inst. eff. pre-test to post-test	.733	1	.733	.349	.555	.001
	Change Inst. eff. pre-test ex. Qu 1 to post-test	.112	1	.112	.052	.820	.000

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Residual	Instructional efficiency pre-test	603.813	423	1.427			
	Instructional efficiency pre-test ex. Qu 1	611.260	423	1.445			
	Instructional efficiency post-test	719.249	423	1.700			
	Change Inst. eff. pre-test to post-test	889.618	423	2.103			
	Change Inst. eff. pre-test ex. Qu 1 to post-test	906.614	423	2.143			

a. R Squared = .163 (Adjusted R Squared = .149)
b. R Squared = .143 (Adjusted R Squared = .129)
c. R Squared = .107 (Adjusted R Squared = .092)
d. R Squared = .046 (Adjusted R Squared = .030)
e. R Squared = .038 (Adjusted R Squared = .022)

Grade 12 English HL students. For the pre-test, excluding question 1, the instructional efficiency scores for Grade 12 students with EAL also improved by 0.428 (95% CI, 0.086 to 0.769) more than for Grade 12 English HL students. This was because Grade 12 English HL students' post-test instructional efficiency scores were lower than the pre-test scores, while the Grade 12 students with EAL improved their instructional efficiency scores from the pre-test to the post-test. This effect can be attributed to the improvement in test scores and decrease in time taken from the pre-test to the post-test for students with EAL over students with English HL.

4.8.2.2 Students without Grade 12 accounting

A two-way ANCOVA was run to determine the effect of the Grade 12 English level (HL/FAL) and the experiment group (test/control) on the test scores of students without Gr 12 accounting (Table 4.39), their subjective experiences of cognitive load, time taken (Table 4.40) and instructional efficiency (Table 4.41). Students' Grade 12 APS aggregate and mathematics and English grades were controlled for in the tests. Pairwise comparisons were run for statistically significant simple main effects, and are reported with 95% confidence intervals and p-values Bonferroni adjusted.

4.8.2.2.1 Test scores

Table 4.39 shows that there was a significant relationship between students' APS and question 1 from the pre-test (p=.008), as well as between their English grades and post-test scores (p=.003). The interaction effect between the Grade 12 English level and the experiment group was not significant for the pre-test and post-test scores or for the increase in scores. The main effect of the experiment group showed that there was no significant difference in mean test scores and the improvement in scores between the two experiment groups. Hypothesis 1 is therefore still not supported.

Table 4.39: ANCOVA between Gr 12 English level and experiment group for test results (Students without Gr 12 accounting)

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Pre-test % (out of 15)	8304.020[a]	6	1384.003	3.293	.004	.068
	Pre-test % Qu 1 (out of 6)	18108.446[b]	6	3018.074	5.538	.000	.110
	Pre-test % ex. Qu 1 (out of 9)	5292.024[c]	6	882.004	1.135	.342	.025
	Post-test % (out of 15)	18627.565[d]	6	3104.594	5.329	.000	.106
	Increase pre-test to post-test	5482.809[e]	6	913.802	1.229	.292	.027
	Increase pre-test ex. Qu 1 to post-test	6402.438[f]	6	1067.073	.992	.431	.022
Intercept	Pre-test % (out of 15)	495.193	1	495.193	1.178	.279	.004
	Pre-test % Qu 1 (out of 6)	16.592	1	16.592	.030	.862	.000
	Pre-test % ex. Qu 1 (out of 9)	1181.481	1	1181.481	1.521	.219	.006
	Post-test % (out of 15)	2886.944	1	2886.944	4.955	.027	.018
	Increase pre-test to post-test	990.825	1	990.825	1.332	.249	.005
	Increase pre-test ex. Qu 1 to post-test	374.717	1	374.717	.348	.556	.001
Co-variates							
Grade 12 APS	Pre-test % (out of 15)	821.835	1	821.835	1.955	.163	.007
	Pre-test % Qu 1 (out of 6)	3873.301	1	3873.301	7.108	.008	.026
	Pre-test % ex. Qu 1 (out of 9)	39.550	1	39.550	.051	.822	.000
	Post-test % (out of 15)	129.182	1	129.182	.222	.638	.001
	Increase pre-test to post-test	299.354	1	299.354	.403	.526	.001
	Increase pre-test ex. Qu 1 to post-test	25.775	1	25.775	.024	.877	.000
Grade 12 maths result	Pre-test % (out of 15)	.222	1	.222	.001	.982	.000
	Pre-test % Qu 1 (out of 6)	35.487	1	35.487	.065	.799	.000
	Pre-test % ex. Qu 1 (out of 9)	22.619	1	22.619	.029	.865	.000
	Post-test % (out of 15)	2128.833	1	2128.833	3.654	.057	.013
	Increase pre-test to post-test	2085.619	1	2085.619	2.805	.095	.010
	Increase pre-test ex. Qu 1 to post-test	1712.583	1	1712.583	1.592	.208	.006
Grade 12 English result	Pre-test % (out of 15)	1137.415	1	1137.415	2.706	.101	.010
	Pre-test % Qu 1 (out of 6)	320.717	1	320.717	.589	.444	.002
	Pre-test % ex. Qu 1 (out of 9)	1959.857	1	1959.857	2.523	.113	.009
	Post-test % (out of 15)	5416.758	1	5416.758	9.298	.003	.033
	Increase pre-test to post-test	1589.860	1	1589.860	2.138	.145	.008
	Increase pre-test ex. Qu 1 to post-test	860.153	1	860.153	.799	.372	.003
Main effects							
Grade 12 English Level	Pre-test % (out of 15)	3725.413	1	3725.413	8.864	.003	.032
	Pre-test % Qu 1 (out of 6)	7879.489	1	7879.489	14.459	.000	.051
	Pre-test % ex. Qu 1 (out of 9)	1810.442	1	1810.442	2.331	.128	.009
	Post-test % (out of 15)	4775.656	1	4775.656	8.197	.005	.030
	Increase pre-test to post-test	65.124	1	65.124	.088	.768	.000
	Increase pre-test ex. Qu 1 to post-test	705.266	1	705.266	.655	.419	.002
Experimental group	Pre-test % (out of 15)	256.646	1	256.646	.611	.435	.002
	Pre-test % Qu 1 (out of 6)	243.103	1	243.103	.446	.505	.002
	Pre-test % ex. Qu 1 (out of 9)	265.878	1	265.878	.342	.559	.001
	Post-test % (out of 15)	210.349	1	210.349	.361	.548	.001
	Increase pre-test to post-test	931.690	1	931.690	1.253	.264	.005
	Increase pre-test ex. Qu 1 to post-test	949.206	1	949.206	.882	.348	.003
Interaction effect							
Grade 12 English Level X Experimental group	Pre-test % (out of 15)	1.223	1	1.223	.003	.957	.000
	Pre-test % Qu 1 (out of 6)	217.254	1	217.254	.399	.528	.001
	Pre-test % ex. Qu 1 (out of 9)	136.174	1	136.174	.175	.676	.001
	Post-test % (out of 15)	340.516	1	340.516	.584	.445	.002
	Increase pre-test to post-test	300.928	1	300.928	.405	.525	.002
	Increase pre-test ex. Qu 1 to post-test	46.019	1	46.019	.043	.836	.000
Residual	Pre-test % (out of 15)	113053.790	269	420.274			
	Pre-test % Qu 1 (out of 6)	146588.615	269	544.939			
	Pre-test % ex. Qu 1 (out of 9)	208955.158	269	776.785			
	Post-test % (out of 15)	156715.913	269	582.587			
	Increase pre-test to post-test	200030.073	269	743.606			
	Increase pre-test ex. Qu 1 to post-test	289434.599	269	1075.965			

a. R Squared = .068 (Adjusted R Squared = .048) b. R Squared = .110 (Adjusted R Squared = .090) c. R Squared = .025 (Adjusted R Squared = .003) d. R Squared = .106 (Adjusted R Squared = .086) e. R Squared = .027 (Adjusted R Squared = .005) f. R Squared = .022 (Adjusted R Squared = .000)

An analysis of the main effect for the Grade 12 English level indicated that the main effect on the pre-test, including question 1 (p=.003), question 1 (p<.001) and post-test scores (p=.005) was significant. Grade 12 English HL students' scores were higher than for Grade 12 students with EAL. Pre-test scores, including question 1, were 9.4% (95% CI, 3.2% to 15.6%) higher, and post-test scores were 10.6% (95% CI, 3.3% to 18.0%) higher. Hypothesis 7 is therefore supported for students without Grade 12 accounting as well. There was no significant difference in the increase in scores from the pre-test to the post-test between the two language groups.

4.8.2.2.2 Cognitive load

Only 200 students answered all four of the subjective experience questions. The ANCOVA table is not shown as none of the covariates, main or interaction effects were significantly related to students' subjective experiences of cognitive load. The interaction effect between Grade 12 accounting and the experiment group was not significant for any of the cognitive load subjective measures. The main effect of the experiment group was also not significant. Therefore, Hypotheses 2a and 2b are not supported. The main effect of the Grade 12 English level on the cognitive load subjective measures was also not significant. Hypotheses 8a and 8b were therefore not supported for non-accounting students.

4.8.2.2.3 Time taken

The interaction effect between the Grade 12 English level and the experiment group was not significant for the time taken to complete the tests or the decrease in time taken (Table 4.40). The main effect of the experiment group was also not significant for the time taken or for the reduction in time. There was therefore still no support for Hypothesis 2c.

An analysis of the main effect for the Grade 12 English level indicated that the time taken for the pre-test and the decrease in time taken was significantly different between the two English level groups. However, the Grade 12 English level did not have a significant effect on the post-test time (p=.266). Hypothesis 8c is therefore supported for students without Grade 12 accounting, but only for the pre-test time. Grade 12 English HL students completed the pre-test 0.98 minutes (95% CI, 0.47 to 1.50 minutes) faster than Grade 12 students with EAL (p<.001). As with Grade 12 accounting students, non-accounting students with EAL decreased their cognitive load (time taken) from the pre-test to the post-test by 0.66 minutes (95% CI, 0.09 to 1.24 minutes) more than for Grade 12 English HL students (p=.023).

Table 4.40: ANCOVA between Gr 12 English level and experiment group for time-on-task (Students without Gr 12 accounting)

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model							
	Time pre-test	59.108[a]	6	9.851	3.398	.003	.070
	Time post-test	21.595[b]	6	3.599	1.033	.404	.023
	Time change	32.857[c]	6	5.476	1.531	.168	.033
Intercept	Time pre-test	133.684	1	133.684	46.115	.000	.146
	Time post-test	98.206	1	98.206	28.196	.000	.095
	Time change	2.730	1	2.730	.763	.383	.003
Co-variates							
Grade 12 APS	Time pre-test	2.543	1	2.543	.877	.350	.003
	Time post-test	.154	1	.154	.044	.833	.000
	Time change	3.951	1	3.951	1.105	.294	.004
Grade 12 Maths result	Time pre-test	.641	1	.641	.221	.638	.001
	Time post-test	5.589	1	5.589	1.605	.206	.006
	Time change	2.444	1	2.444	.683	.409	.003
Grade 12 English result	Time pre-test	3.865	1	3.865	1.333	.249	.005
	Time post-test	7.750	1	7.750	2.225	.137	.008
	Time change	.669	1	.669	.187	.666	.001
Main effects							
Grade 12 English Level	Time pre-test	40.848	1	40.848	14.091	.000	.050
	Time post-test	4.319	1	4.319	1.240	.266	.005
	Time change	18.602	1	18.602	5.201	.023	.019
Experimental group	Time pre-test	1.367	1	1.367	.472	.493	.002
	Time post-test	.681	1	.681	.196	.659	.001
	Time change	.118	1	.118	.033	.856	.000
Interaction effect							
Grade 12 English Level X Experimental group	Time pre-test	.008	1	.008	.003	.959	.000
	Time post-test	.264	1	.264	.076	.783	.000
	Time change	.182	1	.182	.051	.822	.000
Residual	Time pre-test	779.813	269	2.899			
	Time post-test	936.918	269	3.483			
	Time change	962.144	269	3.577			

a. R Squared = .070 (Adjusted R Squared = .050)
b. R Squared = .023 (Adjusted R Squared = .001)
c. R Squared = .033 (Adjusted R Squared = .011)

4.8.2.2.4 Instructional efficiency

As per Table 4.41, the relationship between students' Grade 12 English and mathematics grades and the post-test instructional efficiency scores are significant (<.05). The interaction effect between the Grade 12 English level and the experiment group was not significant for time taken to complete the tests or the decrease in time taken. The main effect of the experiment group was also not significant. Therefore, Hypothesis 3 is not supported.

Table 4.41: ANCOVA between Gr 12 English level and experiment group for instructional efficiency (Students without Gr 12 accounting)

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model							
	Instructional efficiency pre-test	53.494[a]	6	8.916	5.786	.000	.114
	Instructional efficiency pre-test ex. Qu 1	28.853[b]	6	4.809	3.175	.005	.066
	Instructional efficiency post-test	49.912[c]	6	8.319	4.716	.000	.095
	Change Inst. eff. pre-test to post-test	19.080[d]	6	3.180	1.537	.166	.033
	Change Inst. eff. pre-test ex. Qu 1 to post-test	14.432[e]	6	2.405	1.112	.355	.024
Intercept	Instructional efficiency pre-test	32.335	1	32.335	20.983	.000	.072
	Instructional efficiency pre-test ex. Qu 1	18.346	1	18.346	12.114	.001	.043
	Instructional efficiency post-test	46.340	1	46.340	26.270	.000	.089
	Change Inst. eff. pre-test to post-test	1.257	1	1.257	.608	.436	.002
	Change Inst. eff. pre-test ex. Qu 1 to post-test	6.372	1	6.372	2.947	.087	.011
Co-variates							
Grade 12 APS	Instructional efficiency pre-test	4.041	1	4.041	2.623	.107	.010
	Instructional efficiency pre-test ex. Qu 1	.759	1	.759	.501	.480	.002
	Instructional efficiency post-test	.091	1	.091	.051	.821	.000
	Change Inst. eff. pre-test to post-test	2.921	1	2.921	1.412	.236	.005
	Change Inst. eff. pre-test ex. Qu 1 to post-test	.325	1	.325	.150	.699	.001
Grade 12 maths result	Instructional efficiency pre-test	.120	1	.120	.078	.780	.000
	Instructional efficiency pre-test ex. Qu 1	.245	1	.245	.162	.688	.001
	Instructional efficiency post-test	7.413	1	7.413	4.202	.041	.015
	Change Inst. eff. pre-test to post-test	5.645	1	5.645	2.729	.100	.010
	Change Inst. eff. pre-test ex. Qu 1 to post-test	4.964	1	4.964	2.296	.131	.008
Grade 12 English result	Instructional efficiency pre-test	5.766	1	5.766	3.742	.054	.014
	Instructional efficiency pre-test ex. Qu 1	5.674	1	5.674	3.746	.054	.014
	Instructional efficiency post-test	15.754	1	15.754	8.931	.003	.032
	Change Inst. eff. pre-test to post-test	2.458	1	2.458	1.188	.277	.004
	Change Inst. eff. pre-test ex. Qu 1 to post-test	2.519	1	2.519	1.165	.281	.004
Main effects							
Grade 12 English Level	Pre-test % (out of 15)	3725.413	1	3725.413	8.864	.003	.032
	Instructional efficiency pre-test	30.173	1	30.173	19.579	.000	.068
	Instructional efficiency pre-test ex. Qu 1	16.907	1	16.907	11.164	.001	.040
	Instructional efficiency post-test	12.418	1	12.418	7.040	.008	.026
	Change Inst. eff. pre-test to post-test	3.877	1	3.877	1.875	.172	.007
	Change Inst. eff. pre-test ex. Qu 1 to post-test	.346	1	.346	.160	.690	.001
Experiment group	Pre-test % (out of 15)	256.646	1	256.646	.611	.435	.002
	Instructional efficiency pre-test	1.528	1	1.528	.991	.320	.004
	Instructional efficiency pre-test ex. Qu 1	1.118	1	1.118	.738	.391	.003
	Instructional efficiency post-test	.069	1	.069	.039	.844	.000
	Change Inst. eff. pre-test to post-test	2.243	1	2.243	1.085	.299	.004
	Change Inst. eff. pre-test ex. Qu 1 to post-test	1.741	1	1.741	.805	.370	.003
Interaction effect							
Grade 12 English Level X Experiment group	Instructional efficiency pre-test	.000	1	.000	.000	.989	.000
	Instructional efficiency pre-test ex. Qu 1	.147	1	.147	.097	.756	.000
	Instructional efficiency post-test	.288	1	.288	.163	.687	.001
	Change Inst. eff. pre-test to post-test	.269	1	.269	.130	.719	.000
	Change Inst. eff. pre-test ex. Qu 1 to post-test	.023	1	.023	.011	.917	.000
Residual	Instructional efficiency pre-test	414.538	269	1.541			
	Instructional efficiency pre-test ex. Qu 1	407.377	269	1.514			
	Instructional efficiency post-test	474.517	269	1.764			
	Change Inst. eff. pre-test to post-test	556.384	269	2.068			
	Change Inst. eff. pre-test ex. Qu 1 to post-test	581.649	269	2.162			

a. R Squared = .114 (Adjusted R Squared = .095)
b. R Squared = .066 (Adjusted R Squared = .045)
c. R Squared = .095 (Adjusted R Squared = .075)
d. R Squared = .033 (Adjusted R Squared = .012)
e. R Squared = .024 (Adjusted R Squared = .002)

An analysis of the main effect for the Grade 12 English level indicated that the main effect on the instructional efficiency scores for both tests and the difference between scores for the pre-test, excluding question 1, and the post-test was significant. Grade 12 English HL students scored 0.845 (95% CI, 0.469 to 1.222) higher on the pre-test, including question 1; 0.633 (95% CI, 0.260 to 1.006) higher on the pre-test, excluding question 1; and 0.542 (95% CI, 0.140 to 0.945) better on the post-test. Hypothesis 9 is therefore also supported for non-accounting students.

4.8.3 Students' subjective experience of enjoyment and engagement

Students were asked to rate their level of enjoyment of the activity on a scale of 1 (not at all) to 5 (extremely). They were also asked to rate how much they wanted to continue once the

Table 4.42: Experience of enjoyment
[1=not at all to 5=extremely]

Experimental group		Grade 12 accounting			No Grade 12 accounting		
		Total	Gr 12 Eng. HL	Gr 12 Eng. FAL	Total	Gr 12 Eng. HL	Gr 12 Eng. FAL
Control	No.	208	125	83	132	95	37
	Mean (SD)	3.50 (.95)	3.50 (1.02)	3.51 (.84)	3.61 (.82)	3.62 (.73)	3.59 (1.01)
Test	No.	189	127	62	120	84	36
	Mean (SD)	3.63 (.97)	3.52 (.98)	3.85 (.90)	3.93 (.86)	3.94 (.88)	3.89 (.82)
Total	No.	397	252	145	252	179	73
	Mean (SD)	3.56 (.96)	3.51 (1.00)	3.66 (.88)	3.76 (.85)	3.77 (.82)	3.74 (.93)
F		(1,395) 1.815	(1,250) .035	(1,143) 5.801	(1,250) 8.675	(1,177) 6.997	(1,71) 1.855
P		.179	.851	.017*	.004*	.009*	.177

* Significant at .05 level

Table 4.43: Experience of engagement
[1=not at all to 5=extremely]

Experimental group		Grade 12 accounting			No Grade 12 accounting		
		Total	Gr 12 Eng. HL	Gr 12 Eng. FAL	Total	Gr 12 Eng. HL	Gr 12 Eng. FAL
Control	No.	207	125	82	132	95	37
	Mean (SD)	3.38 (1.11)	3.29 (1.16)	3.51 (1.02)	3.55 (.90)	3.58 (.86)	3.46 (1.02)
Test	No.	189	127	62	121	85	36
	Mean (SD)	3.43 (1.08)	3.34 (1.11)	3.61 (1.01)	3.63 (.92)	3.61 (.92)	3.69 (.92)
Total	No.	396	252	144	253	180	73
	Mean (SD)	3.40 (1.10)	3.31 (1.13)	3.56 (1.02)	3.59 (.91)	3.59 (.88)	3.58 (.97)
F		(1,394) .219	(1,250) .124	(1,142) .345	(1,251) .633	(1,178) .062	(1,71) 1.070
p		.640	.725	.558	.427	.804	.304

activity was over (a measure of engagement) on the same 5-point scale. The results in Tables 4.42 and 4.43 indicate that 648 of the 707 students completed these questions. One-way ANOVA tests established that the enjoyment scores of Grade 12 accounting students with EAL (p=.017) and non-accounting English HL students (p=.009) for the test (animation) group were significantly higher than for the control group. Overall, non-accounting students enjoyed the animation more than the control presentation (p=.004). There were no other significant differences between the results of the two experiment groups.

A three-way ANCOVA was run to determine the effect of Grade 12 accounting (yes/no), English level (HL/FAL) and the experiment group (test/control) on the students' motivational scores (Table 4.44). Pairwise comparisons were run for statistically significant simple main effects, and are reported with 95% confidence intervals and p-values Bonferroni adjusted.

Table 4.44: ANCOVA of motivational measures for Gr 12 accounting, English level and the experiment group

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Enjoyment	21.373	10	2.137	2.570	.005	.039
	Engagement	16.811	10	1.681	1.592	.105	.024
Intercept	Enjoyment	70.389	1	70.389	84.623	.000	.117
	Engagement	61.998	1	61.998	58.704	.000	.084
Co-variates							
Grade 12 maths result	Enjoyment	1.548	1	1.548	1.861	.173	.003
	Engagement	2.818	1	2.818	2.668	.103	.004
Gr 12 English result	Enjoyment	1.205	1	1.205	1.448	.229	.002
	Engagement	.576	1	.576	.546	.460	.001
Grade 12 APS	Enjoyment	.458	1	.458	.551	.458	.001
	Engagement	.953	1	.953	.903	.342	.001
Main effects							
Grade 12 accounting	Enjoyment	4.115	1	4.115	4.947	.026	.008
	Engagement	3.144	1	3.144	2.977	.085	.005
Grade 12 English Level	Enjoyment	1.362	1	1.362	1.638	.201	.003
	Engagement	3.255	1	3.255	3.082	.080	.005
Experimental group	Enjoyment	7.989	1	7.989	9.604	.002	.015
	Engagement	1.100	1	1.100	1.041	.308	.002
Interaction effects							
Grade 12 accounting X Grade 12 English Level	Enjoyment	1.411	1	1.411	1.696	.193	.003
	Engagement	2.611	1	2.611	2.472	.116	.004
Grade 12 accounting X Experimental group	Enjoyment	.590	1	.590	.710	.400	.001
	Engagement	.055	1	.055	.052	.819	.000
Grade 12 English Level X Experimental group	Enjoyment	.731	1	.731	.879	.349	.001
	Engagement	.309	1	.309	.292	.589	.000
Grade 12 accounting X Grade 12 English Level X Experimental group	Enjoyment	.995	1	.995	1.197	.274	.002
	Engagement	.165	1	.165	.157	.692	.000
Residual	Enjoyment	529.848	637	.832			
	Engagement	672.743	637	1.056			

a. R Squared = .039 (Adjusted R Squared = .024)
b. R Squared = .024 (Adjusted R Squared = .009)

The interaction effect between Grade 12 accounting, English level and the experiment group was not significant for either of the subjective experience scores.

An analysis of the main effect for Grade 12 accounting indicated that the enjoyment scores of students without Grade 12 accounting were 0.178 (95% CI, 0.021 to 0.335) higher. This difference was significant (p=.026). Students without Grade 12 accounting also had 0.155 (95% CI, -.021 to .332) higher engagement scores, but the difference was not significant (p=.085).

An analysis of the main effect for the Grade 12 English level indicated that students with EAL rated their enjoyment experience .116 (95% CI, -.062 to .403) higher than English HL students, but this difference was not significant (p=.201). Students with EAL also had .180 (95% CI, -.021 to .381) higher engagement scores, but the difference was only significant at the p=.080 level.

An analysis of the main effect for experiment group indicated that students watching the animation scored their enjoyment experience .247 (95% CI, .090 to .403) significantly higher than those in the control group (p=.002). Students in the animation group also had .155 (95% CI, -.021 to .332) higher engagement scores, but this difference was not significant (p=.308). Hypothesis 10 is therefore supported for the enjoyment rating, but not for the engagement rating.

4.9 DISCUSSION

Table 4.45 provides a summary of the results for all of the hypotheses tested in this study. Thereafter discussion is provided for each of the effects that were considered.

Table 4.45: Summary of results

Hypothesis		**Finding**
Effect of animation		
H1	Students in the test group (with the animation) will outperform students in the control group, based on the change in their test scores (pre-test to post-test).	Not supported
H2a	The extraneous cognitive load (students' self-reported measure of clarity) will be lower for all students in the test group (with the animation) compared to the control group.	Only supported for Grade 12 accounting students with EAL. Not supported for Grade 12 accounting students with Grade 12 English HL. Not supported for students without Grade 12 accounting.

Hypothesis		**Finding**
H2b	The germane cognitive load (students' self-reported measure of improvement in understanding) will be higher for students in the test group (with the animation) compared to those in the control group.	Not supported
H2c	Students in the test group (with the animation) will experience a more pronounced decrease in cognitive load than students in the control group based on the reduction in their time taken to complete the post-test compared to the pre-test.	Not supported
H3	The improvement in instructional efficiency will be higher for the test group (with the animation) than for the control group.	Not supported
Effect of Grade 12 accounting		
H4a	Students with accounting as a subject in Grade 12 will outperform students without accounting, based on their pre-test and post-test scores.	Supported
H4b	The increase in test scores from pre-test to post-test will be higher for students who did not take accounting as a subject in Grade 12, compared to those who did.	Supported
H5a	Students with accounting as a subject in Grade 12 will experience a lower intrinsic cognitive load (self-reported measure of difficulty) than students without.	Supported
H5b	Students with accounting will report lower levels of mental effort used in completing the activity compared to those without.	Supported
H5c	Students with accounting as a subject in Grade 12 will complete both the pre- and post-tests faster than students without.	Supported for post-test only, but not supported for pre-test.
H6a	Students with accounting as a subject in Grade 12 will experience higher instructional efficiency levels than students who did not, based on the instructional efficiency scores for the pre-test and post-test.	Supported
H6b	The instructional efficiency of students without Grade 12 accounting will improve from the pre-test to the post-test more than for students with Grade 12 accounting.	Not supported

Hypothesis		Finding
Effect of English as an additional language		
H7	Students with English as a first language will outperform students with EAL in both experimental groups, based on the pre-test and post-test scores, regardless of whether they took Grade 12 accounting or not.	Supported
H8a	After splitting students into whether they had taken Grade 12 accounting or not, students with English as a first language will experience a lower intrinsic cognitive load (self-reported measure of difficulty) than students with EAL.	Not supported
H8b	After being split into whether they had taken Grade 12 accounting or not, students with English as a first language will report lower levels of mental effort used in completing the activity compared to students with EAL.	Supported for Grade 12 accounting students. Not supported for students without Grade 12 accounting.
H8c	After being split into whether they had taken Grade 12 accounting or not, students with English as a first language will complete both the pre-test and the post-test faster than students with EAL.	Supported for Grade 12 accounting students for both tests. Supported for students without Grade 12 accounting, but only for the pre-test, not supported for the post-test.
H9	After being split into whether they had taken Grade 12 accounting or not, English first-language students will have better instructional efficiency for both the pre-test and the post-test compared to students with EAL in both experimental groups.	Supported
Enjoyment and engagement experience of students		
H10	Students in the test group (with the animation) will report higher enjoyment and engagement levels compared to students in the control group.	Supported for enjoyment but not for engagement.

4.9.1 Effect of animation

Overall, there appeared to be no significant difference between the results of the students in the two experiment groups. In other words, the animation did not result in an improvement in student performance compared to the control group. The level at which students took English in Grade 12, and whether they took accounting as a subject or not, did not affect this outcome.

No support was found for the hypotheses that the animation would reduce the extraneous load on the working memory of students and improve their germane load, except in one instance. Grade 12 accounting students with EAL rated the clarity of the explanations in the animation better than for the control video. The clarity rating was used as a measure of extraneous load. It therefore appears that, for the Grade 12 accounting students with EAL, the extraneous load of the animation was lower than for the control video. However, the animation did not affect the germane load of these students as measured by their subjective experience of improved understanding of the topic. Likewise, the animation had no impact on the time that they took to complete the post-test.

Even though these students with EAL had prior experience with accounting, and should therefore have found the control video more familiar, they experienced a higher extraneous load with the control video compared to the animation. As the audio was virtually identical in the two presentations it was the visualisation of the accounting equation in the animation that positively affected their perception of the clarity of the explanation. The intention of the graphic illustration of the accounting equation as a pattern of connected coloured blocks, and presenting pictures corresponding to the effect of the transactions on the accounting equation, was to allow students to connect with their existing knowledge and build upon it. As will be seen from the later discussion, students with EAL brought higher levels of intrinsic load to the activity. As one of the goals of preparing this animation was to limit the overall cognitive load imposed by instructional techniques on the working memory of students with EAL, the positive effect of the animation in potentially reducing extraneous cognitive load is a welcome finding. The fact that the germane load was not affected by the experimental condition was not unexpected, as the improved understanding question had been found by Leppink *et al.* (2014) to be an inadequate measure of this load. One would, however, have expected an improvement in overall cognitive load, by the reduction in time for the test condition being better than for the control condition, which was not the case.

Except in one instance, the animation had no impact on the instructional efficiency measures calculated using the result of the tests and the time taken to complete the tests. There was a significant difference between the two experimental conditions when comparing the post-test instructional efficiency of students with Grade 12 accounting separately from the non-accounting students. The result was the opposite of what was expected. The instructional efficiency of students in the control group was better than for those in the test group. Grade

12 accounting students in the control group obtained higher post-test results and completed the post-test more quickly than those who had watched the animation. Nonetheless, while the students in the control group improved their instructional efficiency from the pre-test to the post-test more than for students watching the animation, the difference was not significant.

This result could be attributed to Grade 12 accounting students' familiarity with the written table format of the accounting equation, which allowed them to build on their pre-existing knowledge structures. Watching the control video that used a familiar format, assisted Grade 12 accounting students in improving their marks for the post-test and in completing the post-test more quickly than for those who watched the more unfamiliar format of the animation. The control video would have enabled these students to activate their prior schemata in long-term memory and to use the presentation to improve their performance and decrease their cognitive load in the process. The control video was therefore easier for Grade 12 accounting students to relate to than the more unfamiliar format of the animation.

In spite of this result, because the improvement in instructional efficiency from the pre-test to the post-test was not significantly different between the two experimental conditions, there is no basis to conclude that the typical table format used to teach the accounting equation is superior in improving learning efficiency.

Both accounting and non-accounting students enjoyed the animation more than the control video. The story in the animation provided students with first-hand experience of business transactions and their effect on the accounting equation in an amusing and emotive way. In line with the findings of Türkay (2016) this favourable response to the animation could be due to the novelty effect. Prior research has shown that experiencing something unique is gratifying, promotes student concentration and stimulates their interest (Türkay, 2016).

The engagement of students was measured by the extent to which they wanted to continue with the activity once it was over. Students' engagement was slightly better for the animation compared to the control video, however as the effect was not significant no definite conclusions can be drawn.

4.9.2 Effect of Grade 12 accounting

The effect of students' previous experience with accounting on their pre- and post-test scores was as expected. Students who had taken accounting as a subject in Grade 12 obtained higher results than those who had not. Also as predicted, students without Grade 12 accounting found the activity more beneficial, as they increased their scores from the pre-test (excluding question 1) to the post-test (i.e. the accounting equation questions) by significantly more than Grade 12 accounting students. When question 1 was included the improvement in scores was not significantly different between the two accounting groups.

An interesting result was that there was not a significant difference between the time for the pre-test for the accounting and non-accounting groups. The presentations were more effective in improving the time that Grade 12 accounting students took to complete the post-test, compared to non-accounting students. This suggests that because Grade 12 accounting students were now familiar with the format of the test questions from doing the pre-test, they were able to use the additional knowledge gained from the intervention to complete the post-test in a faster time (that is with reduced mental effort) compared to those without previous experience of accounting.

As predicted, Grade 12 accounting students reported lower levels of intrinsic load (difficulty) and overall cognitive load (mental effort) compared to non-accounting students. Therefore, the objective measure of overall cognitive load, faster time-on-task for Grade 12 accounting students, matched the subjective measure of students reported level of less mental effort used. The opposite was true for non-accounting students who had a slower time-on-task and reported higher levels of mental effort.

The first instructional efficiency score that was calculated combined the test scores and time-on-task measures for both accounting and non-accounting students. As a result, the change in instructional efficiency from the pre-test to the post-test was positive for Grade 12 accounting students, and negative for non-accounting students. Watching both presentations improved the instructional efficiency of Grade 12 accounting students because it enabled them to improve their test scores while decreasing their cognitive load (i.e. the time it took them to complete the post-test compared to the pre-test). While students without accounting reduced the time they took from the pre-test to the post-test, the decrease in cognitive load was not equivalent in proportion to the improvement in their test results. As the non-accounting students started with higher levels of intrinsic load (difficulty), they had to invest more mental effort than the Grade 12 accounting students to achieve their improved performance.

The use of the instructional efficiency measure to compare two groups of students with significantly different levels of intrinsic cognitive load does not reflect a complete picture of the effectiveness of the instructional intervention. The time-on-task measure in this experiment not only reflected the mental effort students used in the *test* task, but was also a reflection of the mental effort used in the *learning* process, specifically for non-accounting students who had more to learn. Therefore, as Van Gog and Paas (2008) note, where the performance measure is based only on a *test* task, but there are two types of effort measures, there are in fact two separate instructional efficiency measures. For students with prior experience in accounting, test performance is combined with mental effort invested in the *test* phase, and for non-accounting students, test performance is combined with mental effort invested in the *learning* phase. Instructional efficiency will therefore be lower for students without prior experience of accounting, where ‘instruction aims to stimulate learners to invest higher levels of mental effort in processes relevant for learning’ (van Gog and Paas, p. 22). It is highly unlikely that for these students their increase in effort would be proportional to the increase in their performance. Therefore, it would be wrong to conclude that because of their lower instructional efficiency, the intervention was not effective for non-accounting students. The reason for the lower instructional efficiency is because the mental effort measures for the two groups are in fact different.

To back up this argument, non-accounting students also reported higher levels of improved understanding than the Grade 12 accounting students. Both the animation and control video assisted non-accounting students in their germane (productive) processing which allowed them to deal with the intrinsic difficulty of the topic and improve their learning outcomes.

The measure of clarity (extraneous load) was better for Grade 12 accounting students. Due to this measure being related to instructional design only, no difference was expected between these two groups of students. However, considering their different background knowledge of accounting levels, it follows that non-accounting students found the activity less clear. It does, however, bring into question the use of the clarity question as a measure of extraneous load, when starting with one group who had prior knowledge of the topic of instruction, and the second that did not. When students have higher levels of intrinsic load due to the lower levels of prior knowledge, it can be expected that they would find instruction less clear than those who had more knowledge of accounting. This result is indicative of an established construct in CLT research, namely, the expertise reversal effect (Kalyuga, *et al.*, 2003), which means that instructional design should be adapted to the level of experience of the intended students.

Non-accounting students enjoyed both the animation and control video more than Grade 12 accounting students. While the difference was not significant, non-accounting students appeared to be more interested in continuing with the activity than accounting students were. This could be due to the novelty effect, as this was their introduction to accounting, and the whole intervention was new to them.

4.9.3 Effect of English as an additional language

4.9.3.1 Students with Grade 12 accounting

English first-language students significantly outperformed students with EAL on both tests. The presentations appeared to improve the test scores of Grade 12 accounting students with EAL more than for students with English as a first language, but this result was only significant at the $p<.1$ level.

The overall cognitive load (mental effort used) of English first-language students was lower than for students with EAL. Together with more mental effort used, students with EAL reported slightly higher levels of difficulty, but this difference was only significant at the $p=.054$ level. There were no differences between the two groups for the clarity and improved understanding measures. This was as expected for Grade 12 accounting students.

Students with English as a first language completed both the pre-test and the post-test in less time than students with EAL. This corresponds to their reported levels of lower mental effort. Both presentations significantly decreased the cognitive load (time taken) for all students from the pre-test to the post-test. However, the decrease in time was significantly higher for students with EAL compared to English first-language students.

While the instructional efficiency scores for both tests were higher for English first-language students, the improvement in scores was better for students with EAL. All students in this analysis would have had similar prior knowledge of accounting. The major difference was that they had different English language backgrounds. The presentations therefore allowed the students with EAL to become more efficient in the post-test as they improved their test scores and decreased the time taken. The effect was opposite for English first-language students, whose improvement in test scores and in the time taken was less than for students with EAL.

4.9.3.2 Students without Grade 12 accounting

English first-language students significantly outperformed students with EAL on both tests. There was no difference between English first and additional language students' improvement in scores from the pre-test to the post-test.

There were no differences in the self-reported measures of cognitive load between the two the Grade 12 English levels. Students with EAL had higher time-on-task for the pre-test but their decrease in time to the post-test was more than for English first-language students. As for Grade 12 accounting students with EAL, the presentations appeared to be more effective in reducing the cognitive load of non-accounting students with EAL. However, this bigger decrease in time merely served to bring the two English language groups post-test time to a similar level.

As with Grade 12 accounting students, while the instructional efficiency scores for both tests were higher for non-accounting English first-language students, the improvement in scores was better for students with EAL. Again, the lack of prior knowledge of accounting of all the students in this analysis was similar, but their English backgrounds were different. The presentations therefore allowed the students with EAL to become more efficient in the post-test as they improved their test scores and decreased the time taken. The effect on English first-language students was opposite; in other words, the presentations were not as effective in improving their learning.

4.10 CONCLUSION

The purpose of this study was to investigate whether an animation presentation of the accounting equation was more effective than a voice-over PowerPoint presentation in improving the performance and reducing the cognitive load of first-year accounting students. Wynder's (2018) tentative conclusion that visualisations were an effective avenue for increasing the learning efficiency of students with EAL, is not supported by this study. While the animation did not improve student performance more than the control video did, there were nevertheless encouraging aspects identified.

One of the significant positive effects of the use of animations in explaining the accounting equation was that Grade 12 accounting students with EAL and all non-accounting students experienced the explanations as being clearer than those in the control video did. The implication of this finding is that accounting educators may reduce extraneous cognitive load for students with EAL and for students with no prior experience of accounting, by providing pictorial images together with narration in multimedia presentations such as animations.

All students enjoyed the animation more than the control presentation. They were also more likely to want to continue with the animation than with the control video. This is an important outcome considering that this was the first online learning task the students experienced in the course, and the potential benefit it could have on first-year students' motivation to study accounting. Mayer (2014) advises that incorporating motivational features, such as appealing graphics, into multimedia learning, can improve student learning by promoting generative processing. However, he cautions against taxing the student with extraneous processing or distracting them from essential processing.

As measured by the improvement in instructional efficiency scores, the effect of the presentations (both the animation and the control video) was most beneficial for Grade 12 accounting students with EAL and for students without Grade 12 accounting. Both experimental conditions appeared to act as a scaffold for these students that allowed them to build on their existing schemata and activated germane processing abilities to make their learning more efficient.

Finally, all non-accounting students had lower levels of prior knowledge coming into the intervention, and the presentations served their purpose in improving the performance and reducing the cognitive load of these students. Both presentations were effective, but the positive impact that the animation had on student enjoyment and improved clarity for students with EAL could be viewed as mitigating the time and cost involved in preparing the animation.

This research encourages accounting educators to consider the cognitive load and instructional efficiency effects of their teaching practices. Pre-existing differences in students' prior knowledge determines their levels of intrinsic load and overall cognitive load when learning. Students without prior knowledge of accounting and students with EAL may start with higher intrinsic load levels when learning accounting compared to those with more accounting knowledge and students with English as a first language. The use of multimedia presentations, such as those used in this experiment, appeared to assist all students, but were of most benefit to students with higher levels of intrinsic load.

This study contributes to the accounting education literature in the following additional ways:

An animation of the accounting equation implementing the instructional design principles of the CTML is now available as an example to be used as a basis for the development of similar animations. The reader is referred to the discussion under item 4.4.1 in this regard.

The effect of an instructional intervention is measured in a controlled environment, which demonstrates that rigorous experimental research in accounting classrooms is possible. The results of this work are externally valid, as the task and timeframe given to students was a typical learning task for the accounting course in which this experiment took place. The participants were all first-year students, doing the course for the first time; therefore their interest in the task was high and the effort they put into the task was considered credible.

Both subjective and objective measures of cognitive load were used. Total cognitive load could be predicted by the time it took students to complete the pre- and post-tests. The more time it took a student to complete a test implied that their cognitive load was higher. The time-on-task measure for the post-test was consistent with the mental effort measure used for overall cognitive load. Grade 12 accounting students did the post-test in a faster time and reported lower mental effort than non-accounting students. Grade 12 accounting students with English as a home language completed the post-test more quickly and reported lower mental effort than students with EAL. The consistency of the time-on-task measure and students experiences of mental load supports the validity of the latter question in measuring total cognitive load.

Students' improvement in scores were compared to the reduction in time (decrease in cognitive load) from the pre-test to the post-test. Non-accounting students invested more mental effort in improving their performance than Grade 12 accounting students. The decrease in time for the non-accounting students was less than for the accounting students, but the improvement in test scores for the non-accounting students was better. This supports the argument that weaker instructional efficiency scores can be expected when the intrinsic load of instruction is higher and students are required to invest more mental effort in the learning task (van Gog and Paas, 2008).

4.11 LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

This study does not consider approaches used in academic literacy, such as New Literacies and Multiliteracies, which recognise the importance of drawing on and utilising multiple modes of communication, such as text, pictures, moving pictures (including animations), narration, colour and music, to make meaning (Carstens, 2012). The focus of this experiment is instead on the individual student's auditory and visual information processing, as espoused by the CTML (Mayer, 2002, 2005).

A possible reason why the animation did not have a greater effect on student performance is that both presentations made use of cueing. Cueing guides students' attention to important information at each step in the learning process (Amadieu, Mariné and Laimay, 2011). The PowerPoint presentation used visual cueing, in the form of the programme's in-built animation function, and on-screen writing to construct the accounting equation table. Future research could compare the effect of using a downgraded format of the PowerPoint presentation, with a static visual of the accounting equation table that does not allow students to see its construction (i.e. with no visual cueing), to the animated version of the presentation.

This study tested the effect of different visual elements. To extend this work and test different auditory elements, the animation could be kept the same for two experimental conditions but with different audio for each. Background music could be used, the script may be different or different voices could be used.

The pre- and post-test used in this experiment were not identical, as the pre-test included a match-the-term question, which the post-test did not. The results of the match-the-term question in the pre-test were dissimilar to those of the accounting equation questions. This may also have had an effect on the length of time it took for students to answer the pre-test. In repeating research of this kind, only accounting equation type questions in the pre-test should be used to more closely align it to the post-test.

The subjective measures of student experiences used in this study were limited, as only one question was asked for each of the different types of cognitive load. This combination of questions was not validated. The psychometric instrument developed and tested by Leppink, *et al.* (2013, 2014) provides additional questions for all these aspects, which could be used for future studies.

All of the subjective experience questions in this experiment were asked after the students had completed the post-test. In line with other research that has sought to validate questions regarding student experiences as measures of the various types of cognitive load, it may be beneficial to check students' experiences at various stages during the experiment, i.e. after the pre-test, again after the presentation, and finally after the post-test. These measures could then be more directly related to the time taken for the two tests and the change in time. In addition, to ensure that the enjoyment and engagement measures are not affected by student experience of the post-test, these questions could be asked straight after the presentation — that is before the post-test.

This study relates the types of cognitive load in CLT with the types of processing in the CTML as was done by DeLeeuw and Mayer (2008). However, as the measures used for student experiences of cognitive load were limited, as explained above, no conclusions can be drawn about whether the cognitive load measures do correspond to the various types of processes. Kalyuga (2011) also raises this concern.

Student differences, such as their preferred learning styles and motivation to learn, were not measured. As students were randomly spread over the two groups, this was not considered a significant risk to the reliability of the experimental results.

4.12 REFERENCES

Amadieu, F., Mariné, C. and Laimay, C. (2011), "The attention-guiding effect and cognitive load in the comprehension of animations", *Computers in Human Behavior*, Elsevier Ltd, Vol. 27 No. 1, pp. 36–40.

Barak, M., Ashkar, T. and Dori, Y.J. (2011), "Learning science via animated movies: Its effect on students' thinking and motivation", *Computers and Education*, Vol. 56 No. 3, pp. 839–846.

Barnes, H., Dzansi, D., Wilkinson, A. and Viljoen, M. (2009), “Researching the First Year Accounting Problem: Factors Influencing Success or Failure at a South African Higher Education Institution”, *Journal for New Generation Sciences*, Vol. 7 No. 2, pp. 36–58.

Becker, A. (2016), “L2 students’ performance on listening comprehension items targeting local and global information”, *Journal of English for Academic Purposes*, Elsevier Ltd, Vol. 24, pp. 1–13.

Berney, S. and Bétrancourt, M. (2016), “Does animation enhance learning? A meta-analysis”, *Computers and Education*, Elsevier Ltd, Vol. 101, pp. 150–167.

Brünken, R., Seufert, T. and Paas, F. (2010), “Measuring Cognitive Load”, in Plass, J.L., Moreno, R. and Brünken, R. (Eds.), *Cognitive Load Theory*, Cambridge University Press, pp. 181–202.

Butler, J.B. and Mautz, R.D. (1996), “Multimedia Presentations and Learning: A Laboratory Experiment”, *Issues in Accounting Education*, Vol. 11 No. 2, p. 22.

Carstens, A. (2012) Using literacy narratives to scaffold academic literacy in the Bachelor of Education: a pedagogical framework. *Journal for Language Teaching*, 46(2), pp.9-25.

Castro-Alonso, J.C., Ayres, P. and Paas, F. (2016), “Comparing apples and oranges? A critical look at research on learning from statics versus animations”, *Computers and Education*, Elsevier Ltd, Vol. 102, pp. 234–243.

Cohen, J. (1988), *Statistical Power Analysis for the Behavioral Sciences*, 2nd ed., Lawrence Erlbaum Associates, Inc., Hillsdale, N.J.

DeLeeuw, K.E. and Mayer, R.E. (2008), “A Comparison of Three Measures of Cognitive Load: Evidence for Separable Measures of Intrinsic, Extraneous, and Germane Load”, *Journal of Educational Psychology*, Vol. 100 No. 1, pp. 223–234.

Department of Basic Education. (2015), *2015 National Senior Certificate Examination Technical Report*, available at: https://www.education.gov.za/Portals/0/Documents/Reports/2015 NSC Technical Report.pdf?ver=2016-01-05-050208-000.

Eskew, R.K. and Faley, R.H. (1988), “Some Determinants of Student Performance in the First College-Level Financial Accounting Course”, *The Accounting Review*, Vol. 63 No. 1, pp. 137–147.

Halabi, A.K., Tuovinen, J.E. and Farley, A.A. (2005), “Empirical Evidence on the Relative Efficiency of Worked Examples versus Problem-Solving Exercises in Accounting Principles Instruction”, *Issues in Accounting Education*, Vol. 20 No. 1, pp. 21–32.

Ilioudi, C., Giannakos, M.N. and Chorianopoulos, K. (2013), “Investigating differences among the commonly used video lecture styles”, *WAVe 2013: The Workshop on Analytics on Video-Based Learning*, Vol. 983, pp. 21–26.

Jennings, M.A. and Cribbie, R.A. (2016), “Comparing Pre-Post Change Across Groups: Guidelines for Choosing between Difference Scores, ANCOVA and Residual Change Scores”, *Journal of Data Science*, Vol. 14 No. 2, pp. 1–37.

Kalyuga, S. (2010), “Schema Acquisition and Sources of Cognitive Load”, in Plass, J.L., Moreno, R. and Brünken, R. (Eds.), *Cognitive Load Theory*, Cambridge University Press, New York, pp. 48–64.

Kalyuga, S. (2011), "Cognitive Load Theory: How Many Types of Load Does It Really Need?" *Educational Psychology Review,* Vol. 23, pp. 1-19.

Kalyuga, S., Ayres, P., Chandler, P. and Sweller, J. (2003), “The Expertise Reversal Effect”, *Educational Psychologist*, Vol. 38 No. 1, pp. 23–31.

Kisbu-Sakarya, Y., MacKinnon, D.P. and Aiken, L.S. (2013), “A Monte Carlo Comparison Study of the Power of the Analysis of Covariance, Simple Difference, and Residual Change Scores in Testing Two-Wave Data”, *Educational and Psychological Measurement*, Vol. 73 No. 1, pp. 47–62.

Krathwohl, D.R. (2002), “A Revision of Bloom’s Taxonomy: An Overview”, *Theory into Practice*, Vol. 41 No. 4, pp. 212–218.

Laerd Statistics. (2017), “Statistical tutorials and software guides”, [Online], Available at: https://statistics.laerd.com/

Leppink, J. (2017), “Cognitive load theory: Practical implications and an important challenge”, *Journal of Taibah University Medical Sciences*, Elsevier Ltd, Vol. 12 No. 5, pp. 385–391.

Leppink, J., van Gog, T., Paas, F. and Sweller, J. (2015), “Cognitive load theory: Researching and planning teaching to maximise learning”, in Cleland, J. and Durning, S.J. (Eds.), *Researching Medical Education*, 1st ed., John Wiley and Sons, Inc., pp. 207–218.

Leppink, J., Paas, F., van Gog, T., van der Vleuten, C.P.M. and van Merriënboer, J.J.G. (2014), “Effects of pairs of problems and examples on task performance and different types of cognitive load”, *Learning and Instruction*, Elsevier Ltd, Vol. 30, pp. 32–42.

Leppink, J., Paas, F., van der Vleuten, C.P.M., van Gog, T. and van Merriënboer, J.J.G. (2013), “Development of an instrument for measuring different types of cognitive load”, *Behavior Research Methods*, Vol. 45 No. 4, pp. 1058–1072.

Lin, L. and Atkinson, R.K. (2011), “Using animations and visual cueing to support learning of scientific concepts and processes”, *Computers and Education*, Vol. 56 No. 3, pp. 650–658.

Martin, S. (2014), “Measuring cognitive load and cognition: metrics for technology-enhanced learning”, *Educational Research and Evaluation*, Taylor and Francis, Vol. 20 No. November, pp. 592–621.

Mayer, R.E. (2002), “Cognitive Theory and the Design of Multimedia Instruction: An Example of the Two-Way Street Between Cognition and Instruction”, *New Directions for Teaching and Learning*, Vol. 2002 No. 89, pp. 55–71.

Mayer, R.E. (2005), “Cognitive Theory of Multimedia Learning”, *The Cambridge Handbook of Multimedia Learning*, pp. 31–48.

Mayer, R.E. (2014), "Incorporating motivation into multimedia learning, *Learning and Instruction,* Vol. 29, pp. 171-173.

Mayer, R.E. and Estrella, G. (2014), “Benefits of emotional design in multimedia instruction”, *Learning and Instruction*, Vol. 33, pp. 12–18.

Mayer, R.E., Lee, H. and Peebles, A. (2014), "Multimedia Learning in a Second Language : A Cognitive Load Perspective", *Applied Cognitive Psychology*, Vol. 28, pp. 653–660.

Mayer, R.E. and Moreno, R. (2002), "Animation as an aid to multimedia learning", *Educational Psychology Review*, Vol. 14 No. 1, pp. 87–99.

Mayer, R.E. and Moreno, R. (2003), "Nine Ways to Reduce Cognitive Load in Multimedia Learning", *Educational Psychologist*, Vol. 38 No. 1, pp. 43–52.

Mayer, R.E. and Moreno, R. (2010), "Techniques That Reduce Extraneous Cognitive Load and Manage Instrinsic Cognitive Load during Multimedia Learning", in Plass, J.L., Moreno, R. and Brünken, R. (Eds.), *Cognitive Load Theory*, Cambridge University Press, pp. 131–152.

Mostyn, G.R. (2012), "Cognitive load theory: What it is, why it's important for accounting instruction and research", *Issues in Accounting Education*, Vol. 27 No. 1, pp. 227–245.

Naser, K. and Peel, M.J. (1998), "An exploratory study of the impact of intervening variables on student performance in a principles of accounting course", *Accounting Education*, Vol. 7 No. 3, pp. 209–223.

Norman, G. (2010), "Likert scales, levels of measurement and the 'laws' of statistics", *Advances in Health Sciences Education*, Vol. 15 No. 5, pp. 625–632.

O'Brien, R.M. (2007), "A Caution Regarding Rules of Thumb for Variance Inflation Factors", *Quality and Quantity*, Vol. 41, pp. 673-690.

Paas, F. and van Merriënboer, J.J.G. (1993), "The Efficiency of Instructional Conditions: An Approach to Combine Mental Effort and Performance Measures", *Human Factors: The Journal of the Human Factors and Ergonomics Society*, Vol. 35 No. 4, pp. 737–743.

Paas, F. and van Merriënboer, J.J.G. (1994), "Variability of worked examples and transfer of geometric problem-solving skills: A cognitive load approach.", *Journal of Educational Psychology,* Vol. 86 No. 1, pp. 122–133.

Paas, F., Tuovinen, J.E., Tabbers, H. and van Gerven, P.W.M. (2003), "Cognitive Load Measurement as a Means to Advance Cognitive Load Theory", *Educational Psychologist*, Vol. 38 No. 1, pp. 63–71.

Palm, C. and Bisman, J. (2010), "Benchmarking Introductory Accounting Curricula : Experience from Australia", *Accounting Education: An International Journal*, Vol. 19 No. 1–2, pp. 179–201.

Phillips, F. and Heiser, L. (2011), "A field experiment examining the effects of accounting equation emphasis and transaction scope on students learning to journalize", *Issues in Accounting Education*, Vol. 26 No. 4, pp. 681–699.

Rankin, M., Silvester, M., Vallely, M. and Wyatt, A. (2003), "An analysis of the implications of diversity for students' first level accounting performance", *Accounting and Finance*, Vol. 43 No. 3, pp. 365–393.

Sangster, A. (2010), "Using accounting history and Luca Pacioli to put relevance back into the teaching of double entry", *Accounting, Business and Financial History*, Vol. 20 No. 1, pp. 23–39.

Sartorius, K. and Sartorius, B. (2013), "The comparative performance of chartered accountancy students in South Africa: The impact of historical legacies", *Development Southern Africa*, Vol. 30 No. 3, pp. 401–416.

Smith, M., Therry, L. and Whale, J. (2012), "Developing a Model for Identifying Students at Risk of Failure in a First Year Accounting Unit", *Higher Education Studies*, Vol. 2 No. 4, pp. 91–102.

Smolkowski, K. (2013), "Gain score analysis", (Unpublished report), Retrieved from: http://folk.uio.no/deilerts/phd/docs/Gain%20Score%20Analysis.htm, (Accessed: 2018-07-07).

Statistics South Africa. (2012), *Statistics South Africa. Census in Brief*, *Statistics SA*, available at: http://www.statssa.gov.za/census/census_2011/census_products/Census_2011_Census_in_brief.pdf.

Stebner, F., Kühl, T., Höffler, T.N., Wirth, J. and Ayres, P. (2017), "The role of process information in narrations while learning with animations and static pictures", *Computers and Education*, Vol. 104, pp. 34–48.

Stice, E.K. and Stice, J.D. (2006), “Motivation on day one: The use of Enron to capture student interest”, *Journal of Accounting Education*, Vol. 24 No. 2–3, pp. 85–96.

Sweller, J. (1988), “Cognitive Load During Problem Solving: Effects on Learning”, *Cognitive Science*, Vol. 12 No. 2, pp. 257–285.

Sweller, J. (2010a), “Element interactivity and intrinsic, extraneous, and germane cognitive load”, *Educational Psychology Review*, Vol. 22 No. 2, pp. 123–138.

Sweller, J. (2010b), “Cognitive Load Theory: Recent Theoretical Advances”, in Plass, J.L., Moreno, R. and Brünken, R. (Eds.), *Cognitive Load Theory*, Cambridge University Press, pp. 29–47.

Türkay, S. (2016), “The effects of whiteboard animations on retention and subjective experiences when learning advanced physics topics”, *Computers and Education*, Elsevier Ltd, Vol. 98, pp. 102–114.

Turner, J.L., Holmes, S.A. and Wiggins, C.E. (1997), “Factors associated with grades in intermediate accounting”, *Journal of Accounting Education*, Vol. 15 No. 2, pp. 269–288.

University of Pretoria. (2015), “University of Pretoria Statistics at a Glance 2014”, available at: http://www.up.ac.za/media/shared/371/ZP_Files/dipbook_2015.zp43519.pdf

van Gog, T. and Paas, F. (2008), “Instructional efficiency: Revisiting the original construct in educational research”, *Educational Psychologist*, Vol. 43 No. 1, pp. 16–26.

van Merriënboer, J.J.G., Kester, L. and Paas, F. (2006), “Teaching complex rather than simple tasks: Balancing intrinsic and germane load to enhance transfer of learning”, *Applied Cognitive Psychology*, Vol. 20 No. 3, pp. 343–352.

Wagner, R.M. and Huang, J.C. (2011), “Relative Performance Of English Second Language Students In University Accounting Courses”, *American Journal of Business Education*, Vol. 4 No. 5, pp. 31–38.

Wynder, M. (2018), “Visualising accounting concepts: insights from Cognitive Load Theory for English as a Second Language students”, *Accounting Education*, Vol. 27 No. 6, pp. 590–612.

CHAPTER 5
CONCLUSION

5.1 INTRODUCTION

The main question this thesis aimed to address was: What is the impact of social and cognitive dimensions of language on the learning of introductory accounting in English as an additional language? The opening section of this concluding chapter highlights the sociocultural aspects of language and learning covered by this study, which is then followed by a discussion of cognitive learning theory and its applicability to the two experiments conducted as part of this thesis. After that, the sub-questions of this research, which are dealt with by the three research studies, are reviewed, together with their implications for practice. Finally, the contribution of this thesis is considered, together with its limitations and suggestions for further research.

5.2 SOCIAL DIMENSIONS OF LANGUAGE AND LEARNING IN INTRODUCTORY ACCOUNTING

Vestiges of apartheid remain in South Africa's education system even after 25 years of democracy. An example of this is the social injustice that privileged English and Afrikaans mother tongue students for such a long period in the history of the country, and which is still prevalent in the school system (where English and Afrikaans are the only available media of instruction) as well as in higher education, where English is the only de facto medium of instruction. Failing to acknowledge that language is a powerful tool, used to preserve the *status quo* in the teaching and training of higher education students in South Africa, may lead to accounting educators relying on mistaken perceptions (Dyches and Boyd, 2017). The first common misconception is that language is merely an 'instrument of communication', and to become academically literate students only need to know how to read and write at the required level, as well as adhere to grammar, spelling and punctuation rules (Boughey, 2013). The second misconception is that it is the 'language problem' that university students with EAL face, which explains the difference between the success rates of White and Black African students (Boughey and McKenna, 2016).

This thesis responds to the first fallacy, by presenting language as a socially constructed phenomenon, and academic literacy as the social practice of language as it is situated within specific disciplines (Jacobs, 2005). Hence the term 'disciplinary literacy' (Shanahan and

Shanahan, 2012) is used. The way that accounting professionals speak, read, write, think and act are all part of the Discourse of the socially distinctive community to which they belong (Gee, 1989). The problem is that while accounting educators have implicit knowledge and understanding of the accounting Discourse, and can demonstrate appropriate disciplinary literacy practices for their students, this knowledge often remains unarticulated (Jacobs, 2005, 2007a).

The second misconception relates to an individualistic view of student learning that attributes Black African students' failure to assimilate into the academic environment in higher education to their status as students with EAL (Boughey and McKenna, 2016). This idea pays no attention to the social and cultural contexts of the increasingly diverse student population in accounting classrooms. Individuals use language within a particular sociocultural context to make meaning of their life experiences. This language usage becomes part of their identity and sense of self, that is their primary Discourse (Gee, 2008; Boughey, 2013). The challenges that students face who need to acquire the secondary Discourses of higher education and of the discipline of accounting, which are foreign to their own primary Discourse, are profound. In the process, students may become alienated, and question their identity and self-worth (Boughey, 2013). These sensitivities may be exacerbated if disciplinary lecturers do not recognise their own primary and secondary Discourses, and lack an understanding of how primary Discourses are developed (Jacobs, 2005). Accounting educators such as these perceive students with EAL as lacking the academic and cultural resources required to succeed at university (Smit, 2012). This 'deficit' view problematizes the student and their family background, instead of valuing the context from which these students come (Smit, 2012). The deficit notion also presupposes that the higher education context is socially, culturally and politically neutral, and disregards its role in perpetuating the educational injustices in South African society (Smit, 2012).

The argument put forward in this thesis is that a change of perspective is required regarding the issues facing accounting students with EAL, and on how to solve them. This starts with acknowledging that the disciplinary literacy practices of accounting are socially embedded, and are not neutral skills, but 'ways of being' that need to be made explicit in accounting pedagogical practices (Smit, 2012). Secondly, it means making students feel welcome in the accounting academic community, while recognising and capitalising on the personal resources they bring with them into higher education (Smit, 2012; Pym and Kapp, 2013).

The agency of students coming from disadvantaged backgrounds, their will to learn and their persistence in higher education, needs to be recognised (Smit, 2012; Pym and Kapp, 2013). Appreciating the agency of students with EAL is highlighted in the interview study in chapter 2 of this thesis.

Becoming aware of the Discourse used in the accounting classroom and how to scaffold students' learning of this Discourse, was the focus of the two experimental studies in chapters 3 and 4 of this thesis. The cognitive learning theories applied in these studies are discussed next.

5.3 COGNITIVE DIMENSIONS OF LANGUAGE AND LEARNING IN INTRODUCTORY ACCOUNTING

The pedagogical construction for this thesis is based on the relationship between accounting educators' knowledge of the subject of accounting and their understanding of how best to teach accounting to maximise student learning (Shulman, 1986), while actively training students to read, write, think, speak and act like accountants (Carney and Indrisano, 2017). It is axiomatic that educational practice must be founded on an appropriate theory of how students learn.

The instructional techniques used in the two experiments in this thesis are based on a cognitive perspective of learning. This approach emphasises the facilitation of student learning processes in different situations. The focus is on how to make knowledge meaningful and to help learners organise and relate new information to prior knowledge in their memory (Yilmaz, 2011). Applying a cognitive theory of learning was applicable in both experiments, as students were learning how to solve problems for introductory accounting topics which are based on established connections between defined concepts, and where students needed to apply these concepts and their connections in unfamiliar situations (Ertmer and Newby, 2013).

Prior CLT research has established that in the early stages of knowledge development, students learn most effectively from direct instruction that guides them through the learning process, relating new information to prior knowledge, with the aim of developing the student's knowledge base in long-term memory. This is in comparison to learning approaches that favour autonomous problem-solving (Leppink and van den Heuvel, 2015). For example, if a student does not understand what an asset is, they cannot be expected to differentiate an asset from an expense, let alone make decisions that affect the financial reporting of an entity. Thus, the accounting educator, needs to guide students along the learning path, from exposing them to the basic accounting concepts and assisting students in formulating the correct understanding thereof, and directing them towards the objective of becoming an accounting professional who solves real-life accounting problems.

The two experimental studies were aimed at developing and activating the schemata of introductory accounting students to function as a mental scaffold on which to build new knowledge. In other words, to help students understand how the vocabulary and concepts used in CVP analysis and the accounting equation are constructed. The instructional techniques used were directed at making the language accessible to students, thereby providing them with easier access to the concepts referred to or described.

Each of the three studies undertaken in this thesis, to answer the research sub-questions are now reviewed together with their implications for practice.

5.4 RESEARCH STUDIES: PURPOSE, RESULTS AND IMPLICATIONS FOR PRACTICE

5.4.1 Study 1: Experiences of students studying accounting in English as an additional language

The purpose of this study was to answer the first sub-question: What are the language and learning experiences of students studying accounting in EAL? Research of this nature is limited. A reason for this could be that accounting academics believe it is not important, or alternatively that there is not much of a distinction that can be made between the experiences of student with EAL and those with English as a first language. Both of these rationales are problematic, as separating students from their social, cultural and language contexts leads to the notion that while difficulties that students with EAL may face are lamentable, addressing these issues falls outside the domain of accounting education. The challenge is for accounting educators to discern how the use of language in higher education promotes both privilege for students studying in their first language and prejudice for those who are not (Dyches and Boyd, 2017).

This study explored some of the reasons behind why certain students with EAL were able to succeed in their first-year of studying accounting at university, whereas others did not. While their life experiences were diverse, each student in the interview study would have been socialised into the use of a primary language other than English. The results of this study show that students with EAL who are first-generation university students often are not in a position to receive appropriate support and socialisation into the secondary Discourse from their families. It is within the power of accounting academics to provide students with EAL the opportunity to participate in supportive interaction in which they are recognised and can develop. This type of interaction is vital to academic success (Luckett and Luckett, 2009).

This study recommends that an Interactionist perspective be considered when designing curriculum resources and accounting language learning activities for first-year accounting students. Practical suggestions were provided at the end of chapter 2 of ways in which students with EAL may be assisted in the study of accounting.

5.4.2 Study 2: The impact of formulas and language on students' transfer of learning on Cost-Volume-Profit problems

The purpose of this experimental study was to answer the second sub-question: What is the impact of formulas and language (everyday versus specialised) on solving CVP problems in accounting? Research into the effect of using technical terminology and formulas on students' learning of basic introductory topics is limited. Johnson and Sargent's study in the USA (2014) was an exploratory work investigating these pedagogical practices for CVP analysis. The experiment conducted as part of this thesis extended Johnson and Sargent's (2014) work and tested the effect of everyday language and formulas on students' ability to transfer their knowledge gained in questions requiring lower levels of processing to the application of this knowledge in questions with higher levels of interactivity of concepts.

Both students with English as a first language and students with EAL were included in this study. Technical terminology was more problematic for students with EAL than for students with English as a first language. Providing everyday language played a significant role in reducing the extraneous cognitive load for students with EAL, and facilitating their learning. A unique measure was used to test the ability of students to transfer their learning.

Using the principles of CLT, this research provides empirical support for instructional practices that improve students' capacity to transfer their learning when studying a topic such as CVP for the first time. These are to use everyday language and exclude formulas. Instructional design guidelines based on CLT that should assist educators in teaching students to transfer their learning were provided in chapter 3.

5.4.3 Study 3: The instructional efficiency of multimedia presentations of the Accounting Equation for students studying in English as an additional language

The purpose of this experimental study was to answer the third sub-question: What is the impact of multimedia presentations on learning the concepts of the accounting equation? The use of multimedia in teaching introductory accounting topics is a surprisingly underexplored research area. The main idea behind the animation experiment was to stimulate student interest in learning the accounting equation, as the individual student's engagement is critical in the activation of their learning processes (Carney and Indrisano, 2017). The animation created for this experiment explains the accounting equation to students using a story-board with pictures and graphics and was aimed at assisting students in visualising the accounting equation concepts. It was developed using the principles of the CTML that focuses on presenting learning material to students in multiple modes, i.e. visual and aural. Prior research indicates that adding a visual component in a multimedia learning environment to which students with EAL can relate, supports their learning of new concepts in English (Plass, Chun, Mayer and Leutner, 1998; Mayer, Lee and Peebles, 2014; Wynder, 2018).

Wynder's (2018) tentative conclusion that visualisations were an effective avenue for increasing the learning efficiency of students with EAL, is not supported by this study. However, students with higher intrinsic load levels, due to either having no prior knowledge of accounting or being students with EAL, benefitted most from this experiment. The positive impact of both the animation (test) and PowerPoint (control) presentations on improving the performance of students with EAL is an important result of this study. Students with EAL experienced the animation explanation as clearer than that of the control presentation. While there was no evidence that animations were superior to the PowerPoint presentation in improving students' learning outcomes, the animation improved student enjoyment and engagement in the introductory stages of their learning accounting.

Chapter 4 provided a practical example of how to design an animation explaining a basic accounting topic based on the principles of the CTML. This research encourages accounting educators to consider the cognitive load and instructional efficiency effects of their teaching practices.

5.5 CONTRIBUTION OF THIS RESEARCH

The first study (chapter 2) introduces into the literature a description of the language and learning experiences of students studying accounting in English as an additional language, and how these experiences impact their academic success. It builds on the work of Koch and Kriel (2005) who focused on the role of language as a contributory factor to academic failure among first year accounting students who came from a range of different language backgrounds. In this study only students studying in English as an additional language were interviewed. The emphasis was on why certain students were academically successful, and not only on reasons for students' academic failure. In addition, chapter 2 builds a bridge between accounting education and Second Language Acquisition research as suggested by Carstens (2013) by using aspects of the Interactionist approach to Second Language Acquisition (Mackey, Abbuhl and Gass, 2014; Tarone, 2009) as a framework to explain the results. As a result of this, the pedagogical interventions suggested provide a more rigorous linguistic foundation for incorporating language skills into the accounting curriculum and learning materials.

The second study (chapter 3) replicates and extends the work of Johnson and Sargent (2014) who tested the effect of accounting versus everyday language and the use of formulas on student performance in a CVP analysis assessment, using a quasi-experiment with a non-equivalent group design. The experiment discussed in chapter 3 was undertaken in a strictly controlled environment with random allocation of participants, who were both students with English as a first language as well as those with EAL, into equal groups. The results of the two groups were analysed jointly and separately. As Johnson and Sargent (2014) were unable to determine whether the provision of formulas assisted students in solving application problems due to the insufficient number of usable questions, the application type questions were adapted for purposes of this study. Different from Johnson and Sargent (2014), the effect of formulas and language on students' ability to transfer knowledge gained from the formula-facilitated questions to the application questions was tested. This measure of transfer performance is unique, as in prior research students' scores on only application type questions have been used to test for transfer (DeLeeuw and Mayer, 2008; Paas and van Merriënboer, 1994; van Merriënboer, de Croock and Jelsma, 1997). Johnson and Sargent (2014) used CLT to discuss the expected impact of technical terminology on students' cognitive learning processes, but not to explain the impact of formulas. The principles of CLT are used throughout this study to describe how the high levels of interactivity between elements in a CVP question affect intrinsic, extraneous and germane cognitive load, and to explain the cognitive load effects of language as well as formulas on students' performance.

The third study (chapter 4) was an experiment testing the effect of animations on the learning performance of introductory accounting students with EAL. An earlier experiment by Butler and Mautz (1996) found that the use of multimedia, including animations, elicited a more positive response from students than a text-based verbal approach. However, they did not differentiate between students with different English language backgrounds. Since then the technology to produce multimedia learning opportunities for students has become far more diverse and accessible. Despite this, research on the effects of different types of instructional multimedia on student learning and performance is limited (Ilioudi, Giannakos and Chorianopoulos, 2013), particularly with regard to the potential benefit to students with EAL. Therefore, the final study (chapter 4) contributes to the literature by testing the predictions of Wynder's (2018) non-experimental work, that the use of animations may increase the learning efficiency of accounting students with EAL, by means of a controlled experiment. Wynder (2018) based his research on CLT, which Mostyn (2012) points out is widely used in research and instructional design in other disciplines, but is underused in accounting education. Mostyn (2012) argues that educators of first-year accounting students need to raise their awareness of the theory and the contribution it makes in identifying the cognitive constraints of novice learners when learning complex tasks and by providing specific methods for improving learning efficiency. This study responds to Mostyn (2012) and Wynder (2018) in testing the effect of animations on the efficiency of learning for introductory accounting students with EAL, using the CTML.

This research contributes to accounting education literature in a number of additional ways: It provides a theoretical basis for the category of research regarding first-year accounting teaching and curriculum interventions that focuses on making the language of accounting accessible to students (Johnson and Sargent, 2014; Phillips, Alford and Guina, 2012; Phillips and Schmidt, 2010; Phillips and Nagy, 2014; Wynder, 2018). Designing instruction that scaffolds accounting literacy is within the purview of all accounting educators, as is the use of a blended pedagogical framework that incorporates disciplinary literacy practices. As accounting educators, we still have much to learn from our academic literacy colleagues.

Their call to collaboration of our efforts in enhancing the learning processes of accounting students does not mean that the standard of what we teach will decrease, it means that the effectiveness of our teaching will be more profound and impactful on the lives of our students.

The role of language in learning accounting has traditionally been viewed as outside of the boundaries of the discipline. Some accounting educators may believe it is beyond the scope of what they need to be teaching. The perception is that language educators are the specialists trained to deal with the multiplicity of needs arising from the diversity of language backgrounds of students in today's accounting classroom. Other accounting educators are aware of the issues but may either lack the resources or believe they lack the skills to address them. This thesis draws on the work of academic literacy specialists who have been dealing with the language issues of students with EAL for many decades. It is their contention that language is a social practice within a discipline, and that disciplinary educators need to become aware of the vital role they must play in developing students' disciplinary literacies (Boughey, 2002, 2005, 2012, 2013; Boughey and McKenna, 2016; Carstens, 2013; Evans and Cable, 2011; Jacobs, 2005, 2007a, 2007b, 2010; Koch and Kriel, 2005; Lea and Street, 1998, 2006; Paretti, 2011; Spack, 1988; Street, 1998).

Reaction to this call from linguistic researchers in the field of accounting education has been limited. The necessity of taking an interdisciplinary perspective to addressing the language needs of accounting students is promoted in this thesis. This does not only mean teaching students how to read and write in accounting related subjects, which has mainly been done on an ad-hoc or supplementary basis (Dale-Jones, Hancock and Willey, 2013; Evans, Tindale, Cable and Hamil Mead, 2009; Pritchard, Romeo and Muller, 1999; Riley and Simons, 2013). It means changing the way we view language from within the discipline and the role it plays in our students learning. It means thinking about our 'way of being' as accounting educators, and opening the doors of our Discourse to our students. It means allowing our students epistemological access to the language of accounting.

The knowledge base of accounting educators combines a specialised blend of content and pedagogical knowledge (Shulman, 1986). This thesis adds knowledge of the disciplinary literacy of accounting to this pedagogical framework. The experimental studies provide examples of how to make the language of accounting accessible to students. Educators who are able to blend these forms of knowledge will provide effective pedagogical practices that meet the needs of all students in learning how to read, write, think and 'be' in the discipline of accounting (Carney and Indrisano, 2017). This pedagogical framework also recognises the role of language and Discourse in the lived experiences of students, and encourages accounting educators to consider their role in promoting social justice through their teaching.

The use of both CLT and the CTML in this thesis is an important contribution as these theories are particularly relevant in research dealing with teaching introductory accounting courses. The rigorous testing of these theories by means of controlled experiments, with strict implementation of randomisation, and in the case of the animation, the use of a pre- and post-test is relatively uncommon in accounting education research, where rigorous experimental research is scarce (Apostolou, Dorminey, Hassell and Rebele, 2016).

In the CVP experiment, a unique measure of students' ability to transfer knowledge gained from the formula-facilitated questions to the application questions was tested. The optimal condition for transfer performance appeared to be providing everyday language without formulas. A further contribution is the use of both objective and subjective measures of cognitive load in the animation experiment. The consistency found between the time-on-task measure and students' experiences of mental load provide support for the validity of the latter question in measuring total cognitive load.

The implementation of a variety of strategies is necessary to address the barriers facing accounting educators in providing students access to the Discourse of accounting. The instructional interventions and instructional design guidelines used and suggested by the studies undertaken in this thesis, as provided as a checklist in Table 5.1. These could be used by lecturers to address the language and learning needs of introductory accounting students, particularly those studying in English as an additional language.

Table 5.1: Checklist of suggested instructional interventions and instructional design guidelines

Ch 2	**Incorporation of language skills into the accounting curriculum and learning materials**
1	Take cognisance of the communication anxieties of students with EAL and structure the interactions during lectures, tutorials and consulting to provide a comfortable environment for students to engage.

2	Make students' learning materials as accessible and comprehensible as possible, particularly at the introductory accounting level. Accounting educators can assist students in improving their reading behaviours by paying attention to the type, format and level of learning materials they provide and prescribe to their students.
3	Investigate and implement techniques such as previewing the chapter, developing focus questions, mapping, learning Cloze terms, talking-the-chapter and thinking meta-cognitively, which could also help to improve students' reading abilities and comprehension.
4	Allow students to collaborate on academic tasks that require extensive language use in groups specifically configured to include both English first-language speakers and students with EAL. This would give the latter group of students the opportunity to access meaningful input and to produce output. 'Collective scaffolding', where students work together on a task, has been shown to produce results that students would not have been able to produce individually.
5	Provide tutorials or consulting opportunities to students with EAL in their home language(s), and glossaries of terms and definitions translated into their home language(s). Successful senior students with EAL could be gainfully employed as tutors and mentors for entry-level students. Research has shown that the use of code-switching between an individual's home language and English is important in allowing students to explore the real meaning of concepts, and in scaffolding their learning to broaden their understanding. Failure to do this may result in students concealing their misconceptions by using rote learning to memorise English terminology.
Ch 3	**Instructional design guidelines based on CLT research to be used when teaching introductory accounting topics (Leppink, 2017)**
1	Set specific learning goals before instruction commences. Students' prior knowledge, together with the learning outcomes should determine what is intrinsic to the specific instructional activity.
2	Structure the intrinsic load of the topic so that it does not overwhelm students limited cognitive resources, but rather enables them to build up the relevant schemata in their long-term memory in a progressive manner. This can be done by sequencing tasks from low to high levels of interactivity. Together with reducing extraneous load, this should promote students' learning processes. Encouraging germane load in this way allows students to structure the necessary schemata in long-term memory that allow them to apply their knowledge in transfer situations.
3	Minimise cognitive activity that does not contribute to learning (extraneous load). Avoid using technical terminology and formulas when teaching accounting principles for the first time, in order to maximise transfer of learning. Students' working memory resources consumed by technical terminology and their attempts to use the formulas, may not contribute to the intended learning outcome.
4	Provide students with feedback on their progress while completing an assessment. This is easily done in computer-based testing. Students can be told, with reasons, whether their answers to individual questions are correct or incorrect. In the case of an incorrect answer, students may be given further information to assist them in answering the question correctly before being allowed to continue. This will assist them in monitoring their own learning.

Ch 4	**Instructional design guidelines based on the CTML research to be used when using multimedia presentations for teaching introductory accounting topics (Mayer and Moreno, 2002, 2003)**
1	Provide coherent verbal and pictorial information and guide learners to select relevant words and images, thereby reducing the load for a single processing channel.
2	Apply the spatial contiguity principle by placing on-screen text close to the related animation for learners to build mental connections between them. If learners have to search for the animation corresponding to the text, they waste cognitive capacity.
3	Present narration and animation concurrently rather than successively (temporal contiguity principle).
4	Ensure that the narrative, animation, sounds and text are all relevant to the intended learning outcome, as extraneous material overloads working memory capacity unnecessarily (coherence principle). Use narration rather than on-screen text with an animation, as this improves students' ability to transfer their learning. The use of animation and on-screen text together overloads the student's visual channel.
5	Limit on-screen text. Only words that are necessary to understand the concept should be presented together with the narration and animation (modality and redundancy principles). Conversational narrative personalises the animation. Use people that students can relate to in the story. Colour and circles can be used as forms of visual cueing. The use of visual cueing improves the instructional efficiency outcomes of animations.
6	Ensure the animation is system-paced. The positive effect of animation over static graphics is found only for system-paced instructional material, as opposed to when students controlled the pace.

5.6 CONCLUDING COMMENTS

At the end of this thesis, it is important to note, that there can be no single learning theory that provides the 'best' and most efficient teaching approach (Ertmer and Newby, 2013). While CLT is used in this work as a theory that informs instructional design aimed at promoting effective learning for novice accounting students (Kirschner, Sweller and Clark, 2006), students do not exist in a vacuum. Their social environment, past experiences and cultural background all contribute to how they construct knowledge. Individual and social aspects of learning cannot and should not be disassociated from each other. This research aims to bring the two together, by considering the implications of the diversity of language backgrounds of students in South Africa on the teaching and learning of introductory accounting.

This thesis is limited in its scope and further work is required in a number of areas arising out of this work. Firstly, the theories behind the assumptions that underpin current literacy use in the discipline of accounting need to be examined. Research should challenge the dominance of the autonomous model of literacy in accounting education, that views language and its use as a neutral instrument of communication (Boughey and McKenna, 2016). Sociolinguistic viewpoints of language that present an ideological model (Boughey and Mckenna, 2016) of literacy need to be investigated. These include Gee's (1989) notion of Discourse, Lea and Street's (1998) approach to academic literacy as a socially embedded practice, and the impact of multiliteracies as advocated by the New London Group (1996). Including a social understanding of academic literacy and language use into the pedagogical practices in accounting education will serve to assist *all* students in gaining access to the knowledge and social capital necessary to become members of the accounting profession (Boughey and McKenna, 2016).

Secondly, in order to develop accounting students' ability to read, write, think, speak and act like professional accountants, we need to understand the specialised ways that literacy works in the field of accounting (Shanahan and Shanahan, 2012). This means delving into the field of applied linguistics. There is much work to be done on unpacking the linguistic, cognitive and socio-cultural dimensions of accounting language. A framework for analysing academic literacy based on these multiple dimensions, was proposed by Scarcella (2003). This conceptual framework could serve as a blueprint for the development of a knowledge base of the various dimensions and features of accounting disciplinary literacy. This kind of work would of necessity need to be done in collaboration with language experts, who are ahead of discipline educators in understanding the imperative of making the language of accounting accessible to all of our students (Carstens, 2013; Boughey and McKenna, 2016).

Thirdly and finally, theory needs to be put into practice. The fundamental duty of a teacher is to bring together all forms of knowledge to ensure our instruction is effective in promoting student learning (Shulman, 1987). The amalgamation of pedagogical content knowledge with disciplinary literacy knowledge in our teaching, opens the door to a wide range of research for the future. The two experiments included in this thesis are just a foot in this door.

5.7 REFERENCES

Apostolou, B., Dorminey, J.W., Hassell, J.M., Rebele, J.E. (2015) “Accounting education literature review (2015)”, *Journal of Accounting Education*, Vol. 35, pp. 20-55.

Boughey, C. (2002) "'Naming' Students' Problems: an analysis of language-related discourses at a South African university", *Teaching in Higher Education*, Vol. 7 No. 3, pp. 295–307.

Boughey, C. (2005) "'Epistemological' access to the university : an alternative perspective", *South African Journal of Higher Education*, Vol. 19 No. 3, pp. 230–242.

Boughey, C. (2012) "Social Inclusion and Exclusion in a Changing Higher Education Environment", *Multidisciplinary Journal of Educational Research*, Vol. 2 No. 2, pp. 133–151.

Boughey, C. (2013) "What are we thinking of? A critical overview of approaches to developing academic literacy in South African higher education", *Journal for Language Teaching*, Vol. 47 No. 2, p. 25.

Boughey, C. and McKenna, S. (2016) "Academic literacy and the decontextualised learner", *Critical Studies in Teaching and Learning*, Vol. 4 No. 2, pp. 1–9.

Carney, M. and Indrisano, R. (2017) "Disciplinary Literacy and Pedagogical Content Knowledge", *Journal of Education*, Vol. 193 No. 3, pp. 39–49.

Carstens, A. (2013) "Collaboration : The key to integration of language and content in academic literacy interventions", *Journal for Language Teaching*, Vol. 47 No. 2, pp. 109–126.

Dale-Jones, G., Hancock, P. and Willey, K. (2013) "Accounting Students in an Australian University Improve their Writing : But How Did it Happen?", *Accounting Education: an international journal*, Vol. 22 No. 6, pp. 544–562.

Dyches, J. and Boyd, A. (2017) "Foregrounding Equity in Teacher Education: Toward a Model of Social Justice Pedagogical and Content Knowledge", *Journal of Teacher Education*, Vol. 68 No. 5, pp. 476–490.

Ertmer, P. A. and Newby, T. J. (2013) "Behaviorism, Cognitivism, Constructivism: Comparing Critical Features From an Instructional Design Perspective", *Performance Improvement Quarterly*, Vol. 26 No. 2, pp. 43–71.

Evans, E., Tindale, J., Cable, D., Hamil Mead, S. (2009) “Collaborative teaching in a linguistically and culturally diverse higher education setting: a case study of a postgraduate accounting program”, *Higher Education Research and Development*, Vol. 28 No. 6, pp. 597–613.

Evans, E. and Cable, D. (2011) “Evidence of improvement in accounting students' communication skills”, *International Journal of Educational Management*, Vol. 25 No. 4, pp. 311–327.

Gee, J. P. (1989) “Literacy, Discource, and Linguistics: Introduction”, *The Journal of Education*, Vol. 171 No. 1, pp. 5–176.

Gee, J. P. (2008) *Social Linguistics and Literacies*. 3rd edn. London and New York: Routledge.

Jacobs, C. (2005) “On being an insider on the outside : new spaces for integrating academic literacies”, *Teaching in Higher Education*, Vol. 10 No. 4, pp. 475–487.

Jacobs, C. (2007a) “Mainstreaming academic literacy teaching : Implications for how academic development understands its work in higher education”, *South African Journal of Higher Education*, Vol. 21 No. 7, pp. 870–881.

Jacobs, C. (2007b) “Towards a critical understanding of the teaching of discipline-specific academic literacies: making the tacit explicit”, *Journal of Education*, Vol. 41, pp. 59–81.

Jacobs, C. (2010) “Collaboration as pedagogy: Consequences and implications for partnerships between communication and disciplinary specialists”, *Southern African Linguistics and Applied Language Studies*, Vol. 28 No. 3, pp. 227–237.

Johnson, B.G. and Sargent, C.S. (2014), “Impact of Formulas, Language and Instruction on Student Performance on Cost-Volume-Profit Problems”, *Accounting Education: An International Journal*, Vol. 23 No. 1, pp. 22–41.

Kirschner, P. A., Sweller, J. and Clark, R. E. (2006) “Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching”, *Educational Psychologist*, Vol. 41 No. 2, pp. 75–86.

Koch, E. and Kriel, M. (2005) “An argument for integrating language or language related skills in the accounting curriculum”, *South African Journal of Higher Education*, Vol. 19 No. 3, pp. 218–229.

Lea, M. R. and Street, B. V. (1998) “Student writing in higher education: An academic literacies approach”, *Studies in Higher Education*, Vol. 23 No. 2, pp. 157–172.

Lea, M. R. and Street, B. V. (2006) “The “Academic Literacies” Model: Theory and Applications”, *Theory into Practice*, Vol. 45 No. 4, pp. 368–377.

Leppink, J. (2017), “Cognitive load theory: Practical implications and an important challenge”, *Journal of Taibah University Medical Sciences*, Elsevier Ltd, Vol. 12 No. 5, pp. 385–391.

Leppink, J. and van den Heuvel, A. (2015) “The evolution of cognitive load theory and its application to medical education”, *Perspectives on Medical Education*, Vol. 4 No. 3, pp. 119–127.

Luckett, K. and Luckett, T. (2009) “The development of agency in first generation learners in higher education : a social realist analysis”, *Teaching in Higher Education*, Vol. 14 No. 5, pp. 469–481.

Mayer, R.E. and Moreno, R. (2002), “Animation as an aid to multimedia learning”, *Educational Psychology Review*, Vol. 14 No. 1, pp. 87–99.

Mayer, R.E. and Moreno, R. (2003), “Nine Ways to Reduce Cognitive Load in Multimedia Learning”, *Educational Psychologist*, Vol. 38 No. 1, pp. 43–52.

Mayer, R. E., Lee, H. and Peebles, A. (2014) “Multimedia Learning in a Second Language : A Cognitive Load Perspective”, *Applied Cognitive Psychology*, Vol. 28, pp. 653–660.

New London Group (1996) "A pedagogy of multiliteracies: Designing social futures", *Harvard Educational Review*, Vol. 66 No. 1, pp. 60–92.

Paretti, M. C. (2011) “Interdisciplinarity as a Lens for Theorizing Language / Content Partnerships”, *Across the Disciplines*, Vol. 8 No. 3. Retrieved from: http://wac.colostate.edu/atd/clil/paretti.cfm.

Phillips, F., Alford, S.J. and Guina, S. (2012), “Illustrations in financial accounting textbooks: Function and placement interact to affect student learning”, *Issues in Accounting Education*, Vol. 27 No. 4, pp. 999–1017.

Phillips, F. and Nagy, A. (2014), “Does Reading Case Responses and Using Graphic Organizers Enhance Accounting Students’ Case Analyses?”, *Issues in Accounting Education*, Vol. 29 No. 1, pp. 149–168.

Phillips, F. and Schmidt, R.N. (2010), “Creating early success in financial accounting: Improving performance on adjusting journal entries”, *Accounting Perspectives*, Vol. 9 No. 2, pp. 87–96.

Plass, J. L., Chun, D.M., Mayer, R.E., Leutner, D. (1998) “Supporting visual and verbal learning preferences in a second language multimedia learning environment”, *Journal of Educational Psychology*, Vol. 90 No. 1, pp. 25–36.

Pritchard, R. E., Romeo, G. C. and Muller, S. A. B. (1999) “Integrating reading strategies into the accounting curriculum”, *College Student Journal*, Vol. 33 No. 1, p. 77.

Pym, J. and Kapp, R. (2013) “Harnessing agency: towards a learning model for undergraduate students”, *Studies in Higher Education*, Vol. 38 No. 2, pp. 272–284.

Riley, T. J. and Simons, K. A. (2013) “Writing in the Accounting Curriculum: A Review of the Literature with Conclusions for Implementation and Future Research”, *Issues in Accounting Education*, Vol. 28 No. 4, pp. 823–871.

Scarcella, R. (2003) "Academic English: A Conceptual Framework", *UC Berkeley: University of California Linguistic Minority Research Institute*. Retrieved from: https://escholarship.org/uc/item/6pd082d4.

Shanahan, T. and Shanahan, C. (2012) “What is Disciplinary Literacy and Why Does It Matter ?”, *Topics in Language Disorders*, Vol. 32 No. 1, pp. 7–18.

Shulman, L. S. (1986) “Those Who Understand: Knowledge Growth in Teaching”, *Educational Researcher*, Vol. 15 No. 2, pp. 4–14.

Shulman, L.S. (1987), “Knowledge and Teaching: Foundations of the New Reform”, *Harvard Educational Review*, Vol. 57 No. 1, pp. 1–22.

Smit, R. (2012) “Towards a clearer understanding of student disadvantage in higher education : problematising deficit thinking”, *Higher Education Research and Development*, Vol. 31 No. 3, pp. 369–380.

Spack, R. (1988) “Initiating ESL students into the Academic discourse community: How far should we go?”, *TESOL Quarterly*, Vol. 22 No. 1, pp. 29–51.

Street, B. V. (1998) “New Literacies in Theory and Practice : What are the Implications for Language in Education ?”, *Linguistics and Education*, Vol. 10 No. 1, pp. 1–24.

Wynder, M. (2018) “Visualising accounting concepts: insights from Cognitive Load Theory for English as a Second Language students”, *Accounting Education*, Vol. 27 No. 6, pp. 590–612.

Yilmaz, K. (2011) “The Cognitive Perspective on Learning: Its Theoretical Underpinnings and Implications for Classroom Practices”, *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, Vol. 84 No. 5, pp. 204–212.

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APPENDIX A: CH 2 ETHICAL CLEARANCE

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YUNIBESITHI YA PRETORIA

Faculty of Economic and Management Sciences

RESEARCH ETHICS COMMITTEE

Tel: +27 12 420 3395
E-mail: ronel.rensburg@up.ac.za

1 June 2017

Prof JL Stainbank
c/o Department of Accounting

Strictly confidential

Dear Professor Stainbank

The application for ethical clearance for the research project described below served before this committee on 31 May 2017.

Protocol No:	EMS002/17 (Please use this reference in any correspondence)
Research title:	Developing an Accounting discipline based perspective of language use by English second language students in the mainstream accounting classroom
Principal researcher:	SE Smith
Student/Staff No:	04264061
Degree:	PhD: Accounting Sciences
Supervisor/Promoter:	Prof JL Stainbank / Prof A Carstens
Department:	Accounting

The decision by the committee is reflected below:

Decision:	Approved (Phase 2 of research)
Conditions (if applicable):	None
Period of approval:	31 May 2017 – 30 May 2020

The approval is subject to the researcher abiding by the principles and parameters set out in the application and research proposal in the actual execution of the research. The approval does not imply that the researcher, student or lecturer is relieved of any accountability in terms of the Codes of Research Ethics of the University of Pretoria if action is taken beyond the approved proposal. If during the course of the research it becomes apparent that the nature and/or extent of the research deviates significantly from the original proposal, a new application for ethics clearance must be submitted for review.

Please convey this information to the researcher. We wish you success with the project.

Sincerely

pp PROF RS RENSBURG
CHAIR: COMMITTEE FOR RESEARCH ETHICS

cc: Prof A Carstens
Prof M Stiglingh
Student Administration

Fakulteit Ekonomiese en Bestuurswetenskappe
Lefapha la Disaense tša Ekonomi le Taolo

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

APPENDIX B: CH 2 STUDENT INFORMED CONSENT LETTER

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Economic and Management Sciences
Department of Accounting

The influence of language of study and other factors on accounting students success

Research conducted by:
Ms. S.E. Smith (04264061)
Cell: 073 562 8047

Dear Participant

You are invited to participate in an academic research study conducted by Sonnette Smith, a Masters student from the Department of Accounting at the University of Pretoria.

The purpose of the study is to attempt to understand through interviewing students, the perceptions and feelings of students towards their first year Accounting and Financial Management courses which they studied at UP in 2013. We also want to find out how students cope with the level of English used in these courses.

Please note the following:

- Interviews will be voice-recorded and will take approximately an hour of your time. A recording of the interview will be provided to you a few days after the interview takes place.
- All interviews will be kept confidential and individual data will not be released to anyone inside or outside the university.
- The results of the study will be used for academic purposes only and may be published in an academic journal. Within any publication brief quotations may be used from interviews, but these will be under pseudonyms, so that no-one will be able to identify you.
- Your participation in this study is very important to us. You may, however, choose not to participate and you may also stop participating at any time without any negative consequences.
- A copy of the preliminary questions which you will be asked is attached and you are encouraged to go through these questions and reflect on your answers before the interview takes place.
- You are encouraged to answer all questions put to you as completely and honestly as possible. Please use every opportunity during the interview to offer your ideas and thoughts on each aspect of the learning experience that we discuss.
- Please contact my study leader, Ms. Marna de Klerk marna.deklerk@up.ac.za if you have any questions or comments regarding the study.

Please sign the form to indicate that:

- You have read and understand the information provided above.
- You give your consent to participate in the study on a voluntary basis.

__________________________ __________________

Participant's signature **Date**

Participant's name and surname ________________________________

APPENDIX C: CH 3 ETHICAL CLEARANCE

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Economic and Management Sciences

RESEARCH ETHICS COMMITTEE

Tel: +27 12 420 3395
E-mail: ronel.rensburg@up.ac.za

11 October 2016

Strictly confidential

Prof LJ Stainbank
University of KwaZulu-Natal

Dear Professor Stainbank

Project:	Developing an Accounting discipline based perspective of language use by English second language students in the mainstream accounting classroom
Researcher:	SE Smith
Student No:	04264061
Promoter:	Prof LJ Stainbank
Co-promoter:	Prof A Carstens
Department:	Accounting

We refer to our letter dated 29 September 2016 granting conditional ethics clearance for the above candidate.

I have pleasure in informing you that the Registrar's permission has been obtained to involve the proposed UP students in the research.

The Committee requests that you convey this approval to the researcher.

Sincerely

pp PROF RS RENSBURG
CHAIR: COMMITTEE FOR RESEARCH ETHICS

cc: Prof A Carstens
Prof M Stiglingh
Student Administration

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UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

APPENDIX D: CH 3 STUDENT INFORMED CONSENT LETTER

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Economic and Management Sciences

Dept. of Accounting

Developing an Accounting discipline based perspective of language use in the Accounting Classroom

Research conducted by:
Mrs. S.E. Smith (04264061)
Cell: 073 562 8047

Dear Participant

You are invited to participate in an academic research study conducted by Sonnette Smith, Doctoral student from the Department of Accounting at the University of Pretoria.

The purpose of the study is to understand how second year accounting students with different language backgrounds perform on introductory accounting topic questions that may not be familiar to them.

Please note the following:

- This is an experimental study. You will be required to complete an assessment on Wednesday 8 February 2017, from 11.30 to 12.30 in HB 3-23. You do not need to prepare anything for the assessment. You are required to bring your own stationery and calculator. Paper will be supplied.
- The assessment will not influence your academic results in anyway. The results of the study will only be used for research purposes. The information you provide will be strictly confidential and will not be supplied to any other individual.
- In order to encourage you to give the assessment your best effort we will pay you R5 for every question attempted. There are 14 questions, so the maximum you will be paid is R70. However, if any of your answers are incorrect, you will only receive R2.50 for the question that is answered incorrectly. You will only receive this money once the assessments have been marked.
- Your participation in this study is very important to us. You may, however, choose not to participate and you may also stop participating at any time without any negative consequences.
- The results of the study will be used for academic purposes only and may be published in an academic journal. We will provide you with a summary of our findings on request.
- Please contact my study leader, Prof. L.J. Stainbank at stainbankl@ukzn.ac.za if you have any questions or comments regarding the study.

Please sign the form to indicate that:

- You have read and understand the information provided above.
- You give your consent to participate in the study on a voluntary basis.

______________________	______________
Participant's name and surname	**Student No.**
______________________	______________
Participant's signature	**Date**

APPENDIX E: CH 3 RESEARCH INSTRUMENT / ASSESSMENT

(Adapted from Johnson and Sargent, 2014)

There were four different versions of the assessment. For the experimental groups provided with formulas, the following words were added to each question: *Use the formulas provided on the cheat sheet to answer the following questions. Select the number of the formula you used in each case.* The questions below are the Everyday Language version. The solutions are provided in italics. (The Accounting Language version of the assessment is provided in Table 3.1.)

Question 1:

Taco Joe's, owned and operated by Joe Cool, is a favourite of the local university students. Joe's tacos are priced at R1.50 and it costs R1.20 in ingredients (premium taco meat, sour cream, etc.) to make each one.

Formula-facilitated questions:

1.1 For each taco sold, how much profit does Taco Joe's make? *R0.30*

1.2 What percentage of each taco sale goes to profit? *20%*

1.3 If Taco Joe's sold 200 more tacos, how much additional profit would be made? *R60*

Application question:

1.4 If the cost of the ingredients per taco increased by R0.20 to R1.40, what should the new selling price per taco be if Joe wants to keep the same percentage profit on each taco sold? *R1.75*

Question 2:

Top-Loading Tyler's Video Emporium sells classic 1980's movies in the vintage VHS tape format. Tyler purchases his tapes wholesale from a supplier for R16 each and sells them to his customers for R20. He pays R1 600 per month for rent on his store location. For simplicity let's assume he has no other products or expenses.

Formula-facilitated questions:

2.1 How many tapes does Tyler need to sell in a month to cover all his expenses and break even? *400 units*

2.2 What total sales in Rands must Tyler make to break even? *R8 000*

Application question:

2.3 Tyler moves into cheaper premises where the rent is only R1 300 per month. How will this affect the amount of sales in Rands he must make to still break-even? Choose one option: *B*

A Decrease sales by R300
B Decrease sales by R1 500
C No change
D I'm not sure

Question 3:

April Lou Harvey is the founder of April Showers' Flowers, a multimillion-rand floral empire. April got her start as a humble flower girl selling roses to diners at fancy romantic restaurants. She bought roses from a well-known florist for R1.50 each and sold them to her customers for R3.00. She also had to pay the florist a weekly fee of R150 for the right to be their distributor.

Formula-facilitated question:

3.1 April's goal was to make a profit of at least R300 every week to save up for her dream of opening a florist shop of her own someday. How many roses did April need to sell in a week to reach her goal? *300 roses*

Application questions:

3.2 April always worked hard, and in one particularly good week she sold exactly twice as many roses as she needed to reach her profit goal. How much profit did she make that week? *R750*

3.3 If the florist who April bought roses from increased the price for each rose to R1.75, what should April do in order to still achieve her weekly profit goal of R300? Choose one option: *D*

A Nothing

B Increase the selling price per rose by R0.25

C Keep the selling price the same but sell 60 more roses per week

D She can do B or C

Question 4:

The Branlove Cereal Company sells fancy gluten-free organic cereal for R4.00 per box. Branlove expects to sell R400 000 in cereal this month, and needs to make sales of at least R180 000 to cover all its expenses and break even.

Formula-facilitated questions:

4.1 How much does Branlove expect sales to exceed what they need to break even? *R220 000*

4.2 What percentage of the expected sales is the amount in 4.1? *55%*

4.3 How many boxes of cereal sold does the amount in 4.1 represent? *55 000 boxes*

Application question:

4.4 If Branlove increases the selling price per box to R4.40, and the number of boxes it expects to sell remains the same, and the sales amount of R180 000 required to cover all expenses and break-even remains the same, by how much could the rand amount of cereal sales drop before Branlove no longer makes a profit and starts losing money? *R260 000*

APPENDIX F: CH 3 FORMULA CHEAT SHEET

(Adapted from Johnson and Sargent, 2014)

(Table 3.1 provides the accounting language version of the formulas.)

Everyday Language Version:

1. Profit per Product Unit = Selling price per Unit – Cost to make/buy per Unit
2. Profit percentage for each Product Unit sold = $\frac{\text{Profit per Product Unit}}{\text{Selling price per Unit}}$ X 100
3. Total profit from sales = Profit per Product Unit X Number of Units sold
4. Units to Sell to Break-Even = $\frac{\text{Total Non-Product Costs*}}{\text{Profit per Product Unit}}$
5. Total Sales required in order to Break-Even = Units to Sell to Break-Even X Selling price per Unit
6. Units to Sell to reach a Profit Goal = $\frac{\text{Total Non-Product Costs* + Profit Goal Amount}}{\text{Profit per Product Unit}}$
7. Sales above Break-Even in Rands=Actual or expected Sales in Rands – Sales required to Break-Even in Rands
8. Sales above Break-Even as a % of budgeted Sales = $\frac{\text{Sales above Break-Even in Rands}}{\text{Actual or expected sales in Rands}}$ X 100
9. Units sold above Break-Even = Actual or expected unit sales – Units needed to Break-even

* Non-Product Costs are expenses like rent and insurance that are not affected by the number of product units made or sold

APPENDIX G: CH 3 SURVEY QUESTIONS

Please indicate on a scale of 1 to 7:

1. How easy or difficult did you find the questions in this assessment?

1	2	3	4	5	6	7
Extremely easy	Easy	Moderately easy	Neither easy nor difficult	Moderately difficult	Difficult	Extremely difficult

2. How clear were the questions in the assessment to you?

1	2	3	4	5	6	7
Very clear	Clear	Moderately clear	Neither clear nor unclear	Moderately unclear	Unclear	Very unclear

3. To what extent did the monetary incentive provided motivate you to remain focused during your completion of this assessment?

1	2	3	4	5	6	7
No extent	Slight extent	Moderately small extent	Moderate extent	Moderately big extent	Big extent	Very big extent

APPENDIX H: CH 4 ETHICAL CLEARANCE

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Economic and Management Sciences

RESEARCH ETHICS COMMITTEE

Tel: +27 12 420 3395
E-mail: ronel.rensburg@up.ac.za

5 February 2018

Strictly confidential

Mrs SE Smith
Department of Accounting

Dear Mrs Smith

Protocol No:	EMS055/17
Principal researcher:	**SE Smith**
Research title:	Developing an Accounting discipline based perspective of language use by English second language students in the mainstream accounting classroom
Student/Staff No:	04264061
Degree:	PhD (Accounting Sciences)
Supervisor/Promoter:	Prof LJ Stainbank / Prof A Carstens
Department:	Accounting

The Committee's letter dated 17 January 2018 refers.

I have pleasure in informing you that the Dean granted permission for the participation of the students identified in the application. Approval is further subject to the candidate abiding by the principles and parameters set out in the application and research proposal in the actual execution of the research.

The Committee requests that you convey this approval to the researcher.

Sincerely

pp PROF RS RENSBURG
CHAIR: COMMITTEE FOR RESEARCH ETHICS

cc: Student Administration

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APPENDIX I: CH 4 STUDENT INFORMED CONSENT LETTER

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Economic and Management Sciences

Dept. of Accounting

Developing an Accounting discipline based perspective of language use by English Second Language Students in the Mainstream Accounting Classroom

Research conducted by:
Mrs S.E. Smith (04264061)
Cell: 073 562 8047

Dear Participant

You are invited to participate in an academic research study conducted by Sonnette Smith, a Doctoral student from the Department of Accounting at the University of Pretoria.

The purpose of the study is to measure the instructional efficiency of two different methods of explaining the Accounting Equation.

Please note the following:

- This is an experimental study. It will take you approximately 40 minutes to complete.
- The results of the study will be used for research purposes only and may be published in an academic journal. We will provide you with a summary of our findings on request.
- The information you provide will be strictly confidential and will not be supplied to any other individual.
- There are no significant foreseeable risks to any person who participates in this survey
- Your participation in this study is crucial to us. You may, however, choose not to participate and you may also stop participating at any time without any negative consequences.
- Please contact my study leader, Prof. L.J. Stainbank at stainbankl@ukzn.ac.za if you have any questions or comments regarding the study.

Please sign the form to indicate that:

- You have read and understand the information provided above.
- You give your consent to participate in the study on a voluntary basis.
- You give your consent for the academic results you provide to be used in the study and to be verified on the university system.

________________________ _________________

Participant's signature **Date**

APPENDIX J: CH 4 VERBAL AND WRITTEN INSTRUCTIONS FOR STUDENTS

Verbal instructions for students

Please take your seat and read the written instructions provided.

This activity is also being used as a research experiment by your lecturers. If you are willing for your results of this task to be used for research purposes, please complete the attached letter and submit it to the tutor responsible for this session before you leave.

If you have any questions, please raise your hand, and someone will come and assist you.

Written instructions for students

The purpose of this activity is to introduce you to the online learning environment in FRK111. The completion of this activity will count as five Beans – refer to the Study Guide for how these Beans may be converted into marks at the end of the semester. You are encouraged to give this task your best effort.

This activity is also being used as a research experiment by your lecturer(s). If you are willing for your results of this task to be used in this research, please complete the attached letter and submit it to the tutor responsible for your session before you leave. However, if you do not want to have your results used in the research, you do not have to sign the letter, and you will not suffer any negative consequences.

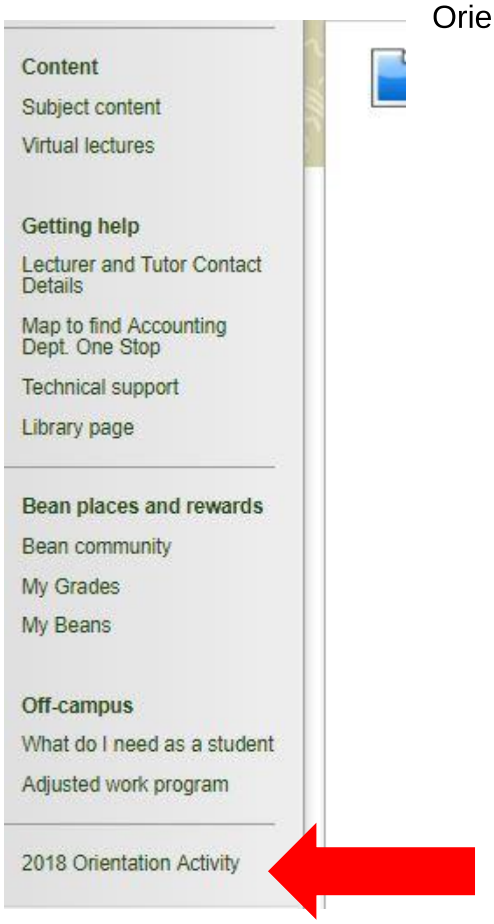
Each student is required to work independently and will not necessarily be assigned the same tasks or information. Any material that you did not gain access to during the activity that was assigned to other students will be made available on ClickUP for all students after the end of the activity period at 13.30 on Friday, 9 February 2018.

Now that the activity has started, please do not talk or in any way communicate with other participants during this task. Please remember to turn off your cell phones. Also, please do not write on these instructions; use the notepad provided. The instructions may not be taken with you when you leave the venue at the end of the session. If you have a question or problem at any point in today's activity, please raise your hand, and someone will come and assist you.

Today’s activity will consist of four stages.

1. Pre-test. You will have a time limit of 10 minutes for the pre-test. However, you are encouraged to complete the test as quickly and as accurately as possible as the time that you take on the test will be measured. It is essential that you try your best to answer the questions correctly.
2. Watching a video (9 minutes) Please pay particular attention to the video as you will have to complete another test afterwards that tests your knowledge of what is covered in the video.
3. Post-test. You will have a time limit of 10 minutes for the post-test. However, you are encouraged to complete the test as quickly and as accurately as possible as the time that you take on the test will be measured. It is essential that you try your best to answer the questions correctly.
4. Completion of an online survey (10 minutes)

Are there any questions? Your first task is to log-on to ClickUP and access the FRK111 ClickUP page. If you are not sure how to do this, please raise your hand, and someone will help you. At the bottom of the Index on the left of the page, please click on the ‘2018 Orientation Activity.’



Please follow the further on-screen instructions on how to access the various tasks.

Thank you for your participation and co-operation. You are requested not to discuss this activity with other students until Friday at 13.30 when everyone has had a chance to participate.

APPENDIX K: CH 4 PRE-TEST

(15 marks, 10 minutes)

Match the term provided to the correct definition: (6 marks)

1	Asset	**A.**	Used to generate income for the business
2	Equity	**B.**	Value of the business to the owner
3	Liability	**C.**	Amounts owing to other parties
4	Expense	**D.**	Amounts spent on doing business
5	Income	**E**	Amounts earned from doing business
6	Capital	**F**	Amounts invested by the owner into the business

Indicate what the effect is in Rands of the following transactions on the accounting equation. Use + to indicate an increase, and – to indicate a decrease. (9 marks)

7. The owner has a music system for which he paid R25 000. He decides to set up a DJ business to play at weddings.

Assets	Equity	Liabilities
+R25 000	+R25 000	R0

8. The owner received R8 000 for his first wedding. The client transferred the money directly into the business bank account.

Assets	Equity	Liabilities
+R8 000	+R8 000	R0

9. The owner paid R1 000 for a Google advert to advertise his business. He paid by means of an electronic funds transfer out of the business bank account.

Assets	Equity	Liabilities
-R1 000	-R1 000	R0

APPENDIX L: CH 4 POST-TEST

(15 marks, 10 minutes)

Indicate what the effect is in Rands of the following transactions on the accounting equation. Use + to indicate an increase, and – to indicate a decrease.

1. The owner opened a bank account for her taxi business and deposited R100 000 of her own money into the business bank account:

Assets	Equity	Liabilities
+R100 000	+R100 000	R0

2. The owner borrowed R50 000 from her cousin and put the money into the business bank account. Her cousin said she could pay him back after two years.

Assets	Equity	Liabilities
+R50 000	R0	+R50 000

3. The owner bought a taxi for R125 000 and paid for it out of the business bank account

Assets	Equity	Liabilities
+R125 000 -R125 000	R0	R0

4. Owner filled up the taxi with petrol and paid R750 out of the business bank account

Assets	Equity	Liabilities
-R750	-R750	R0

5. Owner deposited the R5 000 fares received from passengers for the first week into the business bank account

Assets	Equity	Liabilities
+R5 000	+R5 000	R0

APPENDIX M: CH 4 SUBJECTIVE EXPERIENCE QUESTIONNAIRE

Cognitive load measurement questions (Leppink *et al.*, 2013, 2014)

All of the following questions refer to the activity you just finished. Please respond to each of the questions on the scale provided.

		1	**2**	**3**	**4**	**5**	**6**	**7**
1 Mental effort/ Total cognitive load	In the activity I just finished (pre-test, video and post-test) I used:	Very low mental effort	Low mental effort	Rather low mental effort	Neither low nor high mental effort	Rather high mental effort	High mental effort	Very high mental effort
2 Intrinsic Load	In the activity I just finished (pre-test, video and post-test), the topic covered was:	Very easy	Easy	Rather easy	Neither easy nor difficult	Rather difficult	Difficult	Very difficult
3 Extraneous Load	The instructions and explanations in the video I watched were:	Very clear	Clear	Rather clear	Neither clear nor unclear	Rather unclear	Unclear	Very unclear
4 Germane Load	The instructions and explanations in the video I watched improved my understanding of the topic:	Very little	Little	Rather little	Neither little nor much	Rather much	Much	Very much

Subjective experience questions (Türkay, 2016)

All of the following questions refer to the activity you just finished. Please respond to each of the questions on the scale provided.

		1	**2**	**3**	**4**	**5**
1. Enjoyment	How much did you enjoy the video?	Not at all	Slightly	Moderately	Very much	Extremely
2. Engagement	How much did you want to continue once the video was over?	Not at all	Slightly	Moderately	Very much	Extremely

APPENDIX N: CH 4 SURVEY QUESTIONS

1. Please indicate which one of the following languages you speak **at home** most of the time:

Afrikaans	isiZulu	siSwati
English	Northern Sotho/Sepedi	Tshivenda
isiNdebele	Sesotho	Xitsonga
isiXhosa	Setswana	Other

2. When did you complete Grade 12? 2017/Before 2017
3. I wrote under the following examination authority in Grade 12: NSC/IEB/Cambridge/Other
4. What was your admission score based on your Grade 12 results?
5. At what level did you take English in Grade 12? Home Language/First additional Language
6. What was your final mark for English in Grade 12?
7. What was your final mark for mathematics in Grade 12?
8. What was your final mark for accounting in Grade 12?

APPENDIX O: PHD TITLE REGISTRATION ORIGINAL

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

POSTGRADUATE COMMITTEE

Tel: +27 12 420 5439
E-mail: stella.nkomo@up.ac.za

Faculty of Economic and Management Sciences

8 September 2016

Prof JL Stainbank
University of KwaZulu-Natal

Dear Professor Stainbank

TITLE REGISTRATION: SE SMITH, STUDENT NO. 04264061

This serves to advise that the title, submitted for the research of the above candidate, was approved as follows at the Postgraduate Committee's meeting on 6 September 2016:

Developing an Accounting discipline based perspective of language use by English second language students in the mainstream accounting classroom

Please note that the next step in the research process is to obtain ethics clearance. In terms of UP Guidelines for Ethical Research (S4083/00), ethical clearance is required before any research may be undertaken.

We wish you success with the project.

Sincerely

pp PROF SM NKOMO
CHAIR: POSTGRADUATE COMMITTEE

cc: Prof A Carstens
Prof M Stiglingh
Student Administration

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APPENDIX P: PHD TITLE REGISTRATION REVISED

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

POSTGRADUATE COMMITTEE

Faculty of Economic and Management Sciences

11 February 2019

Prof L Stainbank
C/o Department of Accounting

Dear Professor Stainbank

TITLE REGISTRATION (REVISED)

This serves to advise that the **revised** title submitted for the research of the candidate indicated below was approved by the Postgraduate Committee:

Student:	**SE Smith**
Student number:	04264061
Degree:	PhD (Accounting Sciences)
Supervisor/Promoter:	Prof L Stainbank
Co-supervisor/Co-promoter:	Prof A Carstens
Approved title:	Social and cognitive dimensions of language in the learning of introductory accounting
Date approved:	8 February 2019

IMPORTANT:
Please note that, if ethics clearance has not yet been granted for the above research, the candidate should apply for ethics clearance before any research may be undertaken.

Sincerely

pp PROF JH VAN HEERDEN
CHAIR: POSTGRADUATE COMMITTEE

cc: Prof A Carstens
Prof M Stiglingh
Student Administration

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