

How do mathematics teachers and learners perceive the role of oral interaction in the teaching and learning of English language learners (ELLs) in year 10 mathematics classes?

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Abstract

New Zealand has recently reached a population of five million. Many of these five million are from non-English-speaking-backgrounds. Consequently, many students from language backgrounds other than English find themselves in content classrooms where English is the dominant language. One of these content classrooms is secondary school mathematics.

This qualitative investigation uses exploratory case study, with two sub-units to examine how mathematics teachers and learners perceive the role of oral interaction in the learning of junior (year 10) mathematics. Data were gathered from two classes in one large co-educational school in the greater Wellington region. Data were collected through two interviews with two teachers, one teacher aide, and five English Language Learner (ELL) students from two year 10 mathematics classrooms. Additional data gathered were gathered through observations, narrative field notes, and artifacts. Data were then analysed using thematic analysis.

There were four key findings. The first of these findings was the importance of personal experiences of learning and using an additional language for staff. These experiences shaped the way staff interacted with ELLs and made them empathetic to the language learners. An additional finding was the significance of relationships in classrooms between teaching staff and ELLs, as well as ELLs and their classmates. The ELLs reported that they flourished when they felt comfortable and confident in their classroom environment. A dominant theme was understanding the language demands of mathematics. Students and staff recognised the importance of moving beyond vocabulary, to learning the language of mathematical concepts. The staff discussed the affordances and hindrances for language learning in the classroom. Staff also recognised the challenges for ELLs in accessing the curriculum, and acknowledged

that full participation was not always achieved. The final finding was that the teacher had a role in supporting oral language for learning mathematics in the classroom.

The findings suggest that teachers need support in recognising the role of language in their subject areas including how to promote oral language. This study recommends that pre-service teacher education should include opportunities for teaching discipline specific language in content areas, particularly in mathematics.

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Chapter 1: Introduction

Introduction

This chapter gives a brief overview of the study, and explains the rationale of the study. The wider context of the study is set out, with reference to the context, internationally, nationally and locally, including the impact of changes in international education resulting from a global pandemic. The research question is stated, and key terms used in this thesis are defined. This chapter justifies the need for this research, and concludes with an overview of this thesis.

Overview of the study

This qualitative study explores the perceptions of mathematics teachers and English language learners (ELLs) of the role of oral interaction in the learning of English language learners in two junior secondary mathematics classrooms. It uses the seven ESOL principles (Ministry of Education, n.d.) to analyse how oral interaction is enacted by two secondary school teachers in their classrooms.

My position as a researcher and motivation for the study

This research arose from my curiosity as a former English for Speakers of Other Languages (ESOL) teacher at a mid-decile secondary school in the greater Wellington region. My school, like many other schools, had a large number of fee-paying international students, with the majority coming from Asian countries (China, Japan, South Korea and Thailand). At the time of this study, there were 50 fee-paying international students, as well as five New Zealand citizens from non-English-speaking-backgrounds (NESB) at my school (Ministry of Education, 1999). The ELL students that I was teaching continually asked me questions about mathematics. Mathematics teachers also asked questions about teaching ELLs. Part of the ESOL teacher role was liaising between content teachers and students, and collaborating with them both. As a new ESOL teacher, and a very recently trained teacher, this sparked questions

for me. I did not expect that these ELL students would necessarily need help with mathematics, as I perceived mathematics as a “universal language”, and the least language-dependent subject (Schleppegrell, 2009) These beliefs were being challenged. These challenges, as well as a feeling of helplessness, led to this study.

Context for the study – internationally, nationally, locally

Numbers of English language learners (ELLs) are growing in New Zealand schools, with more and more students being identified as “linguistically diverse” (Edwards, 2012, 2014; Stacey, 2009). Students who are defined as “linguistically diverse” are often migrants, refugees, or children of migrants (Ministry of Education, 1999) whose strongest language (L1) is not English. Similar growth is occurring in other developed countries, such as the Australia, Canada, the United Kingdom, and the United States (Gibbons, 2009).

International literature recommends integrating ELLs into mainstream education, and promotes interactive teacher practices that support ELLs to transition into content classrooms (such as mathematics and the sciences). For some ELLs, this means immersion into language-rich classrooms, for which they (and their teacher/s) may not be ready (Edwards, 2012).

Ministry documents such as *The New Zealand Curriculum* (2015) and *The English Language Learning Progressions* (2008a) advise teachers that literacy is every teacher’s responsibility, and literacy teaching should not be delegated to ESOL teachers, or other in-school literacy specialists. In addition, to be a registered teacher in New Zealand, educators should be able to modify teaching approaches to address the needs of individuals registered teachers and respect the languages, heritages and cultures of all ākonga (Education Council, 2017).

In Wellington, in 2019, there were more than 25,000 students enrolled in 28 secondary schools. Of this number, more than 660 were fee-paying international students (Education

Counts, 2020). There were also 640 students from non-English-backgrounds supported with ESOL funding in the March round (M. Lawson, personal communication, November 9, 2020). Given that there are difficulties in identifying linguistically diverse students, it is likely that the number of students needing support was much higher than those who were funded. So, how are these ELLs supported in schools ?

Covid-19

At the time of writing this thesis, we are experiencing a global pandemic, Covid-19. In response to Covid-19 the New Zealand borders are closed, which has resulted in a loss of international fee-paying students in all sectors of education. Students who were due to arrive have been unable to travel, and many students in New Zealand have been repatriated to their home countries at their government's request. The lack of international students in New Zealand has led to significant job losses in the international education sector. This has affected universities, private training enterprises (PTEs), as well as primary and secondary schools.

This means that there is less support for existing international students, both pastorally, and academically, and that many key people involved in international education have either been redeployed or made redundant. In secondary schools this has resulted in ELL students losing specialised ESOL classes, and being mainstreamed into content classrooms. Now, more than ever, it is important for subject teachers to understand the language demands of their subjects, and integrate literacy teaching strategies into their subjects, as many ELLs are increasingly reliant on content teachers to learn language as well as subject matter .

Internationally, Covid-19 has resulted in schools closing for varying amounts of time. Schools were also closed in New Zealand. ELLs are disadvantaged by this, as they lose opportunities to interact with friends, with classmates and with teachers (Di Pietro, Biagi, Dinis Mota Da Costa, Karpinski & Mazza, 2020). Lost interactions impact on all stages of language

acquisition, particularly oral language development. School closures also may result in inequality as many essential service workers are migrants (Di Pietro, et al., 2020), which means that they are unable to support their child's learning at home. Internationally, migrants may attend schools with fewer resources, and less qualified teachers, which means that they may enjoy fewer opportunities for online learning than students enrolled at schools with more resources and higher qualified teachers (Di Pietro, et al., 2020).

Definition of key terms

The key terms used in this thesis are: oral interaction, English language learners (ELLs), and junior level. This section will describe each of these terms and include synonyms which are often used in the literature and have similar meanings.

Oral interaction

This refers to interactions between educators and students, and amongst the students in the classroom (Tsui, 2001, p. 120). For the purpose of this study, oral interaction is defined as talk between different groups or individuals in the classroom.

Junior school

The term “junior school” applies to students in years 9 or 10 in secondary school (Ministry of Education, 2021). These students are between the ages of 12 to 15 years old.

English language learners (ELLs)?

The term “English language learner” (ELL) is used in Ministry of Education publications, as well as professional development (PD) in New Zealand, and refers to students from migrant and refugee backgrounds (Ministry of Education, 2008a) who have a language other than English as their home language (L1). English is the second language (L2). I am using this term to refer to children of migrants, students who are migrants and/or former-refugees, as well as

fee-paying international students. It is important to recognise the differences that exist between ELLs, and as educators we do ELLs “a disservice if we think of them as one-dimensional on the basis of their limited English proficiency” (Short & Echevarria, 2004, p. 8). ELLs come from diverse backgrounds, languages, and educational profiles.

There is a large amount of literature about, as well as plethora of labels for, English language learners (Abedi, 2008). Classifiers for ELLs include students with English as an additional language (EAL), who are Emergent Bilinguals (EB), those with Limited English proficiency (LEP), or English as a new language (ENL), and English learners (EL). I use ELL in this study.

Identifying ELLs

Within New Zealand, there are a number of ways in which ELLs are identified, and ways in which this information is shared. Schools in New Zealand are required to have procedures in place to identify ELLs, and to provide appropriate support (Ministry of Education, 1999). *The English Language Learning Progressions* (2008a) emphasises the need for the language proficiency of language learners in years 9 – 13 to be assessed accurately by relevant staff members so that ELLs are able to get access to learning materials and programmes that meet their learning needs (p. 2).

These are some of the ways in which ELLs are identified:

- Information is passed on from primary and intermediate schools when students transition to secondary schools.
- Information may be shared through community links (e.g.; refugee services) with the school.

- Parents may discuss the linguistic needs of their children at enrolment interviews with the year 9 Dean, or other relevant staff members, and together negotiate what additional support may need to be in place.
- Enrolment forms often have questions about ethnicity and languages spoken at home to collect information about students for course planning.
- Teachers may also notice students speaking other languages in the classroom, and make referrals to the ESOL department (or sometimes the learning support department).
- It is important to note that there are many ELLs in secondary schools that do not meet the criteria for ELLs as defined by the Ministry of Education and may not be financially supported in schools. They may spend their time in mainstream classes with no extra support.

Thesis overview

This thesis is divided into six chapters. Following this introduction is Chapter 2 which is a literature review. The literature review establishes a theoretical framework, set in sociocultural theory (SCT), and describes the seven ESOL principles recommended by the Ministry of Education (n.d.) as best practice for ELLs. This chapter also canvasses relevant literature. Chapter 3, the methodology, describes and outlines the research design of this study, which is a qualitative case study with two sub-units. Chapter 4 describes the research findings. The research findings are divided into four themes, with some sub-themes. Chapter 5 discusses these findings, against the seven principles framework recommended by the Ministry of Education (n.d.). Finally, Chapter 6 analyses implications, makes suggestions and recommendations based on the findings from Chapter 5, and draws conclusions.

Chapter 2: Literature Review and Theoretical Framework

Introduction

This literature review will introduce the theoretical framework for this study. It describes aspects of Vygotsky's sociocultural theory (SCT) which underpins this study. It also describes the Ministry of Education's seven ESOL principles. This literature review is organised thematically to analyse four streams of relevant literature: English language learners and content classrooms, English language learners in mathematics classrooms, oral interaction in content classrooms, and finally, oral interaction in mathematics classrooms for ELLs.

Theoretical framework

This study takes a sociocultural view of learning (SCT): that learning is social in nature (Hammond, 2006). Sociocultural theory originated from the work of Lev Vygotsky (1978, 1986, as cited in Gibbons 2009). Through the work of Vygotsky, learning is seen as collaborative, occurring within a specific sociocultural setting. A student's intellectual and linguistic development is viewed as a product of their environment (Gibbons, 2009, p. 15). This means that everyone is able to learn language, and also a second language, but how successfully one learns language is a matter of environment (Gibbons, 2009). Wells (2007) sums this up nicely, with the statement "who we become depends on the company we keep and on what we do and say together" (p. 100).

The aspect of sociocultural theory that most contributes to understanding SLA is Vygotsky's theory of the zone of proximal development (ZPD). The ZPD describes the "gap" between what learners can do alone, and what can be achieved with help (Gibbons, 2009, p. 15), in other words, the zone where learning takes place. The idea of the ZPD has been applied to several different fields, including psychology. In later years, the "help" has been referred to as "scaffolding".

Hammond (2006) and Gibbons (2009) state that scaffolding is important for ELLs, as it allows opportunities to extend their language, and acquire new language. There are three notable attributes of scaffolding. The first is that scaffolding is temporary, which means that the help or scaffold is provisional and assists learners to new levels of understanding, at which time the scaffolding is removed (Gibbons, 2009, p. 15). The second attribute is ‘how and what’. This refers to scaffolds that enable learners to know how to do something, as well as what to do. This means that tasks can be replicated in the future, independently. The third is the future orientation of scaffolding, Vygotsky (in Gibbons, 2009) describes scaffolding as “what a learner can do today support today, he or she will be able to do alone tomorrow (p. 15). Stretched language is a term that is used to describe language scaffolding. This is when students are pushed beyond their current language abilities to move out of their comfort zone (Gibbons, 2015, p. 26).

The Ministry of Education outline seven principles for best practice when teaching ELLs in all subject areas on their TKI website (Ministry of Education, n.d.). These principles are derived from sociocultural theory, and are interactive in nature. The seven principles and their interpretations are:

1. Know your learners

This principle emphasises the importance of knowing who the students are in our classrooms, but also understanding the skills which our students already possess. By having a sound knowledge of the linguistic skills that students already have, teachers are able to build on and extend students zones of proximal development. There are several ways which teachers can gather data to inform practice, such as surveying students when they enter the classroom, or using data from previous schools (if available). By teachers learning about who their students are, teachers are able to plan lessons that are culturally relevant and engaging for their students and simultaneously build relationships. Getting to know students requires interacting with them (Lantolf, 2000). Interaction is an important tenet of sociocultural theory, as interaction can lead to mobility and new opportunities with learning (Lantolf, 2000).

2. Identify the learning outcomes

The principle, ‘identify the learning outcomes’ is two-fold. This means that subjects like mathematics, science, or social studies have content learning outcomes, but also language learning outcomes. Teachers need to have a strong understanding of their subject, as well as the language demands of their subject to ensure that content and language outcomes are clearly transmitted to students. Teachers need to ensure that students can access the language which they need to complete tasks, but also ensure that activities are well-designed and scaffolded to ensure that new language learning opportunities emerge and take place. The scaffold is integral for success, but scaffolding should only be temporary (Hammond & Gibbons, 2005; Gibbons, 2015). The teacher provides the scaffold temporarily, so that the student is able to do the same task in the future independently. Interaction with a more knowledgeable “other” allows scaffolding to occur.

3. Maintain the same learning outcomes for all learners

‘Maintaining the same learning outcomes for all learners’ is about ensuring that all students in the classroom have the same access to the lesson and the learning. This outcome promotes equity in education by ensuring that lessons are accessible, comprehensible and students have opportunities to be involved and participate in their learning. Teachers should adjust their practice and make accommodations for ELLs, so that ELLs have the same access as their L1 peers. This could include differentiation of tasks, or planning activities where students can use their home language. Participation should be a range of forms, such as class discussion, working in pairs, or group work, as well as other mediums, involving speaking, listening, reading, and writing.

4. Make the abstract concrete

The concept of making the abstract concrete is salient for all learners, especially ELLs. This principle requires teachers to link learning to real-life scenarios. By using real-life scenarios teachers are able to make connections to students lives, make learning authentic but also build on students’ prior knowledge. Gibbons (2015) mentions using practical demonstrations or pictures/diagrams to support complex ideas. By giving particular subjects a context (eg; mathematics) students are able to make connections to their learning, and in a sense learning comes alive.

5. Provide multiple opportunities for authentic language use

The principle, ‘provide multiple opportunities for authentic language use’ is about ensuring students have opportunities to notice and use new language in a range of different ways.

Providing opportunities to notice and use new language is key to developing academic language that ELLs need to navigate different subjects in secondary school, such as mathematics. Teachers need to ensure that there are varying activities where students can have multiple opportunities to gain and use new language in a range of situations. Gibbons (2015) discusses that having opportunities to use language allows students to process their own language more deeply.

6. Ensure a balance between receptive and productive language

This principle is about ensuring the ELLs have opportunities to learn in a variety of ways. Teachers should ensure that students have opportunities to read, write, listen and speak in the classroom and that there is not an over reliance on one of these aspects. Opportunities for speaking, listening, reading and writing need to be carefully built into lessons becoming part of the learning routine. By building in scaffolding for such activities, learners are familiar with classroom expectations.

7. Include opportunities for monitoring and self-evaluation

The final principle, ‘include opportunities for monitoring and self-evaluation’ is ensuring there are opportunities for monitoring and self-evaluation. This can be both formal, and informal and may or may not be recorded. These might be presented to the teacher, other classmates, or self. Such strategies provide a range of purposes, which teachers need to make explicit to their learners. An example of an informal use would be ‘think aloud’ strategies, perhaps where a teacher brainstorms different opinions presented on a task. A more formal use of self-evaluation might be an exit slip at the end of the lesson, where students are asked to present their opinion or a PMI (Plus, Minus, Interesting) which students write in their books. The PMI strategy asks students to think and provides opportunities for students to evaluate likes and dislikes. Providing such opportunities allows both teachers and students to think about where gaps in learning might be and re-evaluate further teaching and learning sequences. Hammond (2001) believes teachers need to be critically aware of how their classrooms operate and that by having opportunities for teachers to reflect on students ideas, teachers are offering students recontextualised versions of their own lives.

The four themes will be discussed using supporting literature.

1. English language learners and content classrooms

As a result of globalisation there are more and more students from non-English-speaking backgrounds in education in English-speaking countries, like Australia, Canada, The United Kingdom, The United States and New Zealand (Edwards, 2014; Gibbons, 2009). Many ELLs find themselves in content or mainstream classrooms. Content classrooms, as defined by Gibbons (2009), are classrooms where ELLs learn subjects; such as mathematics, science, social studies and English. This section will include ESOL as a subject, as many ELLs in New Zealand secondary schools spend time in ESOL classes prior to or in tandem with learning in the mainstream. This section will present a brief history of mainstream education, as well as current shortcomings arising from mainstreaming ELL students. This section will also look at some of the approaches that are recommended for teaching ELLs in mainstream classrooms, such as form-focused instruction (FFI), linguistic skills and knowledge that teachers need, as well as pre-service teacher education that supports ELL learning. Finally, the issue of teachers' qualifications is raised, and the focus is then brought back to New Zealand.

ELLs may find themselves in specialist ESOL classes. In these classes, new language learners are immersed in English language which may or may not include subject content, before being transitioned into mainstream content classes (Gibbons, 2009). The concept of ESOL as an option is relatively new in New Zealand, but migration and the advent of fee-paying international students' have prompted schools to expand their ESOL programmes (Gleeson, 2012). In ESOL, students may receive cross-curricular language support or a structured teaching programme to support language acquisition. The role of ESOL teachers in New Zealand is ill-defined, as there is no specific curriculum for ESOL (Gleeson, 2012). However, in recent years, the ESOL principles offer guidance about how to support ELLs in mainstream subject classes (Ministry of Education, n.d.).

The mainstreaming of ELLs in subject classrooms as a concept was first advocated by those who wanted to strengthen multiculturalism (Castles, Kalantzis & Cope in Mohan, Leung & Davison, 2001). It was a move away from focusing on the individual and their differences (deficits) to integrating students into society. Mainstreaming ELLs allowed them access to a wider education, but also meant that mainstream teachers needed to take responsibility for ELLs (Mohan et al., 2001). Mainstreaming has received support from English language educators who wish ELLs to learn the language of the subjects they are studying, as well as those outside the field of English language education (Harper & de Jong, 2009). However, international research (Trahey & Spada, 2020) suggests that mainstream teachers are still unprepared for supporting ELLs in content classrooms.

There are several challenges to successful implementation of mainstream teaching for ELLs (Trahey & Spada, 2020) that are related to implementation and design (Davison, 2001; Leung, 2007). The classroom teacher needs to establish a “rich language learning environment where subject matter and language are taught simultaneously” (Hébert, Guo, & Pellerin, 2008, p. 65). There is also a concern that mainstream teachers are unaware of the academic language demands of their subjects, limiting their ability to teach subject and content (DelliCarpini, 2015). The question also arises about whether one teacher alone is capable of meeting the varying needs of diverse learners in a mainstream classroom context (Trahey & Spada, 2020).

There is a plethora of research of English language teaching in content classrooms, and different theories on best approaches. One of these approaches is based on the work of Krashen (1982, 1985), as language teaching in mainstream classrooms is often based the comprehensible input hypothesis This hypothesis surmises that exposure to meaning-based input that is slightly beyond the learner’s current level of comprehension supports second language development (Trahey & Spada, 2020, p. 219). However, contemporary research

suggests that meaning-based input is not sufficient for L2 learning, and an integrated approach with focused language instruction is necessary.

Trahey and Spada (2020) advocate for form focused instruction (FFI). This method of instruction is described differently in the literature, but FFI recommends that learners' attention is focused on language (form) as well as on meaning. There has been limited research on FFI in high schools, but early indicators acknowledge positive impacts for L2 learners', especially through the use of corrective feedback. FFI is suited to secondary school content classrooms where there are heavy academic language demands in content-subjects like mathematics. Secondary school students are also more likely to benefit from FFI, as they are older, have knowledge from other learning experiences (L1) and have a higher level of cognition (Trahey & Spada, 2020, p. 221). FFI has been found to accelerate learning, and especially support secondary-school aged ELLs to study with a subject cohort.

For ELLs to achieve academically several requirements need to be met. Wong Fillmore and Snow (2000) 's research suggests that their teachers need to have an understanding about language, and this includes knowing about oral language, and written language. They highlight that teachers need skills to enable ELLs to develop academic language, and disciplinary linguistic knowledge. Lucas, Villegas and Freedson-Gonzalez (2008) also find that teachers are best equipped to teach ELLs if they have an understanding of disciplinary language and language acquisition. But what does this mean? Turkan, de Oliveira, Lee and Phelps (2014) define disciplinary linguistic knowledge as:

specialised knowledge base for teaching content to ELLs, teachers' knowledge of the academic discourse of a content area, and the knowledge base that all teachers need to facilitate students' oral and written discourse within a discipline and their use of language that allows them to actively participate in disciplinary discourse (p. 9).

Internationally, there are significant differences in pre-service teacher education about language in terms of duration, and pedagogy covered. However, most ELLs in the United

States are placed in content classes (Harper & de Jong, 2004) and this is similar to the situation in many New Zealand secondary schools. Yet, teachers of these ELLs may not have encountered any learning about disciplinary linguistic knowledge either in pre-service education or as PD.

One example of managing a linguistic focus in a pre-service teacher education programme is described by Davison and Ollerhead (2018). They describe a mentoring programme that was set up by the University of New South Wales that introduced some of the linguistic skills science teachers need to effectively teach ELLs in the content areas to develop scientific literacy. This programme involved 110 secondary school students in years 7 -11 and 35 pre-service teachers. Each pre-service teacher mentored three students for one hour each per week for 14 weeks. The findings from this programme were thought-provoking. Pre-service teachers' had their beliefs challenged, and they were reflective, noticing the linguistic demands of subject specific language.

In the United States, few subject teachers seem to earn both ESOL teaching qualifications, and content teaching qualifications. Besterman, Williams and Ernst (2018) conducted a large-scale quantitative study analysing teaching qualifications of Science Technology and Mathematics (STEM) teachers' qualifications in the United States. They found that very few teachers held English as a Second Language (ESL) teaching qualifications (less than 5%), and that very few teachers had received any professional development for teaching ELLs (less than 25%).

Limited knowledge about language and language acquisition is also an issue in New Zealand, as very few teachers have an understanding of SLA (Edwards, 2014). Edwards found that out of 18 teachers in her study, only three had an understanding of SLA. In addition, very few teachers were aware of/or use resources designed specifically to enhance ELL learning in

content classrooms. These resources have the potential to facilitate teachers in providing high academic challenge, and high support to allow ELLs to thrive (Gibbons, 2015; Hammond, 2006; Walqui, 2007).

In sum, while there are ELLs in content classrooms, the teachers may not be able to cater for the unique needs these students. Research from the United States identifies that few teachers have qualifications for teaching ELLs, and their subject. Pre-service education programmes in Australia have allowed pre-service teachers to develop an awareness of language in the content areas. More research in New Zealand classrooms may identify a similar situation as populations of ELLs continue to increase.

2. English language learners in mathematics classrooms

As mentioned above, ELLs spend much, if not all of their time in content classrooms. One of these content classrooms is mathematics. For ELLs to be successful in mathematics, teachers need to have specific knowledge of language, knowledge of their subject and the demands of their subject and be able to integrate the two (Gibbons, 2009; Tan, 2011). This section will highlight key issues that ELLs face in mathematics classrooms.

Defying misconceptions, we are all teachers of language

Mathematics is often referred to as a “universal language” (Bishton, Gleeson, & Tait, 2009; Schleppegrell, 2009), but this is not actually the case, as students and teachers in New Zealand bring diverse cultures and languages to New Zealand classrooms. In practice, many of the challenges ELL students face in learning mathematics are linguistic (Schleppegrell, 2009). Adoniou and Qing (2014) agree, stating that while arithmetical notations are understood across some cultures, not all are. Mathematics that language learners encounter in school are not language free. This means that teachers need to be able to teach the concepts of mathematics, but also teach the language of mathematics (Bishton, et al., 2009, p. 159). To teach mathematics

effectively, teachers need to plan not only content, but plan the language used to convey that content.

Content teachers often view themselves as teachers of specific subjects, and do not recognise their dual roles of content and language teachers (Edwards, 2014; Kitchen & Gray, 2012; Olson & Truxaw, 2009; Tan, 2011). Neville-Baron and Barton (2005) discuss the need for more empirical research on the relationship between language and content in New Zealand.

What are the specific language demands of mathematics?

The language of mathematics has some particularities that may provide challenges for ELLs. These challenges exist primarily at the vocabulary (word) and syntax (sentence) level.

Vocabulary

Learning vocabulary is important in mathematics, for example, square root and product have the same meaning, as do multiply and times (Moschkovich, 2012, 2013). Arkoudis and Love (2008) find that when students do not know the language involved in mathematics, this can have detrimental effects on self-efficacy, and may lead to underachievement in assessment. One way to teach vocabulary is for teachers to ensure students have ample exposure to the language of mathematics and provide students with what Gibbons (2009) refers to as message abundancies.

Sometimes there is no equivalent for mathematical terms in the students' L1. (Latu, 2005), and transliterations of words may have mixed meanings (the example given is the word square). Crosson, Hughes, Blanchette and Thomas (2020) use the example of the English word corner. In Spanish, this can be translated to *rincó*, meaning inside corner, and *esquina* meaning outside corner (Crosson et al., 2020 p. 85). This kind of difference can also operate where the home language might be translated two or more different ways into English.

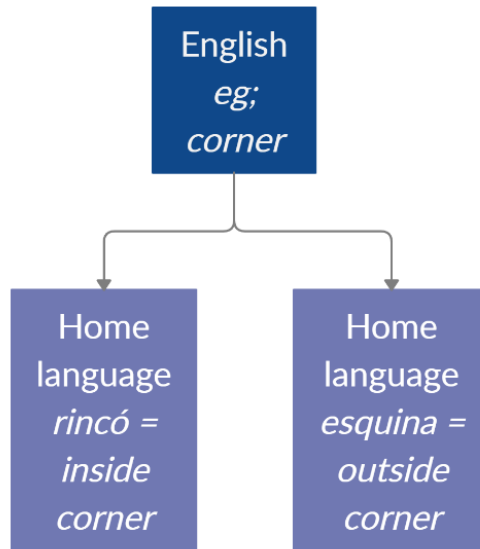


Figure 1: Diagram showing multiple meanings of vocabulary.

It can also be confusing for ELLs when words, like table, have both academic meanings and everyday meanings (Logan & Kieffer, 2017).

Research suggests that ELLs are disadvantaged in mathematics because of vocabulary, but often students themselves are unaware of this. Barton et al. (2005) noted that this disadvantage may be up to 15%. Crosson et al. (2020) concur with this, and offer detailed examples of vocabulary challenges in their multiple meanings small-scale study.

Syntax

As well as vocabulary challenges, there can be challenges from the specific syntax of mathematics.

Syntax poses problems for ELLs when reading and interpreting word problems (Kersaint, Thompson & Petkova, 2014), and when words need to be translated into numbers and symbols. When the teacher dictates problems orally to the students there are two possibilities. ELLs may have difficulty when translating oral language to written language and create inversion errors (Kersaint et al., 2014). An example of this is 648 divided by 8. If the student chooses to write this as a long division question, then they may write the problem as 8

÷ 648 (Irujo, 2007, p. 4). These types of problems take a lot of time and practice to learn and get right and are not unique to ELLs.

The use of passive voice is another syntactical challenge that can also be problematic for ELLs (Irujo, 2007; Kersaint et al., 2014). Many word problems are presented using passive voice, eg; How much change should she have received? (Irujo, 2007, p. 4). This is a specifically academic example of syntax that is rarely used in conversation or out-of-school contexts.

There are several New Zealand studies that illustrate the particular challenges of mathematical syntax for ELLs (Anthony & Walshaw, 2007). Neville-Barton and Barton (2005) administered two mathematics tests for Chinese-Mandarin speaking students in New Zealand. They found that students performed 15% better in the Mandarin test, than the English test. Their findings suggest that mathematical discourse presented challenges for ELLs in terms of word order, prepositions and the expectation that the learner would be able to interpret information from unfamiliar contexts (Neville-Barton & Barton, 2005). Latu (2005) found that Pasifika students in New Zealand also had difficulty understanding syntax in senior mathematics (years 11 – 13). Word problems involving mathematical implication and logical structures such as conditionals and negations were challenging in Latu's (2005) study, questions including word if, or no, never, not are examples. These are two evidence-based studies from New Zealand, which include examples of syntactical challenges.

Translanguaging in mathematics

Teachers who allow ELLs opportunities to solve problems in their first language (L1), and to discuss problems in their L1 with fellow students and support staff demonstrate that the home languages are resources not burdens (Moschkovich, 2013). Research suggests that using the home language in their learning can support student understanding in mathematics (Anthony & Walshaw, 2007; Latu, 2005). Gutiérrez's (2002) study based in the United States analyses

some of the complexities of teaching mathematics to Latina/o students. This study looked at three teachers who understood the how using the L1 can enhance learning content in the L2. They encouraged students that chose to use their home language, Spanish to solve problems, and also students who chose to use English over Spanish to solve problems. The teachers had flexible approaches, and viewed language (home language or other) as a strength. These teachers did not enforce arbitrary rules about using language, but acted out of their strong relationships with students, genuine understanding and empathy. This led to increased self-efficacy for students in these mathematics classrooms.

Using multiple familiar languages can support learners to understand concepts in their new language (Latu, 2005). For this reason, bilingual staff can be an asset to ELLs. Latu (2005) discussed two teachers switching between Tongan and Samoan, which supported their Tongan and Samoan speakers to understand mathematics. Neville-Barton and Barton (2005) discuss the need for more research into the use of first languages in classrooms to solve mathematics problems in New Zealand.

The New Zealand culture of teaching mathematics

Building on prior knowledge is essential for all learners, but particularly essential for ELLs. By building on prior knowledge, teachers are recognising and listening to past experiences of learning. This can be challenging, as mathematics curricula differ globally (Anthony & Walshaw, 2007). In New Zealand for example, much of the curriculum is context-driven (Anthony & Walshaw, 2007), and includes word problems. This approach is not favoured in other countries. Teachers should consider these differences when planning teaching and learning sequences for ELLs, as their ELL students may not have been exposed to word problems in their prior mathematical learning.

English language learners and university mathematics

Learning mathematics in context in secondary school appears to support ELLs' achievement in university level mathematics. Barton et al. (2005) investigated undergraduate English language learners studying mathematics at the University of Auckland. They found that students that had studied secondary level mathematics in New Zealand tended to be successful in 100 level papers, as there were similarities (language used, and repetition of terms) between 100 level mathematics and secondary school mathematics (years 11 – 13). Lecturers used familiar teaching strategies such as providing lecture notes/powerpoints with explanations, as well as multiple examples. Mathematics became more challenging for students as time progressed, and the third year was particularly challenging. Barton et al. (2005) found that the students might have been increasingly challenged because there were more one-off examples, and contexts were unpredictable (students lacked familiarity with context). Barton et al. (2005) suggest that universities need to address these language issues for all language learners (not just fee-paying internationals). Different universities are trialling different strategies, such as providing tutorials in Mandarin and Tongan, but the success of these have not yet been measured. This shows that the challenge of learning mathematics is not limited to primary or secondary school.

In sum, for ELLs to thrive in mathematics classrooms they need to have teachers that know how to teach the concepts of mathematics, as well as the language of mathematics. They need to have teachers that plan content objectives, and language objectives (Kersaint et al., 2014, p. 49). Vocabulary is important, but teaching vocabulary is only one aspect of language. The syntax of mathematics is unique, and needs to be explicitly taught to ELLs. Mathematics teachers need to provide students with opportunities to learn language, such as allowing ELLs to use L1. Having bilingual staff in schools is beneficial to ELL learning and can support language development. Mathematics curricula vary globally. In New Zealand context

embedded tasks are commonly used within the mathematics curriculum (Anthony & Walshaw, 2007). ELLs bring different contextual knowledge from their home backgrounds. Teachers should build on prior knowledge to make sure tasks are accessible.

3. Oral interaction in content classrooms

Oral interaction is important for ELLs to develop skills needed to participate in classroom learning. There are some important underlying principles that support students in understanding what is being said such as having abundant exposure to L2 that is just a little demanding for them to follow (Gibbons, 2015; Harper & de Jong, 2004). Krashen (in Gibbons, 2015, p. 24) refers to this as comprehensible input. Research suggests that comprehensible input should not be interpreted to mean simplified language, as there needs to be challenge to stretch students' language, and allow for growth in students' ZPD (Hammond, 2006; Gibbons, 2015).

There is a common misconception that ELLs will simply pick up the language they need for learning, and that exposure to language and interaction with first language users will be sufficient for language development (Harper & de Jong, 2004). This is not the case, and it is important to recognise differences between 'good pedagogy' for mainstream classes, and 'good pedagogy' for ELLs (Harper & de Jong, 2004). ELLs need specific scaffolding to acquire new language.

Structured group discussions can scaffold oral language development for ELLs (Chappell, 2014). In these types of conversations, the teacher may nominate a topic, and monitor or scaffold the type of talk which is happening. Gibbons (2007) discusses how this type of interaction helps students to learn the specific registers and vocabulary needed for subject learning. Barwell (2005) gives an example of a conversation between two students, Farida and Parveen where they scaffolded one another's learning by questioning and correcting

one another. By working through this problem as a pair, they were much more successful than working as individuals.

Interaction with a teacher can shape the accuracy of an ELL's language use. Sharpe (2008), and Gibbons (2009) discuss the importance of recasting students' ideas. Recasting is when a teacher accepts the student's original response or answer, but modifies this when they repeat it back to the class. Through using this technique, students are able to notice grammatical structures, and acquire register-appropriate language. Gutiérrez's (2002) study, illustrates how this worked in class when one of the teachers working with ELLs would restate language in a way that was understandable to the ELL. This is an approach that allows students to gain access to the language of mathematics.

In sum, there are several different types of oral interaction that teachers can use with ELLs, such as structured discussions and recasting. Different types of interactions have different purposes, but support ELLs in developing oral fluency.

4. Oral interaction in mathematics classrooms for ELLs

Several different types of interactions that occur in classroom discourse have been discussed in the previous section (3). This section will look at specific types of interaction that occur in mathematics classrooms and can be beneficial to ELLs. These are teacher explanations, classroom movement, mathematical discussions and group work.

Teacher explanations may play an important part in developing discipline specific oral language in mathematics classrooms. Veel (1999) reports that the mathematics teachers are the ones that do most of the talking in the classroom. This suggests that the teacher is the one who is making connections between textbooks, and tasks and it is less clear how students interact with the mathematics materials and one another.

Similarly, the teachers' position in the classroom may impact on opportunities for interaction individually with students. Clarke (2004) conducted a study in Australia to look at teacher goals and classroom interactions. He found that the Australia teachers investigated liked to walk around the class. He identified that walking between desks offered: firstly, an opportunity for the teacher to interact with every student in the class, secondly, a chance to check on participation and engagement and finally, the teachers were able to probe and elicit answers from individual or small groups of students.

The opportunity to talk about mathematics appears to play a significant part in learning mathematics. Adoniou and Qing (2014), González and DeJarnette (2012), and Gough (2007) and Turner (2011) argue that discussion is crucial for developing the cognitive skills needed to be successful in mathematics. Mathematical discussions improve how students understand mathematics, how students communicate ideas mathematically and supports the growth of mathematical ideas. For discussion to be successful in mathematics, it needs to be structured and monitored to allow for scaffolding. Without the structure and monitoring of discussion ELLs may struggle to make sense of the task. This is especially important if teachers use both formal and informal terms in an effort to clarify a new concept. Adoniou and Qing (2014) share examples of multiple expressions in mathematics with the same meaning, for example; "take away", "minus" and "less than". If this is not made explicit to ELLs it can be a further stumbling block.

Through listening to and talking to the teacher students are given opportunities to learn the technical language of mathematics. Through discussion there are multiple chances for students to display their mathematical knowledge (Oliveira, Meskill & Yasrebi, 2020). Another role that mathematical talk can play in learning, is that it can be used to apprentice novice learners into a new community of practice. Schleppegrell (2007) highlights the importance of more knowledgeable students' and teachers' talk to apprentice students. She believes it is

important to allow students opportunities to use the mathematical register in interactive activities to develop the register (p. 147). This kind of apprenticeship can also operate in structured group work. For group work to be successful there needs to be clear organisation and instructions from the teacher. Studies have shown that classrooms that are organised for group work can have positive impacts on diverse learners (Thornton, Langrall & Jones, 1997). When students are working with friends in groups, they are more confident to take risks. Group work can also provide students opportunities to develop mathematical thinking, knowledge construction, as well as mathematical self-efficacy (Diezmann & Watters, 2001).

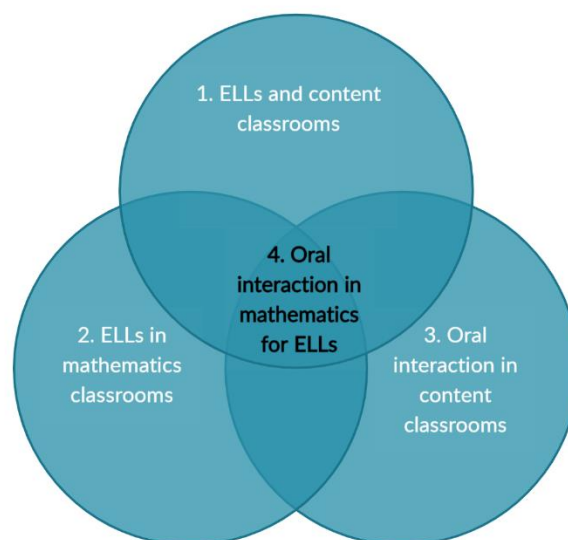


Figure 2: Oral interaction in mathematics classrooms for ELLs

The above diagram illustrates where oral interaction in mathematics classrooms for ELLs fits within this study.

In sum, many different types of interaction occur in mathematics classrooms. These include interactions with teachers, interactions with peers, but also group work. The role of the teacher in interaction is significant, as it is the teacher's role to scaffold mathematical language from textbooks and tasks using comprehensible language. The teacher acts as a bridge between technical vocabulary and syntax and the language needed for ELLs to complete tasks. Moving

around the classroom can enhance interaction between the teacher and students and allow power to be shared. When teachers walk around the class, they have the opportunity to interact with every student in the class. Structured mathematical discussions are important for developing the language of mathematics because as teachers monitor discussion, they are able to recognise language demands which need to be decoded for individual students. Group work is also beneficial, as it can promote mathematical self-efficacy, as well as joint knowledge construction. The role of interaction in mathematics classrooms is requires further understanding through research as the number of ELLs in mainstream mathematics classes increases.

The purpose of this research is to answer the research question (below), which seeks to understand how oral interaction in mathematics can be beneficial to ELLs in junior secondary school.

Research question

How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) at junior secondary school?

Summary

To summarise, this study is set in a theoretical framework based on Vygotsky's sociocultural theory. The Ministry's seven principles for best practice with ELLs will act as a framework in the discussion chapter. This literature review examined four streams of literature thematically. There are many ELLs in content classrooms in English speaking countries as a result of globalisation. To cater for ELL needs, content teachers need to recognise their dual responsibility as teachers of language and content. Another content class that ELLs participate in is mathematics. Mathematics present ELLs with unique challenges and specific language demands of vocabulary, and syntax. Teachers allowing students to translanguage in mathematics affirm their learners' home languages and recognise these as resources. New

Zealand has a unique mathematical curriculum in which mathematical problems are context-embedded. This can create challenges for ELLs, especially when building on prior knowledge. It is important for teachers to take these differences into account when planning teaching and learning sequences. After finishing secondary school, many ELLs study at New Zealand universities. Research suggests that there are similarities between language used in secondary mathematics and some undergraduate courses. Another stream of literature is oral interaction in content classrooms. Scholarship looks at identifies structured group discussions and appropriating/recasting student language as means to support ELLs in gaining oral fluency. There are interaction techniques mathematics teachers can use in the classroom to support content and language learning. Teacher explanations, moving around the classroom, group work and mathematical discussions are examples.

Chapter 3: Methodology

Introduction

This chapter describes the methodology used in this study, including the theoretical framework set in sociocultural theory (SCT). It begins with a description of qualitative methodology – describing and justifying why a qualitative approach was selected. This chapter explains who the participants were, how they were selected, as well as ethical considerations in the research process. Finally, this chapter discusses how data were analysed as well as benefits and limitations of this research design.

Qualitative methodology

A qualitative approach was selected for this research for the following reasons:

- To align with the research question; investigating ‘how’ (Fraenkel, Wallen & Hyun, 2015).
- To achieve a holistic understanding of the classroom and interactions happening in that space (Johnson & Christensen, 2017).

Qualitative research seeks to understand a problem (Creswell, 2014). My study seeks to understand how teachers and learners perceive the role of oral interaction in the learning of mathematics at junior level and how oral interaction in junior mathematics classrooms promotes learning for ELLs.

Qualitative researchers can have different roles (Creswell, 2014). As a teacher, I am familiar with New Zealand secondary schools and this allowed me to gain entry to the research site and confidently talk with a range of people about their perspectives. I took a holistic approach and used a range of qualitative instruments; observations, narrative field notes, artifacts, and interviews.

Case study

I selected case study as the approach for this study, as case study:

- Investigates ‘how’ (Stake, 1995; Yin 2018).
- Captures complexity (Stake, 1995).
- Focusses on individuals, their beliefs and the decision-making processes.
- Provides rich descriptions.

Stake (1995) and Yin (2014, 2018) describe how case study is best suited to research questions investigating how and why. For this reason, exploratory case study is used as it is an “empirical inquiry that investigates a contemporary phenomenon (the ‘case’) within its real-life context, especially when the boundaries between phenomenon and context may not be clearly evident” (Yin, 2014, p. 16). The phenomenon of this case is the perceptions of the role of interactions in two mathematics classrooms.

The two classes were the sub-units of this case, which was bounded by the students and educators inside these classrooms (Merriam & Tisdell 2016; Smith 1978; Stake, 2006; Yin, 2012). Two classes were selected to ensure that the data were manageable (Stake, 1995). Since four rich sources of data (interviews, observations, narrative field notes and artifacts) were used, they can be compared and contrasted (Creswell, 2014; Johnson & Christensen, 2017).

By using exploratory case study, I was able to offer individuals (students and educators) the opportunity to share their thoughts, beliefs and decision-making processes which shed light on their experiences in the classroom (Yin, 2012). As this research seeks to understand the role of oral interaction in mathematics classrooms, exploratory case study (investigating the how and why) was the best fit (Yin, 2012).

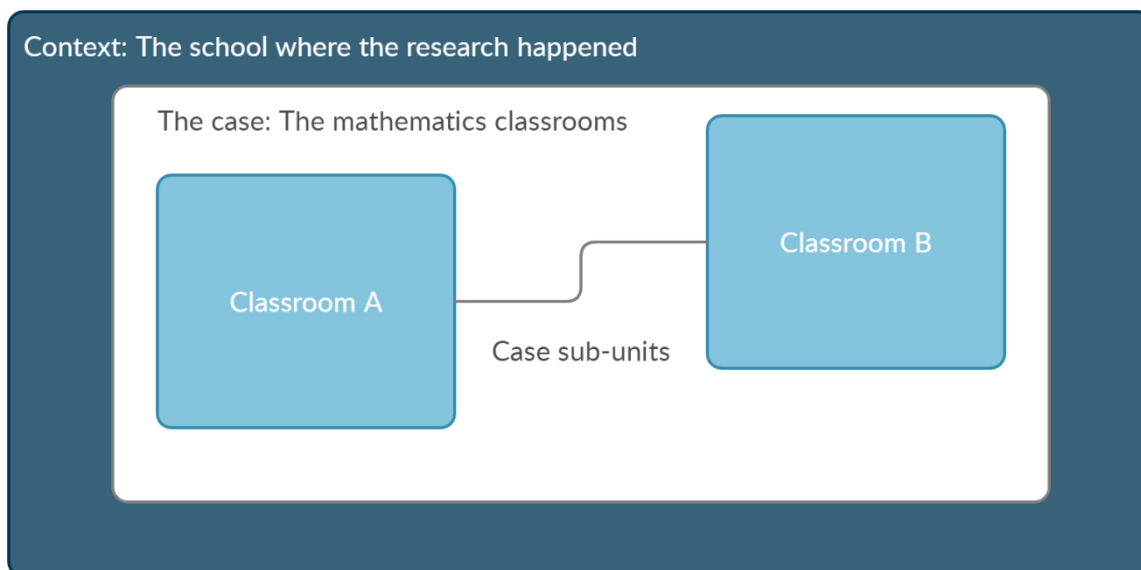


Figure 3: Diagram of the case study design

The above diagram is adapted from Yin (2009), p. 46. It illustrates how the two sub-units (classroom A and B) fit within the case (the mathematics classrooms), within the wider context of the host school.

Why two classes – in one case?

- Manageability of participants and data.
- Availability (researcher and classes).
- Challenges with recruitment; having to change from a senior secondary school setting to junior setting.
- Boundaries of time – a few weeks remaining in the school year.

Context

The data were collected from one large (more than 1000 students) co-educational state secondary school in the Wellington region. The school is predominantly Pākehā (non-Māori), with Pākehā making up almost 60% of the roll. Like many schools in urban settings, this school also had fee-paying international students, migrant and refugee students, as well as NZ-born

language learners. The data were collected from two year 10 mathematics classrooms (the sub-units of the case).

Recruitment and participants

The purpose of this study was to gain insight into how mathematics teachers and English language learners perceive the role of oral interaction in the learning of ELLs, so I used purposive sampling to recruit participants (Creswell, 2014; Johnson & Christensen, 2017). Purposive sampling occurs when a researcher identifies the kinds of participants who are most likely to contribute to an understanding of the phenomenon and then locates individuals or schools that meet those characteristics (Creswell, 2014; Johnson & Christensen, 2017, p. 268). The potential participants were teachers of mathematics and English language learners who were studying mathematics in secondary schools in the Wellington area.

I approached principals of schools with over 800 students because there would be a bigger pool of mathematics classes than at smaller schools. While some principals agreed, some heads of faculty declined on behalf of the teachers because of workload pressures on the teachers. Eventually because the data collection was scheduled near the end of the year when there were assessment pressures in senior school, I decided to recruit teachers of junior mathematics classes. I applied for and was granted an amendment to the original ethics approval.

The principal of one school then forwarded information about my study to the Head of the Faculty of Mathematics. Two teachers responded and were interested in participating in this study. I was then invited into their classrooms where I explained my study to their mathematics students. In the two classrooms, there were five ELL students that participated in all aspects of this research, including focus group interviews.

Participants

Table 1: Overview of participants

Participants	Teacher A	Student One	Student Two	Student Three	Student Four	Teacher B	Teacher Aide	Student One
Home language	English	Tagalog	Hindi	Fijian Hindi	Farsi	English	English	French German
Other languages	Spanish	English	English	English	English	Korean	Spanish Māori	English
Experience overseas	Lived in England	Lived in Philippines	Grew up in NZ	Lived in Fiji	Prefer not to reveal	Lived in South Korea	Lived in South American countries	Lived in France
Teaching/learning experience	15 yrs teaching	Learned math in Philippines	Learned math in NZ	Learned math in Fiji	Learned math in NZ	Experience in South Korea, and less than one year in NZ	Volunteer work in central America	Learned math in France

Data collection methods

A qualitative approach requires the collection of non-numerical data, such as words and pictures (Fraenkel et al., 2015; Johnson & Christensen, 2017). I used the following methods to collect data: semi-structured interviews, observations, narrative field notes, focus group interviews, and artifacts (documents). Each of these sources (described below) contributed to the richness of both data and context (Fraenkel et al., 2015, p. 425). Data collection occurred in the last weeks of Term 4, 2019, at the same time as NCEA external assessments.

Observations and narrative field notes

Observations and narrative field notes gave me a feel for the school environment and the classes, allowing me to observe and record non-verbal behaviour (Cohen, Manion & Morrison, 2007; Creswell, 2014). Classroom A, and Classroom B were observed twice. A cell-phone was used to audio record the observations, and I transcribed these notes and audio-recordings. I

made narrative field notes in a notebook, and included information about the layout of the room, technology used in the room, and events, activities and people (Creswell, 2014). These were descriptive and reflective (Creswell, 2014).

By observing the classes before interviewing the students in the focus group, I was able to start to develop a presence with students so they knew who I was prior to the focus group interview (Cohen et al., 2007; Creswell, 2014). This trust between the teacher, and me as an observer reassured the students when I was interviewing them later for the focus group interviews.

A benefit of the narrative field notes and observations was that I began to understand the space, and I record behaviour as it was happening (Creswell, 2014). These notes were useful when interviewing all participants, as I was able to recall specific events, and ask detailed questions about behaviour, decision-making and language use.

A limitation in gathering data from observations and narrative field notes was the difficulty of recording. The narrative field notes were challenging to record, and took time to transcribe (Cohen et al., p. 260). The observations were also challenging to transcribe, because of classroom noise in the audio and my lack of familiarity with mathematics as a subject.

Semi-structured interviews

Semi-structured interviews were used because they are a way in which the researcher can enter the inner world of another person and understand someone else's perspective (Patton, 1987). Fontana and Frey (2000) concur that interviews are "one of the most powerful ways in which we try to understand our fellow human beings" (p. 645). Semi-structured interviews were used as they are open, and allow for a feeling of trust, and allow the researcher to gain a rapport with the participant (Kvale, 1996; Johnson & Christensen, 2017).

I used semi-structured interviews to interview teacher A, teacher B, the teacher aide and student 1 from classroom B. In my pre-observation interviews, I asked participants about themselves, their teaching experience, and opinions (Fraenkel et al., 2015). I listened carefully to the participants' responses as Creswell (2014) discusses the importance of listening without injecting personal opinions. In post-observation interviews, I drew on observations and narrative field-notes to ask questions about the educators' decision-making, lesson and learning objectives, and beliefs (Fraenkel et al, 2015). By drawing on observations and narrative field notes in post-observation interviews, I was also able to get clarity as a researcher (Johnson & Christensen, 2017).

The interviewer conducting semi-structured interviews can be critiqued for leading the participant towards the focus of the research. This was mitigated by using open-ended questioning to "indicate an area to be explored without suggesting to the participant how it should be explored" (Fraenkel et al., 2015, p. 453).

Focus group interviews

Focus group interviews were used to collect data from the ELL students, the group of interest (Cohen et al., 2007; Johnson & Christensen, 2017). The four students from classroom A were interviewed together during their mathematics lesson. This interview was recorded using a cell-phone and the audio-data were later transcribed.

The focus group interviews were used to collect a shared understanding from students, as well as specific views on the mathematics classroom and the oral interaction in these classrooms (Creswell, 2014, p. 240). I found the focus group interview was also useful in that students were able to bounce ideas off one another, and this triggered further discussion (Johnson & Christensen, 2017). The data emerged through students' interactions with one

another, and through open-ended questioning (Cohen et al., 2007). In classroom B, only one student participated, so this student was interviewed individually.

I acted as a moderator in the focus group, and students agreed on a set of ground rules (Johnson & Christensen, 2017). The ground rules included respecting one another, keeping confidentiality, and information about how the interview was recorded (see appendix 8). As a moderator, I ensured that the discussion was balanced, and the four students interviewed from classroom A all had opportunities to participate in the discussion and voice their opinions (Cohen et al., 2007; Johnson & Christensen, 2017; Kvale, 2007), and their individual viewpoints (Cohen et al., 2007; Kvale, 2007).

As it was almost the end of the school year, I was under pressure to finish my own teaching responsibilities at the same time as I had to finish data collection. Cohen et al. (2017) and Creswell (2014) highlight one of the advantages of focus group interviews as being timesaving, which was definitely the case in conducting research near the end of the school year. Using a focus group was also advantageous as it would have been challenging contacting individuals, organising a time, and organising a space in the host school.

Artifacts

Teacher A and teacher B were each given a pie graph to illustrate their thoughts about interactions in their classroom. They were asked to colour in various sections to show the classroom interactions (see appendix 10). This was also used in post-observation interviews with the teacher as well as providing a prompt in focus group interviews with students.

Students were also asked to complete a ranking activity (1-5) describing what types of interactions they prefer in mathematics and indicating their priorities (Cohen et al., 2007). One disadvantage of using this was that some students could not differentiate their responses, or possibly did not feel strongly enough about the activity to make such distinctions (Cohen et al.,

2007, p. 325). This was mitigated by allowing flexibility, and giving students' ownership of their choices, and allowing two items to be ranked as a 3 et cetera. This allowed students to express their feelings (Cohen et al., 2007). This ranking activity was also used as a prompt for asking questions in the focus group interview and in the post-observation teacher interviews. By having one more source of data collection I was able to triangulate data, which leads to trustworthiness in qualitative studies.

Table 2: Overview of data collection 13th November 2019 – 9th December 2019

Data Sources and Participants	Pre-observation Interview	Post-observation Interview	Observation 1 and Narrative Field Notes	Observation 2 and Narrative Field Notes	Artifact	Focus Group Interview
Classroom A			✓	✓		
Teacher A	✓	✓			✓	
Student 1					✓	✓
Student 2					✓	✓
Student 3					✓	✓
Student 4					✓	✓
Classroom B			✓	✓		
Teacher B	✓	✓			✓	
Teacher Aide		✓				
Student 1					✓	✓

Data analysis

Data were analysed using thematic analysis, which is a flexible and accessible approach to analysing data (Braun & Clarke, 2006, 2012). Thematic analysis is a method for identifying, analysing and interpreting meaning ('themes') within qualitative data (Clarke & Braun, 2017, p. 297; Braun & Clarke, 2012). Thematic analysis allows the researcher to see and make sense of collective and shared meanings and experiences (Braun & Clarke, 2012, p. 57).

After data were collected, I imported the transcripts into a software programme, NVivo12, designed for qualitative research (Bazeley & Richards, 2000). After data were imported into NVivo, I read and re-read the transcripts and I assigned initial codes (Braun & Clarke, 2012). To familiarise myself with my data, I also listened to my interviews while driving between my school and my research site. Braun and Clarke (2012) discuss the importance of immersing oneself into the data by either reading or listening to data.

These initial codes were succinct, descriptive (Braun & Clarke 2012) and were gerund orientated (Spence, 2017). Gerund orientated codes reflected the livelihood of the classrooms, where data was collected (Braun & Clarke, 2006) and conceptualised the codes as active rather than static.

NVivo software is quite flexible, so I also created memos when I could not think of a code to explain my thought process. After scanning the initial codes (about 50), these were then exported to a pdf and printed.

After printing initial codes, and looking at data that had been coded under each code, a culling process began. Some codes were deleted, some codes were collapsed, and some codes became part of a family. Data was re-read and themes started to emerge from the data (Braun & Clarke, 2012). Overlap and similarity emerged between codes, and the pieces of paper that had been printed were clustered together (Braun & Clarke, 2012).

This process resulted in 17 candidate themes. After long conversations with my supervisors, we discussed several questions and I pondered the following questions from Braun and Clarke (2012, p. 65).

- If it is a theme, what is the quality of this theme (does it tell me something useful about the data set and my research question)?
- Are there enough (meaningful) data to support this theme (is the theme *thick* or *thin*)?
- Are the data too diverse and wide ranging (does the theme lack coherence)?

I managed to narrow down to four themes:

1. Learning an additional language.
2. Developing relationships.
3. Understanding the language of learning mathematics.
4. Teaching that is supportive of oral language development.

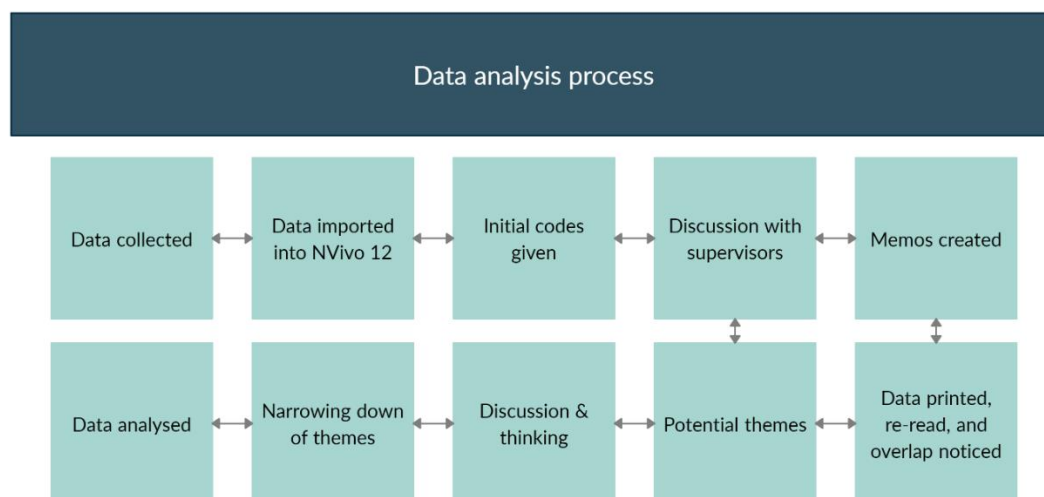


Figure 4: Data analysis process

The above diagram is based on Braun and Clarke's (2006, 2012) six phase approach to thematic analysis. The diagram shows the iterative process (back and forth) of qualitative research.

Limitations

Challenge of recruiting participants

It was difficult to recruit participants (schools, teachers and ELLs) for this study. This led me to change the classroom context – from senior classes to junior. I was only able to recruit one school, and two classrooms in that school. This resulted in a limited number of ELL participants in one of the classes.

Time constraints

As data collection occurred at the end of the school year, I faced several time constraints. I had originally planned to do three observations, but this was not possible due to my responsibilities at my own school, and end of year curriculum planning at the host school. As a result of this, I was unable to collect as much data as intended. NCEA external examinations were also running parallel to research collection, which meant room changes for both of the observed classes. As neither of the classes were in their usual classroom, Teacher A and Teacher B did not insist on their normal seating plans. This meant that classes had more freedom than at other times during the school year.

Trustworthiness

Within qualitative frameworks several key concepts need to be employed to ensure trustworthiness. These are: credibility, transferability, dependability, and confirmability (Shenton, 2004).

Credibility

To ensure that this research was credible, I used well established research methods (Shenton, 2004). After data were collected I had frequent debriefing sessions with my supervisors. I

employed member-checking, and interview transcripts were shared with the educators that participated in this study (Creswell, 2014; Johnson & Christensen, 2017; Lincoln & Guba, 1986).

Transferability

The findings of qualitative research, and case study are particular to specific environments and participants (Shenton, 2004). Denscombe (1998) suggests that although each case is unique it is still a representation of a broader group, so transferability should not be eliminated. To ensure transferability, I made that my data was “thick and descriptive” (Lincoln & Guba, 1986, p. 77.) so that others will be able to identify any parallels with their own teaching and research environment.

Dependability

To ensure dependability in this study, I used a wide-range of data collection methods. This resulted in overlapping data sources (observation, interviews, focus group interviews and artifacts) (Shenton, 2004). This study is also reported in detail, which means that it could be re-created by other researchers.

Confirmability

Lincoln and Guba (1985) discuss the importance of ensuring that data and interpretation of the study are grounded in the events, as opposed to my own construction (p. 324). To ensure this, I have made the research process transparent. Confirmability is shown through the range of data collection methods (see table 2). Confirmability is demonstrated by connection between data collection and analysis (see findings chapter). Thorough appendices are also provided. I acknowledge my role as a qualitative researcher through reflexivity (Johnson & Christensen, 2017). I was reflective, self-aware and had frequent discussions with my supervisors.

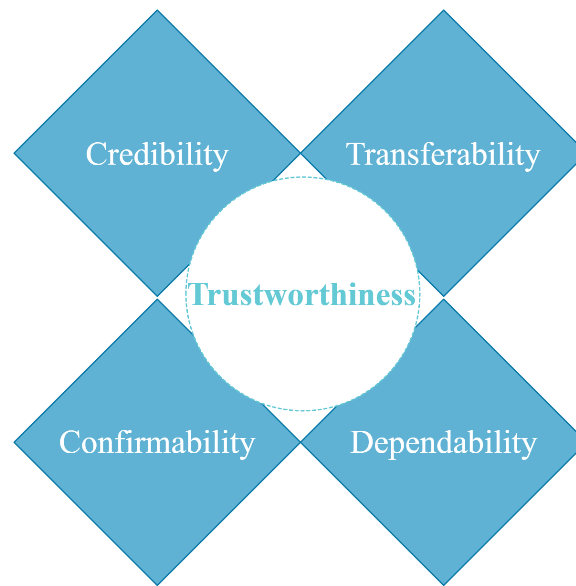


Figure 5: Steps to ensuring trustworthiness

The above diagram highlights the key steps that I took as a researcher to ensure trustworthiness.

Trustworthiness is at the centre of this study.

Ethical considerations

Creswell (2014) and Johnson and Christensen (2017) discuss key principles for maintaining ethics in qualitative research. These are maintaining confidentiality, gaining informed consent from participants, storing data securely, doing no harm to participants, and maintaining respect for the research site and participants. These align with Victoria University of Wellington's Human Ethics Policy (2019). This is what I did to ensure this study was ethical:

- This research was approved by Victoria University of Wellington's Human Ethics committee, and adheres to Victoria University of Wellington's Human Ethics Policy (Victoria University of Wellington, 2019). When I could not recruit participants for the original ethics proposal, an amendment was made, and approved which allowed me to conduct research with people under 16 years of age (see appendix 1).

- All participants involved in this research gave their informed consent (see appendix for consent forms). They voluntarily entered the study. This included the principal of the school, the educators involved in this study, the students present during classroom observations, students that participated in focus group interviews as well as parents/caregivers. As I was seeking consent from English language learners, and their families are from non-English speaking backgrounds, I gave them the option to have these forms translated into their home language, or for an interpreter call and explain the study. They did not take this option.
- As the researcher, I made every effort to keep the identity of the school and research participants' confidential. This was done through ensuring data were secured by using a password protected cell-phone and laptop, physical data were stored in a locked drawer, and only sharing information about participants either with the participants themselves, through member-checking, or with my supervisors (Johnson & Christensen, 2017). This also included using pseudonyms for participants.
- All participants were free to withdraw from this study up until 20th December 2019 when data analysis would begin. Students in the focus group were free to withdraw from the focus group but could not retract information shared during the focus group interview as that was part of discussion shared with other students.

Summary

This chapter has described the methodology of this qualitative case study. It has explained why one case was selected, with two sub-units. The context and participants have been outlined, as well as ethical issues involving research with minors and research in schools. Trustworthiness, and limitations of the study have been described. The following chapter outlines the findings of the study, using thematic analysis.

Chapter 4: Findings

Introduction

I use thematic analysis to uncover the four themes that emerged and were analysed from the data. The figure below gives an overview of the themes and their associated sub-themes.

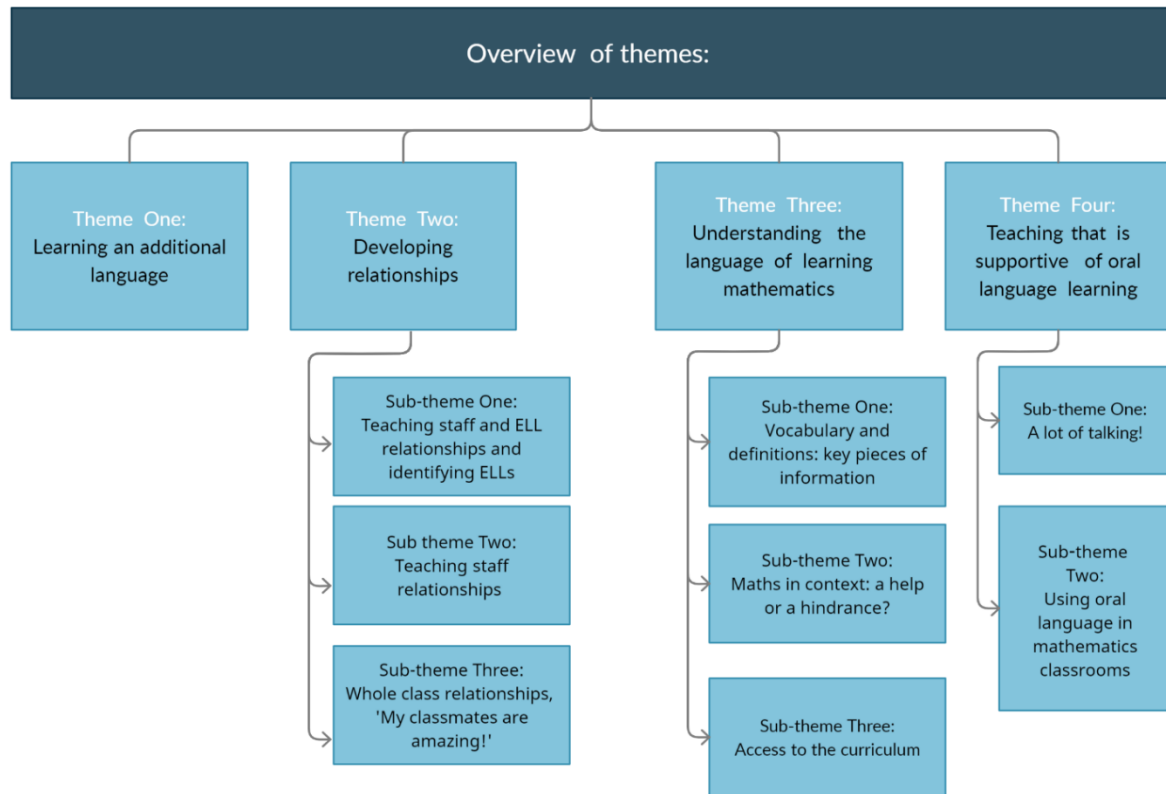


Figure 6: Overview of themes

Each theme is supported with indicative quotations from the participants. In this chapter, students in the focus group are referred to as student 1, classroom A for example. In classroom B, there was teacher B, a teacher aide, and one student. This student will be referred to as student from classroom B. In indicative quotes, the letter R refers to questions that I asked as the researcher. The first of these themes is: *Learning an additional language*. This arose from data shared by all the participants, including the educators. This theme looks at different perspectives, experiences, empathy and how the participants connected with personal experiences of using an additional language. The second theme is *Developing relationships*. This theme looks at the different types of relationships that exist in the case, and the labels of

“ELLs”. The third theme is *Understanding the language of learning mathematics*. This theme explores participants’ points of view of understanding the language of learning mathematics through three sub-themes. These are vocabulary, context and access to the curriculum. The fourth theme is *Teaching that is supportive of oral language learning*. This theme has two sub-themes: *A lot of talk* and *Using oral language in the mathematics classroom*. These sub-themes analyse aspects of the educators teaching with English language learners that promoted mathematical talk and different speaking strategies that teachers used to teach their ELLs. The above diagram acts as an infographic overview of the themes. These themes illustrate what happened in the classroom, as well as opinions from teachers, a teacher aide and students. The participants presented their views on the role of oral interaction in the learning of ELLs in junior mathematics classrooms.

1. Learning an additional language

This theme captures the experience of being a language learner. It was an experience that was common to all educators in the study, both teacher participants, as well as the teacher aide who worked in classroom B, and the participants in both focus groups. The staff describe their experiences learning languages below:

I mean I can speak moderate Spanish but um yeah but the boy in my class does speak Spanish. The boy in my class would speak Spanish. I do communicate every now and then with students in Spanish, but not much more than that. (Teacher A).

Yeah, I taught in Korea for a bit. South Korea. But that was when I was quite a bit younger. I speak a little bit of Korean, but not that much. (Teacher B).

I speak Spanish, probably not quite fluently but well enough. I have studied Te Reo Māori for three years. (Teacher aide, classroom B).

Even though this was an experience all the participants had in common, it was something that each of the three educator participants viewed quite differently. Teacher A, for example, knew he could not communicate mathematical ideas using Spanish, so tended to use Spanish as a way of building relationships, and managing classroom behaviour.

R: would you ever communicate anything mathematical ideas or concepts?
No, I don't. It would be more conversational, and behavioural and things of that nature. More telling him to hurry up and concentrate and things like that. (Teacher A).

In contrast, teacher B and the teacher aide had both lived in areas where the language they were learning was used, South Korea, and central America, respectively. Teacher B had been employed as an English teacher, and the teacher aide was in a volunteer abroad scheme.

Two of the participants had lived overseas in countries where the language that they were learning was spoken. This intensified their understanding of language learning and may have contributed their desire to work with students from other language backgrounds.

Both the teacher aide and the student in classroom B commented further on their experiences using other languages.

...but um I think the main differences are mainly in the language. Um it's like how you use the language to express yourself is really different, like for example in French you don't have 'I like' and 'I love', you just have 'I love', um you can't really say 'oh I have a crush on you', you just say 'I love you', so it's like a different way to express your feelings. So I think that's the main difference between French and English, because French has like less words to express yourself. (Student, classroom B).

This quote indicated an acknowledgement of the connections between language and culture and an understanding of the complexity of moving between languages.

...like Spanish is similarish to English in terms of its structures and the way you express things and then like Māori is very different. Māori is very different in terms that it's not a Latin based language. It was cool having that experience of learning two languages that were very different language learning experiences. (Teacher aide, classroom B).

In contrast, the teacher aide discusses the similarities of one of the languages she has learnt with English, but also the differences she noticed learning Māori, explaining that it was a good experience learning languages that were so different from one another.

These participants showed an awareness of some of the differences between languages, and the challenges associated with being a language learner.

In addition, the educators all commented on their empathy towards ELLs and indicated that language can make people feel marginalised.

And it was kind of like her English was good and her Algebra was amazing, but nobody in there spoke any Korean and it must be quite isolating for her um not quite understanding what was being asked in certain senses. (Teacher A).

This teacher recognised that the student had a good content knowledge of mathematics but realised that the student felt left out at certain times which may have isolated her from the rest of the members of the class.

...and listening was my weakest of the four aspects of language learning when I was learning Korean so maybe it's kind of me sympathetic to my own language learning difficulties that I speak a little bit at a moderate pace instead of too fast. (Teacher B).

This teacher reflected back on his own experiences learning a language, and living overseas and thought about his challenges. He reflected on how he had changed his practice to speak at a moderate pace based on his own experiences and weaknesses in learning a language.

The teacher aide remembered her experiences resettling former refugees, and commented on what a significant role language plays in a new environment.

...and my experience with resettling former refugees was that English language was such a huge part of their resettlement so I thought that would be a very valuable place to volunteer in. Because basically it impacts everything about their resettlement. (Teacher aide, classroom B).

The teaching staff were aware of the affective factors of learning a language based on their own experiences as language learners, and often positioned themselves in the shoes of students in their classroom demonstrating empathy and an understanding of language learning.

Some of the students used their bilingualism to help them learning mathematics. The students in focus group A, and the student in classroom B were all from different language backgrounds, and some had experience learning mathematics in their home language country. Several students discussed mathematics at home with their parents in their home languages. The Filipino student described being able to talk to his parents.

Nah. I don't talk to anyone in Filipino. I just talk to my parents.
R: Ok. Do you ever have mathematical conversations with them at home?
Hmmm... sometimes... if it's like for homework. (Student 1, classroom A).

Student 1, classroom A used Filipino with his parents to discuss homework, as well as school work. He could not use his language with anyone else in the classroom.

Likewise, Student 2, classroom A also discussed her schoolwork in her first language at home.

My parents they talk in Hindi, all the time. And any question they ask it in Hindi as well. Once we talk in Hindi about math and everything. (Student 2, classroom A).

The student in classroom B reported solving mathematics problems from school collaboratively with her father.

...both my parents really like maths, like me, especially my dad, because he's a physicist so he basically works with maths. So yeah for example if I've been annoyed the whole day because of a math problem I couldn't do, I'll just write down on a piece of paper and maybe ask him what he thinks of it, we'll just solve it together. (Student, classroom B).

Furthermore, she added an insight into what they would discuss. Quite often it's just I kind of do the equations because when I've got a problem I know I went wrong somewhere I just write

everything back down and I show it to him. In French I sort of explain the situation and then we'll he'll talk me through it in French until we get the right result.

R: Ok so when he's talking through the different steps in French, do you ever switch between French and English?

Hmmm usually no. um except if for example in the equation or the word problem there's a word that I don't know I'll just say it to him in English and he'll translate it to me in French. Um but no usually we stay mostly on French. (Student, classroom B).

The father of Student B was able to help, quite significantly due to his background as a physicist. Mathematics was clearly a common interest.

Many of the students involved in the focus group had parents that were interested in their education, and parents that would ask them about what they were learning at school. The students reported that often parents asked questions about mathematics, with one parent solving problems with his daughter in their first language.

One student shared how she used her first language to support other students in the classroom.

Yeah. Yeah, most of my friends they need help, so like, I explain it to them in Hindi sometimes. Sometimes it's just English, but mostly Hindi. (Student 2, classroom A).

Out of all the students interviewed, she was the only student that was able to use her first language in the classroom because she had classmates who shared the same language. Solving problems in first language allowed these students to manage the demands of subject learning by using their strongest language.

To summarise, the experience of being a language learner was a very significant theme and there were examples of how this experience influenced the mathematics learning of EAL students. It was an aspect which all participants had in common. The experience of learning another language prompted the teaching staff to show empathy for the language learners that

they were working with and also provided the educators with some understanding of how language works (this will be discussed in depth further). The use of home languages served many different purposes for the participants, such as connecting students to their parents, first language maintenance, as well as supporting others in the classrooms.

2. Developing relationships

This theme highlighted the relationships, which exist in the classroom space, and these were commented on in different ways by all participants. These relationships were also visible in other sources of the data, such as classroom observation data. The relationships were evident in the active engagement of the teacher, the teacher aide and the students in interaction. The relationships that were identified are: teaching staff and ELL student relationships, teaching staff relationships and whole class relationships.

Teaching staff, ELL relationships and identifying ELLs

The first aspect of this relationship was knowing the learners, and knowing students specific learning needs – in particular identifying students' status as ELLs. Teacher A and teacher B had different approaches to this.

Ok, so it is provided to us in a sense that when we go on to our school system there is a specific icon for students that are registered as English language learners within the school. (Teacher A).

Teacher A relied on the school system to do this, and students that the school had identified as being language learners were flagged in an easily identifiable way. He noted that there were students in his class that spoke another language at home, that were not identified as ELLs by the school.

In contrast, teacher B had a different approach to identifying who his language learners were and relied upon other staff members relaying this information to him.

I think I just got told at the beginning of the year. I can't really remember. We've got seven ELL students. Two of them joined recently. When they joined the class, I got told that they were coming from abroad... and they had virtually no English language ability. The other five I have had since the beginning of the year. (Teacher B).

The teacher aide in classroom B had specific students that she worked with, and she had been timetabled into this class to specifically work the seven students mentioned by teacher B. When the two new students joined the class, the teacher aide adjusted her timetable to offer more support to these students in mathematics. The teacher aide had strong relationships with the students that she worked with, as commented on below.

Six of them, definitely. There's one who is, his attendance is not consistent, so um he's not actually in the science class, so even though he's part of that class, he doesn't do the science for whatever reason. He does extra English um and often misses maths spells and he's quite a closed book type of person. So most of them yes, um less so one. (Teacher aide, classroom B).

Teacher B also commented on the relationships which the teacher aide had with the students that she works with.

She knows those students a lot better than I do. The teacher aides just know their job, and know the students better than I do. I probably, might have a better idea of the students' maths ability than them. But they work with those students not just in my class but in other classes as well, so they have got a really good relationship and working knowledge of those students. (Teacher B).

The data from formal observations, (observation one of classroom B), the teacher aide appeared to have a good working relationship. She moved around the classroom, and anticipated challenges that students would have with their learning. The students seemed more receptive to her help, than the teacher's help, but she also had more time to spend supporting individuals than the teacher. This teacher aide is with the ELLs for many of their other classes, so has

positive relationships with these students. This teacher aide had flexibility in how she used her time to support students.

Those particular students? Yes. I am with them for the majority of my 12 hours. But in maths and science and ELAF, so their English language class. Um I was only timetabled for one maths spell a week, to support them for one maths spell a week but a few weeks ago I realised that one of the other spells that I was covering for a different subject was not a particularly valuable use of my time and the math teacher had asked for extra support... Um yup, so I switched around my hours to add an extra spell. (Teacher aide, classroom B).

It is interesting to note that teacher A, and teacher B both work in the same school, yet have very different approaches to identifying the language learners in their classrooms. When recruiting student participants for this research, none of the students identified by the teachers participated in this study. The students that participated self-identified as English language learners (through selecting one of two forms handed out by the researcher – described in more detail in the methodology chapter).

The students in focus group A, and focus group B, both identified that their teacher had a significant impact on their learning of mathematics.

I like the fact that the teacher can explain things pretty well, and he can demonstrate them pretty well. And if you need help, he will come over and help you out. (Student 4, classroom A).

This was a statement that all students in the focus group agreed upon, with several other participants echoing this sentiment when asked what they enjoy about their mathematics classroom. Knowing that the teacher would support their learning, and would check on them regularly was important to students in classroom A. The was also evident in the data from classroom B. The students appreciated that their teachers were approachable and that they could ask for help.

Um Mr (names teacher) is a really good teacher as well, he's always there if we have questions. I don't mind asking for help and same for Mr (names teacher). I know that if I have a question, he's there, and he will help me. So I do feel confident asking him if I need to.
(Student, classroom B).

The consistent feeling that teacher A and teacher B were approachable to help students was important to all students. This gave the students confidence to ask for help when stuck.

Teaching staff relationships

Out of both classrooms observed, classroom B had a teacher aide actively supporting students. The teacher aide was actively supporting seven language learners in this class, working alongside the teacher. The teacher aide described having a good working relationship with the teacher, but acknowledged that there was little collaboration between the two. The teacher aide stated that debriefs served as a chance for the teacher to reflect, with the teacher aide hoping that communication between the two could be more proactive in the future.

Yes, I feel like I have quite a good relationship with the teacher... At this stage, no, he doesn't email me before a lesson with what's going up. I have said that this is something that I would like to happen in the future. It's more debrief, as opposed to proactive at this stage. (Teacher aide, classroom B).

Teacher B acknowledged this, and stated in the interviews that he would normally have a brief conversation with the teacher aide at the start of the class, outlining important learning for the lesson. The teacher recognised how valuable teacher aides are to the class, and respected the work that this teacher aide does.

I'll normally have a brief conversation with them at the beginning of the spell and give them any information that I think is useful for them but they completely work out what they're going to be doing, how they're going to be assisting themselves yeah, and they're a great asset to the class. (Teacher B).

The teacher trusted the teacher aide, as he is comfortable with her organising her time and making decisions about who she will work with while in the classroom.

Whole class relationships 'My classmates are amazing!'

This theme centres on class-relationships, and the notion of “working together”. This was commented on in different ways by all five student participants.

Well, I do think my classmates are amazing. I've known most of them about what nearly two years now. Um and I do think they're amazing. We're quite a good class. We're good in maths and we help each other, which is great. (Student, classroom B).

This student draws attention to the importance of forming a relationship within the class, and the importance of being in the class for almost two years. All students had been in the same class the previous year, with the exception of one of the participants who was new to the school in year 10. The significance of relying on class relationships was echoed in classroom A, where friendships and getting support from friends was also mentioned.

Like with your friends, and ask them if you need help. Cause like you already know them because you're like friends. (Student 1, classroom A).

This was reiterated by all students in focus group A. All of the students discussed the importance of sitting with friends, as well as the support of the class. Sitting with friends served as a way of getting academic support in both classes. In classroom B the teacher had a rule, “ask three before me”. This allowed for two different opportunities to get support before asking the teacher. The student in classroom B found this strategy particularly useful in forming relationships. It allowed her to show her expertise in mathematics, as she stated that mathematics was her best subject. It also allowed her opportunities to talk to other people in the class, including classmates and the teacher aide before asking the teacher for help.

The students felt like their teachers knew them, and discussed having positive relationships. Teaching staff also had positive relationships with one another. Whole class relationships for the students was more than sitting with their friends as these friend groups allowed support..

Most of the classes had been together for two years. Students relied on each other, and being good, or being seen to be a good class was important to them.

3. Understanding the language demands of learning mathematics

The educators discussed the importance of *Understanding the language of learning mathematics* in depth and this was also identified by students in both focus groups. Participants described vocabulary, context, and access to the curriculum as aspects of mathematical language.

Vocabulary and definitions: key pieces of information

Vocabulary was identified by participants as an integral element to understanding the concepts of mathematics. Vocabulary was discussed in depth by educators and students in their interviews.

Teacher A in his pre-observation interview discussed a typical teaching and learning sequence in his mathematics classroom, and the different ways in which he introduces a new topic or unit of work.

I will put up a display a slide or something of that equivalent with a title and some learning objectives and maybe key pieces of vocabulary and definitions. I will ask the students to write that down because it is key information. (Teacher A).

He identified that he believed that vocabulary definitions are important for students, and these are worth noting down. The teacher aide in classroom B agreed that teaching vocabulary at the start of a unit was an important learning strategy for ELLs.

So, in terms of most helpful, at the beginning of a unit, having a bit of vocabulary and concept definition would go a very long way. (Teacher aide, classroom B).

Teacher B also recognised the importance of teaching vocabulary in his lessons. He discussed the words numerator and denominator.

Well, you need to teach students all the technical, all the technical mathematical language. When I was in, and some of the time I think I do a good job at this, and some of the time I think I don't, but like I try to repeat. So I'm not sure if I did it when you were there, but a lot of the time I'll be like numerator, the number at the top, denominator, the number at the bottom to kind of link, the common explanation for what a denominator and a numerator are with the technical vocabulary. (Teacher B).

This teacher practised amplifying language by frequently putting the meaning alongside the technical terms during the lesson to support students to learn technical vocabulary.

Teacher A discussed breaking down words, and looking at different parts of the word to understand the whole meaning, as well as the context behind the word. The teacher gives the example of trigonometry:

I'll try and break down words for them quite a lot. Things like trigonometry for example. I'll kind of spend a protracted amount of time going right, let's have a look at what this word actually means to debug the myth around it. I will look at the idea of... look at our patterns here... decagon, nonagon, octagon, heptagon, hexagon, pentagon, and go down there and see look we've got a real theme going on here now we should be calling the next one tetragons, but because humans make things incredibly difficult we call them quadrilaterals and don't follow the pattern and then the next one should be called trigons but we call them triangles. Then metri means measuring, so tri-gon-o-metry is simply the measuring of trigons. Umm try and get them to think about words and what they might mean mathematically and things like that to try and take some of the scary mathematicalness away from what we are looking at. (Teacher A).

This example separates the word into parts and links word parts to meanings to allow students to build on prior knowledge, as most students at this curriculum level would know that tri is three. The teacher also highlights vocabulary patterns in mathematics to allow students to make strategic guesses about similar words. The teacher recognised that it is important for students to think about words and their meanings in mathematical ways. This teacher reported that he would often integrate this type of vocabulary teaching into lessons, and would often explain the history of mathematical words to students.

Um so I would, there would be a lot of conversation from me about the history of mathematics, some about the words, some about how things have come to be the way they are, naming conventions, there's a lot of talk in that space. (Teacher A).

Untangling the meanings of words was important for teacher A, as he saw this as a way of bridging. He thought that explaining the meaning of words, and reinforcing these meanings demystified mathematics.

I'm very, very, very keen on this history of mathematics and debugging words like algebra and where that word came from, and why it's not anything to be scared of... breaking it down into its parts, so that students can see this is not some mystical thing they're not supposed to understand. Um trying to simplify the language element of it, because it takes away this scary part of maths in that sense. (Teacher A).

Teacher A believed that a strong understanding of mathematical vocabulary was important for reading and inferring factual information in mathematics questions. The teacher gave the example of a square.

... I use the example of a square heaps and I use that example in that lesson where one of the problems that we have is separating the reading from what it means... Anybody in that room can read a, b, c, d is a square. Right, fantastic. But why, what does that mean, how can I use that information? It's not like the start of a novel by John Steinbeck, where it's just going to say a, b, c, d is a square you know and you get more about that square as the story goes on and it's not, it's a very different thing. It's a piece of factual information. You are designed to read that factual information and infer a whole bunch of things from it. That's what it's designed to do. And what you're supposed to be inferring from the fact that it's a square... arghh the equal length sides, the opposite parallel sides, the right angles, the symmetrical properties, all the other things that make a square a square and I don't think it's possible for teachers to emphasise enough that the difference between being able to read a, b, c, d is a square and then taking that to the next step and go what does that mean. (Teacher A).

This example explains the information that needs to be inferred when reading the word square. The teacher also explained why knowing these types of details are important, and applied this to real life examples that students will encounter. An example of this was the teacher's experience of ambiguity around the wording of NCEA externals:

Arghh probably experience of words that I know in the past have presented problems in terms of argh particularly things like square. I've taught so many classes in the past and seen kids try and debug exam papers where they've sat there in a geometry paper and go a, b, c, d is a square, and they're going but I don't know where to go mister. And you're like it's a square, what's that mean, tell me something about this, all the information you have is in those words and yet all you've done is read the words. You have

not made the inference from the words to the property and that's what we needed to fix. The language of mathematics isn't about words, it's about inferring properties from those words. (Teacher A).

Student 1 in classroom A discussed mathematical vocabulary. He used the example of the word equal:

We know what it is, we just don't know what it means (Student 1, classroom A).

This aligns with teacher A's statement about reading the word square, knowing what a square looks like, but being unable to infer and apply understanding of what a square is in context questions. Teacher A mentioned in his interview, and his perception that this level of understanding differentiated stronger mathematicians from weaker mathematicians.

In focus group A, student 3 commented on learning mathematics in her home country, Fiji. She was learning mathematics in English in Fiji, but noticed differences in the types of words that were used in Fijian classrooms, compared to New Zealand classrooms.

So back in Fiji teachers used like math language. It was quite different to what we have here. Here Mr (names teacher) he says add on, or 3 more, but back in Fiji we would say plus 3 or plus this, plus that. So the math language was quite different. So I had to adapt to that and I think if you're from a different school, or maybe a different country, the math language is a bit different. (Student 3, classroom A).

This student was adapting from the more formal use of technical terms for mathematical functions to less formal terms such as "add on".

In sum, the educators perceived teaching vocabulary was important. Teaching strategies included teaching vocabulary at the start of each unit, amplifying words through forms of repetition, breaking words down into parts with meanings, and making inferences when reading word questions. Students recognised the role of subject vocabulary in conveying meaning. One of the students in focus group A also discussed differences in vocabulary between countries where English is the medium for education.

Maths in context: A help or a hindrance?

Data suggest that in the New Zealand education system, curricula and assessments are often driven by the New Zealand's unique context. Context is also used in this section to discuss mathematical contexts. Mathematical problems in the New Zealand curriculum are often set within a context. This was identified by participants when discussing challenges for ELLs when learning mathematics, especially Teacher A, who discussed this in depth in both his pre-observation interview and post-observation interview.

There are very clear language barriers. The New Zealand maths curriculum all the way through it's very keen on contextual maths, rather than any kind of raw procedural math, and therefore because of that it makes the maths more challenging for our English language learners. (Teacher A).

Teacher A distinguishes two different types of mathematics, 'raw procedural math', and context driven mathematics. He notes that the context could be a barrier for ELLs. Further on in the interview, teacher A elaborated on this, specifically mentioning challenges of the New Zealand curriculum.

New Zealand maths curriculum makes things harder than it should be in some ways because there is an insistence that maths must have a context all the time, which I completely disagree with. Um and there are some parts of maths that should just exist for maths sake, and that's fine. There is no problem with that. (Teacher A).

This teacher discussed the challenges of NCEA mathematics, specifically, and compared this to other systems that are used within New Zealand:

NCEA as a curriculum is a language rich curriculum in subjects that intrinsically aren't necessarily language rich. For example; if we had a maths program here for our year 13 ESOL students they'd be better off doing Cambridge papers than NCEA, because Cambridge papers are much less language rich. You don't need to understand English. You're asked to churn out some higher-level maths, but there's no bizarre context shoehorned around it all because there's less of a concern in that curriculum. It doesn't make one better than the other. (Teacher A).

In response to his perception that context was a challenge for international students, there were steps that the mathematics department and teacher A took to transition students into the New Zealand mathematics curriculum. Teacher A discussed the importance of building ELLs' confidence in English to support mathematical learning, but also the significance of building on their prior knowledge to support language learning.

I think the New Zealand curriculum's insistence on the context stuff takes away from that um which is why with a lot of our internationals we often start them on algebraic topics, because then it gives them confidence in their English a little more because the algebra will be the same in their country, as it is over here. (Teacher A).

The student in classroom B also mentioned differences between learning mathematics in New Zealand and her home country.

Now I think about it, I don't think I did a lot of word problems. It was mainly only like numbers and a few signs. So, yeah, I can't really remember doing word problems. Like more like a lot of algebra and that sort of things, yeah, I think. (Student, classroom B).

She did not recall studying word problems in France, where there was a focus on algebra in which concepts are represented by symbols. Studying algebraic equations aligns with the focus on teaching and learning sequences at this school. This department believed that starting off on a less-language dependent topic allowed some students to link back to prior knowledge and build confidence. Even so, the student stated that she quite liked word problems, as she enjoyed reading.

...um it's mainly like books where there's a murder at the start, like mystery books, and you find out through the whole book who did it. And I'm kind of finding that in word problems, which I find really nice. So I don't think I'm amazing at word problems, I'd say I'm pretty good at it though, because I mean I can usually figure out what's happening and how to solve it. Um yeah. And if you know the maths part the word problem is pretty easy. (Student, classroom B).

She recognised that if she understood the context, and knew the mathematics then she would be able to solve mathematical problems. Situations were important in word problems.

In a word problem, you know you're in a situation, and you know what's happening. And so I think it's much easier when you have a word problem so you know what's happening and you know the situation. (Student, classroom B).

Likewise, students in focus group A appreciated it when their teacher related word problems to real-life situations that they might encounter in the future.

He relates it to real life. (Student 3, classroom A).

Students further explained this, and discussed an example of decisions involved in buying a car.

Yeah, you could have like a second-hand car and how it would be better than buying a brand new car and being under loan and having a second hand car... (Student 3, classroom A).

He was saying something about the mileage. I didn't catch that but it was pretty helpful. (Student 2, classroom A).

There were differing views of the importance of connecting learning to real-situations that interested students, and could be of benefit to them in the future. Teacher A recognised the importance of mathematics being relatable and interesting, but had doubts about the role of context-based examples.

Where you have Tane and Marie are walking down the road, and they look at the amount of money they have in their pockets and Tane realises that if he gave Marie \$5 then she'd now have three times what he had um work out how much money they had. That's not how life works, they would just count it, yeah. People would just, they don't sit there and form mad equations in their heads to figure out how much money they've got in their pockets, it's contrived, it's meaningless, and the students know it and we know it. (Teacher A).

Teacher A discussed similarities between New Zealand education, and British education. He believed that there could be other alternatives to teaching in this way. He described approaching

maths with a “procedural” way in the beginning and then working with contexts once the students had time to develop language skills.

That’s what I taught in the UK and similar things in those kind of spaces... Like just I don’t think we get it right for a lot of these learners, like I say, a context rich maths curriculum is the last thing these kids need. They need a very procedurally maths introduction to allow them to be. So you’re much better off with those students going down algebra and numerical skills and bits of geometry and things like this. But very much the forwards and the backwards, none of the context, none of the why. Because you need to give them time to be comfortable in the environment and with the language yeah. (Teacher A).

The teacher aide in classroom B agreed that context could be confusing for ELLs.

But really actually it’s just blurring the lines between what is important information to be able to solve the maths problems and what’s just I don’t know ah yeah. (Teacher aide, classroom B).

Students in focus group A concurred that the wording of questions was often a challenge.

It’s hard how they word it. Sometimes I just don’t get it. It seems like they’re trying to say something else. (Student 2, classroom A).

Sometimes you focus too much on what’s what they’re saying about what’s the equation, what they’re trying to make us do. (Student 1, classroom A).

The students acknowledged that it is sometimes very difficult to get the mathematics out of the words, and they struggled with ambiguity.

In sum, mathematics is embedded within wordy contexts in the New Zealand curriculum. The New Zealand curriculum is different from other international curricula, which were perceived as approaching mathematics learning more procedurally. By teaching procedural mathematics teachers believed they could draw on their students’ existing mathematical knowledge. In contrast, the students wanted word problems to be connected to their lives, and involve information that will be of use in their future.

Access to the curriculum

All the educators perceived that Learning in English while adapting to life in a new country was challenging.

For them it is enough hard work transitioning to live over here, without trying to learn something as complex as mathematics in another language. (Teacher A).

Both teachers tried to mitigate against these challenges by ensuring learning intentions and success criteria were clear and they emphasised these in different ways. Teacher A discussed the role of motivation when learning in a new language, with reference to one particular student in the class.

... I guess it's easy to become unmotivated when you're struggling badly with the language. Like I said before, kids that are succeeding are motivated. Well the kid can't succeed because he's not understanding what's being asked of him. So he loses motivation and then at some point it becomes impossible to discern the difference between the unmotivated student who is intrinsically unmotivated and the unmotivated student whose trying to do everything in a second language and has had the motivation beaten out of them by a lack of success. It's very difficult to kind of figure that difference in the end. (Teacher A).

Teacher A acknowledged that sometimes it was difficult to differentiate general lack of motivation to learn mathematics from lack of motivation arising from language challenges. Demotivation resulting from limited language was also mentioned as a barrier to learning mathematics by teacher B in relation to NCEA internal assessments.

Two of the newest students who have only just come to the country speaks no English. I didn't think it was fair of me to put a test in front of them because they're not going to get a lot of the questions right. (Teacher B).

Teacher B made the decision for these students not to do an internal assessment to avoid setting ELL students up for failure, which could have longer term implications on their learning. This was a difficult decision to for this teacher to make, as it meant that these ELLs were already a couple of numeracy credits behind the rest of the cohort. Teacher B also discussed the challenges of being assessed for mathematics in English.

But tangentially it felt unfair that these students are expected to do a qualification in a language that they are completely disadvantaged in and that they are not proficient in. My understanding is that that's NZQA rules. That they are either done in English [or] Te Reo Māori (Teacher B).

The teacher recognised that students are at a disadvantage being assessed in a second language. Teacher B recognised that English proficiency meant ELLs were often unable to participate in all parts of the lesson.

Obviously, it's quite difficult for them. Because it's a math. Especially for some of them discussing mathematics in English is very, very, very difficult. Perhaps they might not have the vocabulary for it or such. (Teacher B).

This may lead to feeling on the periphery in classrooms for some ELLs.

In the focus group interviews none of the students expressed any concerns about learning in English. Students in focus group A did point out that having a bilingual teacher aide would be useful for newer learners of English language.

Argh I reckon they should have like another teacher or someone who has had like experience maths and know the same language as that student to help them out. Kind of teach them English on the way and like the English version as well. (Student 4, classroom A).

In summary, this sub-theme has identified some of the challenges of learning in a new language and being assessed in a new language. These challenges can include a lack of motivation, students being viewed as disengaged, transitioning to a new country and ELLs inability to express themselves in English and participate in mathematics classes. Teacher B highlighted difficult decisions that teachers need to make surrounding assessment for ELLs. He noted ideas of being assessment-ready, and how language is an integral part of that. He also discussed the inequitable nature of assessing mathematics in English. Students in focus group A did not mention having challenges with assessments, but recognised the challenge for newer learners of English language. One student recommended the use of a bilingual staff member to assist newer learners with learning of both mathematics and English.

4. Teaching that is supportive of oral language learning

This theme discloses different teaching strategies that were used in both classes that supported language learning. These are talk strategies, modifying, enriching, interpreting and pacing language, all of which will be explained in depth below.

A lot of talking!

Teacher A, and students in focus group A identified that there was a lot of talk in the classroom. Both in the interview and through the artifact, Teacher A identified that he talks a lot in class (see appendix 9).

This was also evident in one of the observations of the class where the learning objective for the lesson was to learn mathematical vocabulary, and learn about the Cambridge App for mathematical definitions. The teacher made the learning intention clear in the lesson, and reiterated this and the intended outcomes throughout the lesson. During this lesson, students were asked about several key terms, such as square, average, and factor. This lesson was structured in a way that allowed for whole class discussion, and the teacher differentiated questions for individual students to allow students that were weaker mathematically to answer. The teacher used a range of questions to elicit different responses, such as guiding questions to allow students to get to the answer, and display questions to allow students to display their knowledge.

The thing is I'm aware of who my weaker students are and I try and make sure that they get given questions that they find accessible when I'm asking around the class....I'd do it in such a way so that I'm able to control that the students who might need a bit of help um are getting questions which they find accessible. (Teacher A).

The teacher differentiated his teaching for particular students. He considered who he asked and what types of question he asked to allow students to participate and experience success.

When the students were asked about how much the teacher talked in the class, students had similar answers, and all suggested he spent about 50 – 75% of the lesson talking. Students also indicated that they liked the teacher talking in class, and enjoyed listening to him. They commented on how the teacher explained the processes of mathematics very clearly, and how he supported the explanations with activities.

He explains really clearly. He goes through all the steps, and makes sure we understand each step. Like each step...well. (Student 3, classroom A).

Well he has this thing where he teaches us the first step, and a few more activities based on the first step and then the next step, there's another few activities based on that step. And it goes just little by little, he keeps on teaching us the strategies. (Student 4, classroom A).

The step-by-step approach meant students were able to practice mathematical skills and build new knowledge sequentially. Other useful teaching strategies were:

I think he uses a lot of like visual, and computers and powerpoint. Like a graph, he uses that online, and he teaches us that way sometimes. (Student 1, classroom A).

The teacher used a wide range of strategies at different times. The students also highlighted that the teacher did not rush through content, but took his time to make sure he covered everything that the students needed to know.

He starts from the basics. He doesn't get to the hard parts. (Student 3, classroom A).

He doesn't go through it like quickly. He takes his time to help us out. (Student 4, classroom A).

And he explains each step is important and why it should happen. (Student 3, classroom A).

Yeah, and shows us the difference between if it going wrong and it correct kind of path. (Student 4, classroom A).

Like he does just little steps. Like one spell this might be the most easiest part. Then gives us a bunch of activities. Then the next spell a bit harder. (Student 1, classroom A).

The above quotes from students in the focus group illustrate what teacher talk strategies students found useful. Students really appreciated the teacher breaking down the learning, going through examples slowly, and also demonstrating the difference between the right and wrong way of solving an equation.

In classroom B in observed lessons there was less whole class classroom discussion. Classroom talk was structured in a very different way. The teacher prompted students to speak with one another using mathematical language.

I try to promote students talking about mathematics, with each other. If they're all talking then there's many teachers in the room, but if none of them are talking, then there's only one teacher in the room. (Teacher B).

Teacher B perceived talk to be very useful in the classroom. He understood it as creating extra resources for the class, and as a way to have many teachers in the room. By being allowed to talk in class, students were able to support each other's learning.

It's like in friend groups someone understands the thing, so that we explain it to the rest of them. And then there's another who knows it, and then that one explains it to everyone. (Student 3, classroom A).

Students in classroom A recalled the puzzle lessons as examples of group work. The puzzle lessons were not strictly linked to the curriculum. They were reward activities for Friday afternoons that involved group work. Students liked puzzle lessons, as they were able to sit with their friends, and work together. They were highly engaged by the material that they learnt during these puzzle lessons. They enjoyed acting as teachers in class.

This idea of being allowed to talk in class was new to the student in classroom B. This was not common in her home country.

One big difference is in New Zealand you actually like you can talk to your classmates. In France, it's more like you do you, you do your work, you don't work in groups, you more work on yourself individually, but the teacher is there if you need, but you don't really talk to your classmates. And I was

really surprised when I saw in New Zealand you like, you are allowed to ask your classmates for help and not just like secretly like when the teacher turned around, so that's quite nice. That's what I love about New Zealand, you can work in groups. And so yeah, that's amazing. I'd say the main difference is that in France, it's more you work but like yourself, you don't really talk to your classmates and here your much more open and you're allowed to ask for help to your friends. (Student, classroom B).

Like the students in focus group A, she really appreciated being able to ask her friends for help. She noted key differences between New Zealand and France as being allowed to talk in class, and a more collaborative nature to learning mathematics, opposed to solving equations independently.

I do talk pretty often in maths. Um because yeah, again that's what I like about New Zealand. You're allowed to be open, so like Mr will do an equation on the board, and then we'll be allowed to solve it in groups, or just do it all together, each person says what they think, then once we're done Mr would call on one of us, and then that person tries and solves it. And if that person can't do it, they're allowed to ask for help. So yeah, we talk really often, which is a great thing. (Student, classroom B).

In summary, teacher A was aware of using talk in his teaching. He differentiated questions to allow all students to be participants of the class. He also allows them to talk a lot to help their learning. Teacher B also recognised the value of students talking in mathematics, and stated that by allowing this, there were many teachers in the room.

Using oral language in the mathematics classroom

The teacher aide in classroom B recognised that language was a barrier to accessing mathematics. She had strategies to explain words to students and gave real life examples of technical vocabulary. In classroom B where patterns and graphs were being taught, the teacher aide recognised that the word 'gradient' was a challenge for the ELLs (and non-ELLs) in the classroom.

So I'll just I suppose check in with the students to see if they understand that new vocabulary or and sometimes it's just backtracking. To use the gradient example again but start with gradient, do you know

what it means? No, do you know what steep is? Do you know what a slope is? (Teacher aide, classroom B).

She had conversations with students to find out whether they knew the word gradient, and when it was apparent that no one knew the word, she asked whether they knew the word steep. After noticing that there were students that were unsure of the meaning of this word, she went around different groups explaining the meaning of both of these words. From observing this, I could see different strategies that she was using. These included drawing diagrams in students' books of hills, and slopes and gradients, she then transferred these over to the graph and drew links between the lines (gradients). She worked backwards to see where the students were at.

You know, and then you sort of work backwards to see what level you are starting with and then scaffold it up from there to the concept. Um I don't know. Yeah, there probably are if I'm actually with a student I can very much see clues of like non-registering whatever. (Teacher aide, classroom B).

The teacher aide was able to recognise when students do not understand, and adapted her teaching to suit their needs. She modified language and gave real life examples to reach a shared understanding of the mathematical vocabulary. She enriched language, repeated language and created an environment with rich conversations and used other media to allow understanding of concepts.

Both teacher A, and teacher B recognised the value of students using their first language in the classroom and being able to interpret information for peers. This was promoted by both the teachers.

Two of them do, but they are both extremely shy. One strategy I've heard (I cannot confirm that) males and females don't talk a huge amount to each other. I don't know if that's true. It might be the age as well. They are both extremely shy, so like in term one or two I tried to sit them together... hoping that they would talk in their native language some of the time and in English some of the time, but they didn't talk to each other at all. (Teacher B).

In classroom B, the teacher's efforts to facilitate these students talking to one another were unsuccessful.

In classroom A, the teacher commented on how it is difficult to understand whether ELL students who share the same language have understood what is being discussed and whether this is being translated correctly. This was a concern for the teacher even though he recognised that students could be drawing on previous knowledge about mathematics.

If I end up with two language learners in the same class, that share the same language in class, they will often talk to each other about what's going on. It's very difficult to understand whether one of them has understood what I am saying and is relaying it to the other, or whether one of them has an understanding from a previous part of their life that they are bringing to this, so they have understood the concept mathematically because they have learnt it before and they're explaining it to the other English language learner. Um yeah, I feel like, very much there will be quite a lot of what is said that is lost in translation and it is a concern for me. (Teacher A).

As previously mentioned, student 2 in classroom A did use her home language to speak in class, and used it as a tool to support her friends.

Like teacher A, the student in classroom B noticed students using their first language to speak to one another. She was unsure what these students were speaking about, and whether their discussion was on task and about mathematics.

Um we do have quite a lot of ESOL students in our classroom. So for example, two Spanish brothers and I always hear them speaking Spanish, which is quite interesting. I mean, I have no idea what they're saying, but it is pretty interesting to hear them talking in that language. (Student, classroom B).

Teacher B tried to set up ELLs from different language backgrounds to speak mathematically.

Now EAL students, because they don't have a common language, except the two we talked about before, now they don't always do that much talking. Although I do remember sitting down with two students who were both English language learners, and asking them to try and explain the content to each other in English, they are from different languages. Certainly, occasionally, I will try and do that among the English language learners as well. Obviously, it's quite difficult for them. Because it's a math. Especially for some of them discussing mathematics in English is very, very, very difficult. Perhaps they might not have the vocabulary for it or such. (Teacher B).

The teacher recognised that this was a challenge for ELLs, but viewed it as being useful for language development. This teacher was very careful about the ways he interacted with English language learners, and often did not ask ELLs questions in front of the class.

So then there's five other people in the class and I very rarely, I don't really ask them questions, because it feels like they might have difficulty understanding what I'm saying and answering. Someone like (names student) maybe I could fire a few more questions at um but he's been in New Zealand for I'm not really sure, maybe a year and a half, or 2 years, but his language is still quite basic. Still developing. (Teacher B).

As previously mentioned, teacher B remembered his own struggles listening in a new language as a language learner. Consequently, he modified his talk when speaking with ELLs and spoke more distinctly. The student in classroom B acknowledged that she could understand her teacher, but did not directly mention whether the teacher speaking at a slower pace was useful to her learning.

In summary, this theme has analysed teaching practices that participants believed would supports oral language learning. Both teacher A and teacher B shared strategies that they used in their teaching, such as using differentiated questions to allow all students to participate in lessons, and taking a step-by-step approach to solving problems, Students liked these approaches and also liked being able to talk freely in class to collaborate and help each other with problems. The teacher aide realised when students were struggling, and used a variety of oral language based strategies to help. Teacher A and teacher B seated first language users together in an attempt to support oral interaction. In classroom A this was successful, but it did not result in interaction in classroom B. Teacher B tried other strategies to get ELLs talking, such as pairing students from different language learners together. He was also careful to pace his teaching to make it more comprehensible.

Summary

This chapter has described the key findings of this research project. It has described four themes that were embedded within the data; *Learning an additional language*, *Developing relationships*, *Understanding the language of learning mathematics* and *Teaching that is supportive of oral language learning*, as well as sub-themes. Indicative quotes have been used to illustrate how participants have connected to each theme and to show their lived experiences in mathematics classrooms in New Zealand. Indicative quotes link the lived experiences of participants to the research question and illustrate how mathematics teachers and learners perceive the role of oral interaction in the learning of ELLs in junior secondary school mathematics. The diagram below uses data to illuminate how the classrooms were environments where a range of different interactions could occur.



Figure 7: Diagram illustrating different interactions in the classroom

Chapter 5: Discussion

Introduction

I will start this chapter by showing how the data addressed the research question explaining how mathematics teachers and learners perceive the role of oral interaction in the learning of ELLs in junior secondary school. The rest of the chapter will analyse the themes from chapter 4 using the theoretical framework of seven ESOL principles from the Ministry of Education (n.d.). This allows the themes from the findings to be contextualised within the literature on effective practice for ELLs in New Zealand classrooms.

Response to the research question

Four key themes emerged from the data (discussed in previous chapter) to address the question of:

How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) at junior secondary school?

The first was *Learning an additional language*. The experience of being a language learner deeply affected the educators involved in the research and affected their pedagogy. The educators often put themselves in the shoes of their learners, and were empathetic toward ELLs in their classes (de Oliveira, 2011). This resulted in several accommodations for ELLs, such as seating them with students from the same language background or with friends, and promoting students' use of their home language in class to explain mathematics to other students. This accommodation supported ELLs learning, as ELLs were allowed to interact in their home language.

The second theme, *Developing relationships*, was reported by all participants. Relationships were at the heart of interaction in these classrooms in order to ensure that learners felt safe to interact in class. ELLs recognised the importance of having a relationship with educators, as this allowed them to ask for help with mathematics when needed. Having

the confidence to talk to educators was key for these students. Likewise, educators recognised the significance of building relationships with students. Positive relationships in class were seen as paramount for interaction by all the participants.

The third theme, *Understanding the language of learning mathematics* unveiled the participants' perspectives of the complexities of the language of mathematics. The educators perceived that vocabulary, the mathematical context, and accessibility to the curriculum were the biggest challenges for ELLs. Students in focus groups also commented on this theme, and stressed the importance of knowing the vocabulary as well as the mathematical concept it represented. My observations provided evidence of differentiation strategies, and vocabulary teaching strategies.

The final theme, *Teaching that is supportive of oral language development*, is at the nucleus of this thesis. This theme identified the different types of oral interaction in classroom A and classroom B. This theme drew out both educators' and student perspectives on discourse that they found helpful to ELLs learning. Findings indicated that the participants believed that whole class discussion, enriching language, modifying and interpreting language were useful strategies for ELLs in terms of interaction.

ESOL principles

The ESOL principles recommended by the Ministry of Education (n.d.) are derived from sociocultural theory as well as research in the field of teaching ELLs (Gibbons, 2009). Ministry of Education (n.d.) identifies seven principles that underpin best practice for ELLs in New Zealand classrooms. These principles have been briefly described in Chapter 2, but will be further explored and will act as a theoretical framework to interpret the findings of this research.

Principle 1: Know your learners

Principle 1 is ‘know your learners’. This principle is that educators should know about the language background and schooling experience of all their learners. By learning about the backgrounds, content knowledge and language proficiencies and experiences of learners, educators can use teaching approaches to build on their students’ prior knowledge (Ministry of Education, n.d). This principle is reinforced by the *New Zealand Curriculum* (Ministry of Education, 2015) which puts learners at the centre of teaching and learning (p. 109). Findings from theme one, *Learning an additional language* as well as theme two, *Developing relationships* provides further empirical evidence to support Principle 1. This principle is also supported by the work by Anthony and Walshaw (2007), Mercado (2002), Villegas and Lucas (2002), but this the data in my study provide evidence of this process in action in two secondary school mathematics classrooms in New Zealand.

Knowing the learners creates a bridge between students’ existing knowledge and new knowledge (Villegas & Lucas, 2002). Knowing about their learners’ lives outside of school allows teachers to build relationships with individuals and informs their pedagogical practices (Mercado, 2001, p. 690). If teachers can recognise the “funds of knowledge” held by ELLs’ families, and they can build on this knowledge to plan teaching activities (Anthony & Walshaw, 2009; Moll & Gonzalez (1997, as cited in Villegas and Lucas, 2002). By recognising skills that ELLs already have, teachers are able to interact to learn about and from their students (Anthony & Walshaw, 2007). Learning from students also aligns with kaupapa Māori and sociocultural views of learning (Anthony & Walshaw, 2007).

What the educators knew about their students and how they gathered this information is an important consideration in my research. The educators involved in this research were aware of the language backgrounds of some of the students in their classrooms, but not all. Teacher A relied on the school management system to provide this information, whereas

teacher B relied on information being relayed from other members of staff. Edwards (2012) discussed ways in which New Zealand teachers find out about ELLs. In her study, teachers found out about ELLs through discussion with students themselves, observations, the ESOL teacher, and from school records (p. 112).

Students that participated in this study self-identified as English language learners, and were not identified as ELLs by either of the teachers' measures. This finding suggests that there may be challenges in identifying language learners for some teachers. Abedi (2008) discusses challenges of identifying ELLs in the United States, and questions the validity of ELL classifications. Kibler and Valdés (2016) describe different categorisations that ELLs have been/and are given, stating that when ELLs are assigned the wrong category this can have "life-impacting consequences for individuals" (p. 96).

Both participant teachers knew that there were students from language-backgrounds-other-than-English in their classes, but were not aware of specifics such as the students' language backgrounds, education history (where they had studied mathematics previously), or any other knowledge these students might have about mathematics. This is a similar finding to Edwards' (2012) study which revealed that very few teachers were aware of the educational background of their ELLs, or the length of time they had been living in NZ. Teacher A alluded to this in his interview, when he admitted that he was not sure whether the student did not understand the mathematics, or the language, or whether they lacked motivation. The teacher had trouble identifying whether the student was under-achieving because of the language demands of mathematics. Participants from Edwards' (2012) study shared teacher A's conundrum. Edwards (2012) found that mainstream teachers were unsure of their learners' proficiency in English because they were not confident to place their students on *The English Language Learning Progressions* (2008a), and participants expressed a range of views on its

significance (p. 112). Similarly, the participants in my study did not seem aware of the value of this tool.

Developing relationships with all teaching staff supports knowing learners. Positive relationships promote interaction. While the ESOL teacher-aide had time and opportunity to develop these relationships because she was assigned to work with the same ELLs in different classes, she was able to build relationships not only with the ELLs, but the whole class, including the teacher. This reflects Rutherford's (2011)'s finding that teacher aides "played a valuable role in creating opportunities in which students could reveal and further develop their competence in the presence of their peers and teachers" (p.110).

All students valued positive relationships. They felt comfortable interacting with both their teacher and their classmates. It appeared to be important for teachers to allow students opportunities to interact with classmates to acquire new language, and this was also a means for making ELLs feel secure in class (Gibbons, 2015; Khisty & Chval, 2002; Murrey, 2008; Villegas & Lucas, 2002). Anthony and Walshaw (2009) describe this as a "togetherness" environment, where teachers can make everyone feel respected by valuing culture and skills that exist in the mathematics classroom (p. 150). The data from Theme 1, *Developing relationships*, provides insight into how this was seen as important to the participants in this study. The below diagram illustrates the different types of relationships that were revealed in my study.

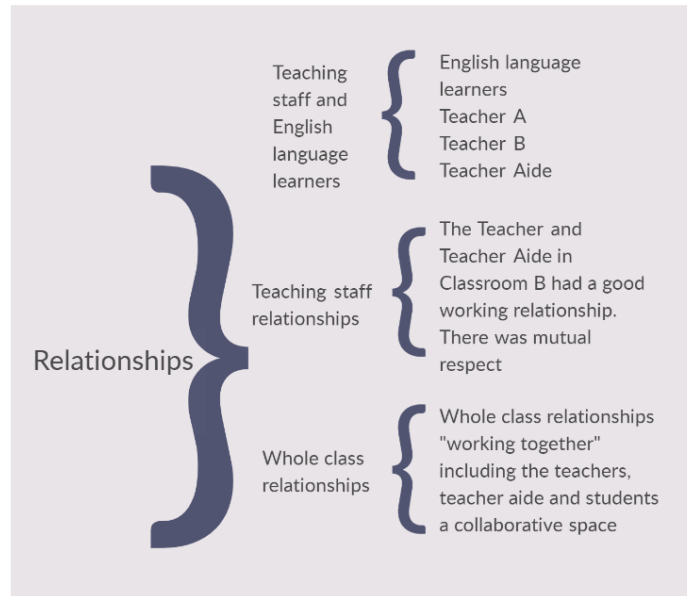


Figure 8: Overview of relationships in the case

The teachers that participated in this study knew that they did not know all they should about their ELLs. This contributed to their motivation for participating in this study. They were reflective and honest about their practice. Edwards (2012) had similar findings as her participants also reported that they did not know enough about their ELLs, possibly because they did not have enough time.

In sum, Principle 1, 'know your learners' has contextualised findings in secondary school mathematics classrooms from themes 1 *Learning an additional language*, and theme 2 *Developing relationships*. Learning about students' backgrounds has an impact on language development. The role of relationships between educators, ELLs, and the class is significant, as positive relationships allow ELLs to participate in class and interact with peers and educators.

Principles 2 and 3: Identify the learning outcomes and maintain the learning outcomes for all learners

Principle 2 ‘identify the learning outcomes’, and Principle 3 ‘maintain the same learning outcomes for all learners’ emphasise the need for teachers and students to set both content and language learning outcomes to make lessons accessible to all students. Educators need to be able to identify and address language forms that will allow students to complete tasks confidently. These outcomes enable planned language scaffolding through learning tasks that involve whole class participation. These two Principles are supported by evidence from theme three, *Understanding the language of learning mathematics*, and the sub-themes, vocabulary and definitions: key pieces of information, as well as, access to the curriculum. Principle 3 also links to theme four, *Teaching that is supportive of oral language learning*, and the sub-theme, using oral language in the mathematics classroom. This section will explore how these principles relate to these themes using a range of literature.

Teachers need to understand the language demands of their subject and how language is used in that subject (Gibbons, 2009, p. 153). For learning outcomes and language demands to be explicitly taught teachers need to understand the relationship between the two, and how to integrate the two. Each lesson should specify content objectives as well as language objectives so that important language is explicitly developed (Kersaint et al., 2009, p. 49). Gibbons (2009) discusses ways in which teachers can implement learning outcomes into their teaching by using questioning to ask why, and allowing students to ask their own questions. Further to this, Pereira and de Oliveira (2015) mention that teachers need to identify the language demands of tasks and state that this is beyond vocabulary. Teachers need to identify “challenging linguistic forms and functions” (p. 122).

All educators involved in this research had a shared concern about ELL success in mathematics. Noticing and paying attention to language and language demands was evident in

teacher A's practice, In this classroom, while there were no specific language learning intentions, the learning intentions included a focus on both content and language.

Both teachers introduced learning outcomes at the beginning of each lesson, and would repeat these outcomes, reminding students what they were learning, why they were learning this information and how it would be useful to them (Ministry of Education, 2008b). Teachers used questioning techniques throughout the lesson to check that the focus of lessons remained clear to students. Gibbons (2009) refers to this as a way of monitoring students' learning. If the focus was unclear to particular students, the teachers would refocus the classes' attention back to the original learning intention and present this in a different way.

In the classrooms that I observed teachers explained the tasks, but were inconsistent about explaining the language needed for the tasks. Educators need to ensure they provide ELLs with sufficient background (both language and content) to understand the task (Pereira and de Oliveira, 2015).

Teacher A was concerned about the accessibility of content for ELLs when mathematics is taught through contextualised examples. He saw contextualised mathematical problems as a barrier to ELLs, especially when students needed to know the language to make mathematical inferences. To make mathematics content more accessible he used explicit vocabulary teaching, whole class discussions and differentiated questions. This was a way of making the learning outcomes the same for the students in the class.

Whole class discussions are a form of interaction and were used by both teacher participants to focus on mathematical vocabulary. Engaging students actively in this way with an emphasis on meaning focused activities is valuable for ELLs because an environment rich in language enables students the opportunity to appropriate subject specific language as their own (Khisty & Chval, 2002).

The teachers made adaptations to support ELLs in the classroom (Ministry of Education, 2008b). For example, Teacher A differentiated questions for all students in his class to make mathematics more engaging and accessible. By being able to participate, ELLs were supported to meet the learning outcomes of the class.

Teacher questioning has been recognised as supporting vocabulary development (Gibbons, 2003). Cardimona's (2018) study, like Gibbons', situates interaction in a sociocultural framework drawing on the work of Vygotsky. Her study had three key findings relating to differentiation of instruction for ELLs. She revealed three distinct questions with three distinct uses. These were procedural, guiding and reflection questions (Cardimona, 2018, p. 32). Procedural questions acted as comprehension checks, and usually had a yes or no answer, whereas guiding questions had high levels of support and allowed ELLs to work in their zones of proximal development. Guiding questions are collaborative in nature and allow for dialogue between what Vygotsky (1978) refers to as the more experienced other (eg; teacher). The final question type, reflection, allows students to internalise problem solving, allows for opportunities to ask questions and demonstrate knowledge. This type of question is better suited following a guiding question.

Teacher A assembled all of these different types of questions into his lessons to allow access to the curriculum. He tailored questions to the individual and used procedural questions where students were allowed to use yes or no answers as one way he to check for understanding of mathematical concepts. He used guiding questions, which provided a back-and-forth dialogue between himself, other class members and the students being asked the questions. This type of question is very interactive, and treated students as worthy conversational partners (Gibbons, 2015). Finally, reflective questions were used. This is significant, as sociocultural theorists, like Vygotsky (1978) believe this to allow internalisation as well as growth in their ZPDs.

Teacher B had several concerns about accessibility to learning in mathematics for ELLs. These included the language demands of assessment, and whether assessing ELLs in English in mathematics was equitable and fair. Teacher B was also concerned about the pacing of his lessons, and whether students could keep up with his talk. Furthermore, Teacher B was concerned about providing rich exposure to language, amplifying language and providing message abundancies (Gibbons, 2009, 2015). Teacher B acknowledged the importance of not watering down content for ELLs, his message was amplify not simplify.

Literature from sociocultural theorists suggests the importance of amplifying, not simplifying instruction for ELLs. Hammond (2006) and Gibbons (2009) introduce the idea of high challenge and high support. The idea of high challenge and high support is optimal and is the zone of proximal development. This means students are engaged, stretched, but scaffolding can occur. This when learning happens. In other words, providing an amplified language environment provides ELLs the best opportunities to acquire and use new language. There is challenge, but there is temporary scaffolding provided. In classroom B this scaffold was provided by the teacher and teacher aide. The teacher aide knew when students were challenged but how to support them with the language demands of the mathematics classroom. She took a backward mapping approach which ensured ELLs knew vocabulary related to concepts.

Maintaining the same learning outcomes for all learners was a concern for Teacher B when he considered the accessibility of assessment for ELLs given their English language proficiency, and the ramifications for ELLs of teacher decisions about assessment. New Zealand has nation-wide assessment, although how this is administered varies between schools (McGee, Haworth & MacIntyre, 2015). McGee et al. (2015) question whether it is fair for ELLs to take assessments designed for mainstream students who are first language English users (p. 4). Interestingly, prior to 2010 ELLs were not required to take national assessments from year 1 through to 8 unless they were at a specified level in the curriculum. International

literature suggests this is best practice, as it is generally accepted that it takes between five to seven years to gain the academic English needed for such assessments, the Ministry of Education (2008a) acknowledge that reaching the “same level” can take several years.

Abedi and Lord (2001) conducted extensive research into mathematics assessment for ELLs in the United States. They found that language proficiency had a profound effect on ELLs’ academic success. The familiarity or frequency of non-math vocabulary, voice of verb phrases, length of nominals, conditional clauses, relative clauses, question phrases and abstract or impersonal presentations all impacted the performance of the ELLs in their study in mathematics assessments (Abedi & Lord, 2001, p. 221).

Abedi and Levine (2013) discussed the importance and equity of assessing ELLs in their home language to determine whether ELLs are ready to participate in English-only classes. In the United States, assessment writers are working on making assessment more accessible to ELLs in terms of cultural differences and language demands (Abedi & Levine, 2013, p. 28). There are very few accommodations provided to ELLs in NZQA internal assessments, and a lack of clarity means that often teachers do not make provisions for ELLs in assessments.

Another accommodation made by teacher B was to carefully pace the speech he used in his lessons. Murrey (2008) recognises this as being a useful strategy to ELLs in the mathematics classroom. Teacher B was distressed when ELLs could not participate in lessons, so drew attention to language and reiterated the meaning of technical vocabulary.

Sociocultural theory emphasises the importance of recognising the skills that ELLs have. Moschkovich (2007) states that sociocultural views of learning centre on what learners can do, and shifts away from deficit thinking. Focusing on deficits can create inequalities in the classroom. It is important for all teachers to maintain high expectations of all learners to

bridge gaps. It is beneficial to respond to the skills that bilingual learners bring to mathematics classrooms (Moschkovich, 2007, 2010; Yeong I & Yu, 2020).

In sum, Principle 2 ‘identify the learning outcomes’, and Principle 3 ‘maintain the same learning outcomes for all learners’ emphasise the need for teachers to have clear learning intentions and clear learning outcomes for ELLs. Clear learning intentions and outcomes allow for many types of interactions to occur in the classroom. The data from my study aligns with effective practices in research literature for ELLs. Teachers had high expectations of their learners, and worked hard to make curriculum accessible to students. There were various strategies implemented by teachers to make learning accessible and interactive. These principles are strongly situated in a sociocultural framework. High challenge, but high support is paramount to ELL success.

Principle 4: Make the abstract concrete

The notion of making the abstract concrete is salient for all learners, especially ELLs. This principle requires teachers to link learning to real life using context-embedded tasks to make the abstract concrete (Ministry of Education, n.d.). Anthony and Walshaw (2007) also recommend that teachers use contexts that “are rich in perceptual and social experiences to support the development of problem-solving and creative skills” (p. 2). This principle aligns with the third theme, *Understanding the language of learning mathematics*, particularly the sub-theme, *Maths in context: A help or a hindrance?* This sub-theme looks at participants’ perspectives on teaching using a context-driven curriculum (a curriculum where context is often used to illustrate and explain concepts).

Incorporating students’ culture and prior learning into mathematics is a way in which context can be made familiar to ELLs (Yeong I & Yu, 2020). When ELLs encounter an unfamiliar context in mathematics, they need to both context-solve (make sense of the context

the problem is set in), and problem-solve using mathematical skills. Teachers need to select tasks that are accessible to all students, regardless of their background (Anthony & Walshaw, 2007). Mathematics can be engaging through real-world contexts that are accessible and encourage creative thinking (Lesser, 2020). However, real-world problems are not always meaningful to ELLs (Gustein, 2003). In the United States, contexts which may be unfamiliar and embedded into aspects of the majority culture, for example; Thanksgiving or Football (the Super Bowl) (Yeong I & Yu, 2020). Teachers can adapt activities to make them meaningful, linking to familiar environments, like school (Chval, Pinnow & Thomas, 2015). It is important for teachers to recognise that adapting problems should not make them easier to solve, but make the task more accessible while maintaining the same academic rigour (Chval et al., 2015). When teachers discuss their real-world experiences as mathematicians, they are likely to “hook” students and encourage mathematical thinking beyond the four walls of the classroom (Lesser, 2020).

Teacher A thought that contrived contexts could be stumbling blocks for ELLs in NCEA external exams, and observed that contextualising language had been a barrier to his students’ success in the past. He believed that contexts would only aid ELLs’ learning if they were realistic and authentic (Chval et al., 2015). Key elements to contextualising problems was making them relevant to the lives of the students.

Likewise, the student from classroom B liked how using word problems in New Zealand gave the maths a setting. This is a reminder that there are differences in mathematics teaching globally (Anthony & Walshaw, 2007). In some countries, mathematics is decontextualised and practised as an individual (Anthony & Walshaw, 2007). Teacher A believed that procedural mathematics (often without real world applications) was easier for some ELLs. He also believed that by starting off with less language, students from other language backgrounds were able to gain confidence in their mathematical ability.

The teacher aide in classroom B believed it was important for teachers to make the abstract concrete by introducing vocabulary with context, and at the start of new topics. This belief aligns with a sociocultural perspectives of learning (de Jong & Harper, 2005). Teachers introducing vocabulary in context through guiding a class discussion supports oral language development (de Jong & Harper, 2005). This was a teaching strategy that teacher A integrated into his teaching.

Students commented that mathematics can be confusing when it is difficult to decode. Students can become fixated on words. Teaching vocabulary builds familiarity with mathematical concepts and also illustrates how words are used in other situations (Chval et al., 2015). Students struggled with nouns, names of people and objects (Moschkovich, 2005; Schleppegrell, 2007). Often students recognised that these words may not be important, as they may not necessarily be linked to the mathematical concepts but not knowing them often seemed to demotivate the ELLs. My study contributes students' perspectives on the challenges of word problems in mathematics by garnering both students' and educators' voices.

In sum, Principle 4, 'make the abstract concrete' is supported by findings from theme three, *Understanding the language of learning mathematics*, particularly, sub-theme two, *Maths in context: A help or a hindrance?* This sub-theme looked at participants' perspectives on this principle and grounded these in literature. Contexts need to be 'real' for the students, if they are to support learning and not contrived. Contexts also need to be accessible to all learners, including those who bring different prior knowledge and experience to their learning. Teachers can adapt lessons, but need to maintain the academic integrity of tasks.

Principles 5 and 6: Provide opportunities for authentic language use and ensure a balance between receptive and productive language

These principles address the importance of providing opportunities for students to engage in authentic language use. As my study specifically looked at oral interaction, this section will

acknowledge these educators' efforts to integrate interactive activities that provided opportunities for authentic language use. These principles link to themes three and four, *Understanding the language of learning mathematics* and *Teaching that is supportive of oral language learning*. The findings will be discussed with reference to literature in conjunction with Principle 5 and 6. These principles strongly align with sociocultural theory which views learning as action, social in nature, and interactive (Oliver & Gregory, 2020).

Providing opportunities for authentic language use is important for developing academic language. Principle 5 highlights how oral language can be used to support reading and writing (Ministry of Education, n.d.). Educators need to integrate activities that use listening, speaking, reading and writing into their teaching to allow ELLs opportunities to notice and use new language (Gibbons, 2009; Ministry of Education, n.d.). Gibbons (2009) emphasises the significance of teachers using students' language, repeating this back in more technical terms, so that students are able to repeat and replicate this (p. 141), which is what happened in classroom A.

Students in classroom A noticed that the teacher spoke a lot during his lessons. In speaking so much, the teacher was able to model how to talk about mathematics. Runesson (2005, as cited in Anthony & Walshaw, 2009) discusses modelling of mathematical language and notes that over time this talk relocates from the teacher to students (p. 153). It is important for all types of mathematical language to be modelled, including informal language, or words with multiple meanings, so that students can understand the role this language has in mathematics (Anthony & Walshaw, 2009). Examples of these types of words are "more than", "table" which have different meanings in different settings. Anthony and Walshaw (2009) also discussed using formal and informal mathematical terms, like "times" and "multiple". The frequency of informal language in the classroom compared to her previous experience of learning mathematics was noted by one of the student participants.

Planned, interactive lessons such as the puzzle lessons, allow students to learn both language and concepts (de Oliveira & Civil, 2020) and interact in both formal and informal ways. Interactive lessons supported students to solve problems with friends but also to evaluate and present arguments to classmates. These lessons provided real and authentic opportunities for students to learn, use and practice language through group and whole class interaction, and provided opportunities for ELLs to use stretched language (Gibbons, 2015, p. 26).

Teacher B promoted student talk in his mathematics classes. He recognised that students talking about mathematics was a tool for learning. This included creating opportunities for students to talk in their home languages if they wished. This provided opportunities for ELLs to overcome the difficulty of explaining their ideas in English (Yeong I & Yu, 2020). Yeong I and Yu (2020) also highlight the importance of allowing ELLs other resources to communicate, like gesturing, using first language, and drawing illustrations (p. 12) as was done by the teacher aide. Learners need opportunities to build on resources of their first language (Gibbons, 2015, p. 29).

ELLs need access to the curriculum by having authentic and varied opportunities to learn (Franken & McComish, 2003). Anthony and Walshaw (2007, 2009) believe it is important that students are exposed to a range of different tasks that allow for high order thinking. When teachers plan their lessons, they need to integrate a range of tasks and activities to support language learning (Harper & de Jong, 2004). When teachers recognise the needs of ELLs and plan accordingly, there will be a balance of activities and tasks in their classrooms that include opportunities for oral language use.

These findings from themes three and four align with the Ministry of Education's (n.d.) Principle 5 of providing authentic opportunities for language use. In summary, principle 6, 'ensure a balance between receptive and productive language' corresponds with findings from themes three and four. Principle 5 outlined making opportunities to make language learning

authentic and meaningful. Principle 6 builds on this, by ensuring a multi-modal balance of receptive and productive language. The findings from the observations and the interviews revealed opportunities for speaking, reading, writing, listening and presenting, and activities which stretched ELLs' thinking. Students from classroom A and classroom B both expressed positive attitudes about learning mathematics, and all seemed engaged with the range of activities.

Principle 7: Include opportunities for monitoring and self-evaluation

Including opportunities for monitoring and self-evaluation is the final principle. Monitoring and self-evaluation can be both formal and informal (Ministry of Education, n.d.). Findings from theme two, *Developing relationships*, as well as theme three, *understanding the language of learning mathematics*, support this principle, as does a range of literature.

Teachers' conversations with individuals provide opportunities to monitor student learning (Ministry of Education, 2006). Through interacting with individuals, teachers are able to notice gaps or uncertainty in student learning (Ministry of Education, 2006). Checking in with individuals is a way of monitoring student uptake of concepts and their ability to express and apply these concepts. If many students have the same types of questions during these interactions, the teacher can then re-teach a concept. It is important for teachers to put themselves in the shoes of their students and gain feedback on the effectiveness of their practices (Ruiz & Gallagher, 2020).

Through teacher reflection, and observation the teacher B was more aware of the linguistic challenges of this lesson, linking to theme three, *understanding the language of learning mathematics*.

In the four lessons that I observed in classroom A, and classroom B I did not see students self-evaluating. However, I was only in the classes for such a limited time. It is important that students are given opportunities to self-evaluate and reflect on their learning.

Reflection writing activities at the end of topics, or exit slips at the end of lessons can provide students with formal opportunities to reflect. However, ELLs need support with “learning to learn” (Ministry of Education, 2008b, p. 80). “Students have to learn how to learn ... students need to develop a range of information-processing abilities (both cognitive and metacognitive)” (Ministry of Education, 2003, p. 23). This means that to be reflective, students need to be equipped with the tools to be reflective.

In sum, Principle 7 ‘include opportunities for monitoring and self-evaluation’ has contextualized findings from themes two and three. To monitor student learning effectively, teachers need to have positive relationships with students. Positive relationships allow students to be open to sharing their learning with their teacher both formally through assessment and informally through individual interaction, but also students need to feel able to ask for help when it is needed. By roaming the class, and monitoring student learning teachers can evaluate student learning both of content and language. If many students are having trouble with the learning, this is a good indicator for the teacher that they may need to re-teach content and language in following lessons. Students were not guided to self-reflect.

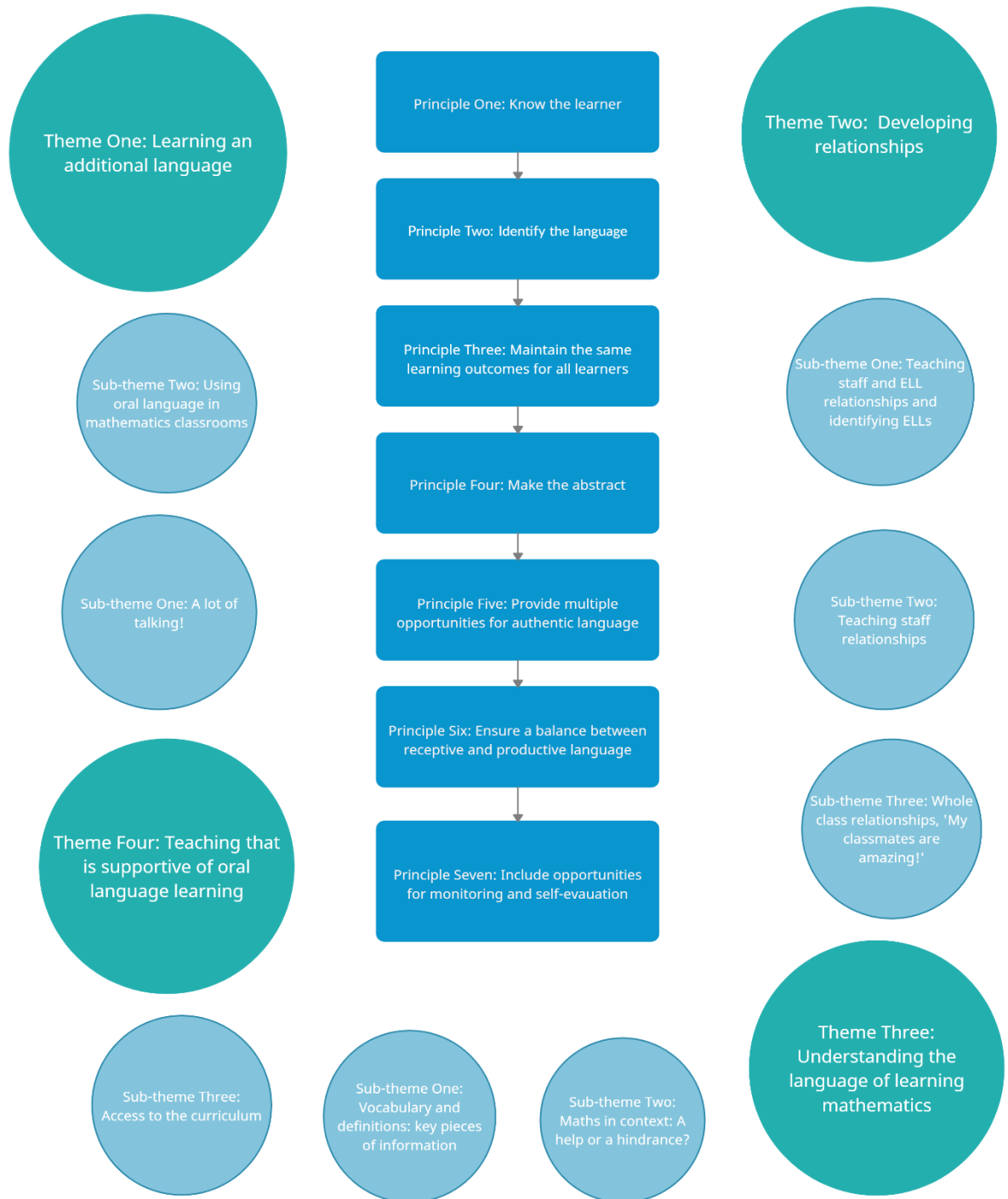


Figure 9: Diagram of relationship between findings and principles

The diagram illustrates the connectedness between the findings and the Ministry of Education's (n.d.) principles.

Summary

This chapter has responded to the research question and has aligned themes with the Ministry of Education's (n.d.) 7 Principles for best practice with ELLs. This discussion chapter has

aligned the principles to the themes and this work is situated in a sociocultural framework. Principle 1 links to the theme of *Learning an additional language*, as well as theme 2, *Developing relationships*. Principle 2 and 3 link to theme three, *Understanding the language of learning mathematics*. Principle 3 also links to theme four, *Teaching that is supportive of oral language learning*. Principle 4 aligns with theme three, *Understanding the language of learning mathematics*. Furthermore, Principle 5 and 6 align with themes three and four, and finally, Principle 7 correlates to themes two and three. These findings and discussion are significant, as it aligns data gathered through observation and teacher and student voice with these seven principles. The data show how mathematics teachers and learners perceive the role of oral interaction in the learning of ELLs at junior secondary school. This study is underpinned by sociocultural theory. Interaction is an important aspect of sociocultural theory. This study has illustrated how different types of interactions occurred in the classroom.

Chapter 6: Conclusion – where to next?

Introduction

This chapter begins by summarising my study. Following on from the summary, the limitations of this research are outlined including the transferability of this research. Implications from this research are discussed. I make some recommendations arising from the study and outline and future-focussed research and finally, I make a concluding statement.

Summary of research

This study arose from my curiosity as a former ESOL teacher, and questions from ELLs about mathematics in the ESOL classroom. Students asked specific questions about NCEA statistics internal standards as well questions about how to read and order information.

This qualitative research takes a sociocultural view of learning, as learning is social in nature. This research used a case-study design, with two sub-units, and used thematic analysis to code and find themes in a range of data drawn from interviews, observations, narrative field notes, and artifacts with students and educators.

The key themes derived from thematic analysis were:

1. Learning an additional language
2. Developing relationships
3. Understanding the language of learning mathematics
 - Vocabulary and definitions: key pieces of information
 - Maths in context: a help or a hindrance?
 - Access to the curriculum
4. Teaching that supports oral language learning
 - A lot of talking!
 - Using oral language in the mathematics classroom

These themes were then aligned with the Ministry of Education's (n.d.) seven ESOL principles, which are sociocultural in nature and regarded as best practice with ELLs. The findings provided empirical evidence of these principles in action in two junior secondary school mathematics classrooms.

Limitations

There are some limitations to be considered with this research.

Challenge of recruiting participants

It was challenging recruiting participants for this study (schools, teachers and ELLs). Subsequently, I changed the focus of this study from senior to junior mathematics. I was able to recruit educators from one large co-educational urban school and two classrooms. In classroom B, only one ELL volunteered to participate. However, data were triangulated methodologically through observations and interviews with the educators from each class.

Time constraints

This study is bounded by a particular time period when data were gathered. As mentioned in the methodology chapter, this research took place in the last weeks of term four, 2019. I observed two lessons in each class but had planned on observing three lessons in each class. The two lessons did not allow me to see a range of topics being taught or how teaching approaches might have developed throughout the year as the teacher and students get to know each other. As it was the very end of the year, teachers were wrapping up topics and may not have used as wide a range of teaching strategies as in the middle of a topic, or at the start of a topic. Classes may have had more freedom than the start of the school year.

ELL participants

The participants in this research were bilingual. The students that participated had a strong understanding of the English language and were able to float confidently between worlds (their home life, as well as school life). These students were able to interact in English as well as their home languages. They were achieving at or above expectation and achieving good grades

in mathematics (Merit or above). This group of students are seldom recognised and studied as they are on peripheries. Due to their proficiency in English, they were able to articulate their perspectives on interaction in the mathematics classroom and fully participate in all aspects of this research.

Transferability

My research was small-scale. It was set in two classrooms in one school in an urban setting. This research adds to scholarship on mathematics and oral interaction for ELLs in New Zealand classes, but more research is needed on the experiences of ELLs in secondary subject classrooms in New Zealand and internationally. The findings have applications for mathematics teachers and content teachers of ELLs and have a degree of transferability in a secondary context – for both junior (years 9 – 10) and senior (years 11- 13) ELLs. The views of participants (educators and ELLs) involved in this research aligned with elements from other studies and also provided further imperative for content teachers to reflect upon the ESOL principles in their teaching of ELLs.

Implications

The data indicated that educators involved in this study were dedicated to both their profession and the students they were responsible for educating. The student participants respected the educators and enjoyed the subject of mathematics. This study emphasises the importance of relationships. Relationships are important and develop from teachers knowing their learners. Knowing the learner is much deeper than knowing what activities students enjoy after school, or the student's home country. This information is important, but knowing the learner includes knowing about the students' background; their language background and proficiency as well as prior subject learning (Edwards, 2012, 2014). Educators need to utilise opportunities to build on this knowledge and recognise skills that ELLs and their families bring to school. There were strong relationships evident in both classes, but the teachers that participated in this research

were unable to identify all of students that participated in this research as ELLs. Teachers were able to easily identify students classified as emergent bilingual, but students from non-English-speaking-backgrounds that were performing similarly or better than their English first language peers were not identified through the existing formal and informal channels.

This study has raised the important connection between language and content in secondary school classrooms. A question arises about how much New Zealand teachers know about the inter-relationship between language and content and what opportunities they have to learn about it. Pre-service teacher education varies across the country. In the United States and Australia pre-service teacher education differs state-to-state, but in recent years pre-service education has started to address the language needs of ELLs. As New Zealand is recognised as a multicultural country, there should be opportunities for teachers to learn how to address the language needs of ELLs, as well as understanding the relationship between content and language.

There are a number of professional-development resources that have been developed by the Ministry of Education to support in-service teachers working with ELLs. There are different resources targeted at different groups of ELLs; to support fee-paying international students, refugees, migrants, as well as Pasifika learners. An example is *The English Language Learning Progressions* (Ministry of Education, 2008a), which explain “what ESOL specialists and mainstream teachers need to know about English language learners in order to maximise their learning and participation” (p. 4). The Ministry of Education also offer a TESSOL scholarship targeted toward teachers of English language learners in ESOL roles, as well as content teachers. These scholarships cover university courses from a variety of institutes. The Ministry has recently offered a new scholarship for further training post TESSOL scholarship. While there are a number of resources freely available and professional development opportunities, research suggests that these resources are not commonly used by mainstream

teachers, and that there are many mainstream teachers that do not know about these resources (Edwards, 2014).

There are other factors that prevent mainstream teachers from finding out about ELLs, such as time constraints, and teacher beliefs about ELLs (Edwards, 2014). While there are resources available, there are often limitations with resources. As a result of this resources need to be updated frequently to fit with changes and trends in education. Many secondary schools in New Zealand are bring-your-own-device (BYOD). Current literature and resources in New Zealand have not been updated to address ELLs education in BYOD secondary mathematics classrooms.

As mentioned in the introduction, Covid-19 has had a devastating impact on education. As a result of the loss of fee-paying international students in New Zealand secondary schools there have been restructures in many schools ESOL and international programmes. Restructures have resulted in loss of jobs, and redeployment to different departments or parts of the school. The loss of skilled professionals is having immeasurable consequences for migrant, children of migrants and former refugees' education and second language development. This means that the dual role of the content teachers as a teacher of content and language is more important than ever. Good teacher practices are pivotal for ELL success. Content teachers no longer have the option of relying on ESOL educators for support for ELLs.

Although the teachers involved in this study had good intentions and were aware of some of the language demands of their subject, they were not aware of all the language demands of mathematics. They viewed themselves as mathematics teachers first and foremost. Research suggests that content teachers are often not receptive to learning about the language demands of their subjects (Gleeson & Davison, 2016). For mathematics teachers to cater for all students in their classes, they need to be aware of the challenges of language and recognise their dual role as language teachers AND content teachers.

Where to next? Future directions for research

In the future, educators could learn from longitudinal studies undertaken over a year or multiple years of ELLs' experiences in different secondary content classrooms in a range of regions (urban and rural) in New Zealand. Such studies would provide educators and those in charge of teacher education insight into the lives of ELLs in different content classrooms. Such longitudinal studies would provide insight into teacher practices that benefit or compromise the learning of ELLs in content classrooms. If educators can apply good teaching practice, ELLs are likely to have greater academic success in content areas. This would allow for effective change to be made in pre-service teacher education programmes, and in-service teacher professional development/learning. Longitudinal studies would not be limited by short time periods, as was the case in this study. This would mean that the results would have a greater degree of trustworthiness, and by including a range of contexts there would be greater transferability.

Another possibility would be a study on New Zealand teachers' beliefs about teaching ELLs in New Zealand secondary classes. This study could complement my qualitative study by taking a mixed-methods approach and gathering quantitative data (questionnaires) and qualitative data (interviews). Such a study could investigate what teachers think is important to know about their students and their backgrounds, and why such information is important. This study could also investigate how teachers learn about students' lives, what they do with such information and how and what they think is useful information about students' backgrounds.

Further research is needed in New Zealand classrooms to understand experiences that ELLs encounter. A similar study on oral interaction in mathematics on a larger scale with a greater number of student participants and parent/caregiver/whānau participants in different secondary schools in New Zealand would be beneficial. ELLs' families seldom participate in

research literature. Given that connecting with and learning about students' lives is at the centre of teaching in New Zealand, this group needs to have their voices heard. Learning from more participants from diverse backgrounds, educators would be in a better position to address the needs of diverse learners.

Summary

This study asked the question 'How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) at junior secondary school?' and has contributed to the literature about ELLs in mathematics classrooms, and content classrooms in New Zealand. The findings have implications for teachers of ELLs and suggest that relationships and making connections with learners' lives are at the heart of good teaching practices for ELLs. This study suggests that content teachers need to recognise their dual role, and really understand the language demands of their subjects. Mathematics as a subject has unique vocabulary, syntax and grammar. There is additional cognitive challenge involved for ELLs in decoding this language, so teachers need to teach the language of their subject as well as the concepts of the subject.

Sociocultural perspectives of learning highlight the importance of interaction. This study highlighted interactive strategies that students both enjoyed and supported their learning. Teacher empathy for the language learning process shaped the way these educators interacted with ELLs, as a result there were some affordances offered to ELLs. Access to the curriculum is important for all learners, including ELLs. Teachers that recognise and accommodate are bridging the equity gap in education. Further studies on ELLs in New Zealand classrooms would add to both New Zealand literature, and international literature and influence meaningful change.

References

- Abedi, J. (2008). Classification system for English language learners: Issues and recommendations. *Educational Measurement: Issues and Practice*, 27(3), 17-31. doi: 10.1111/j.1745-3992.2008.00125.x.
- Abedi, J., & Levine, H. G. (2013). *Fairness in assessment of English learners. Leadership*, 42(3), 26-38.
- Abedi, J., & Lord, C. (2001). *The language factor in mathematics tests. Applied Measurement in Education*, 14(3), 219-234. doi: 10.1207/S15324818AME1403_2.
- Adoniou, M., & Qing, Y. (2014). Language, mathematics and English language learners. *Australian Mathematics Teacher*, 70(3), 3-13.
- Anthony, G., & Walshaw, M. (2007). *Effective Pedagogy in Pāngarau/Mathematics: Best Evidence Synthesis Iteration (BES)*. Wellington: Ministry of Education.
- Anthony, G., & Walshaw, M. (2009). Characteristics of effective teaching of mathematics: A view from the West. *Journal of Mathematics Education*, 2(2), 147-16.
- Arkoudis, S., & Love, K. (2008). Imagined communities in senior school mathematics: Beyond issues of English language ability. *Journal of Asian Pacific Communication*, 18(1), 71-90. doi: 10.1075/japc.18.1.05ark.
- Barton, B., Chan, R., King, C., Neville-Barton, P., & Sneddon, J. (2005). EAL undergraduates learning mathematics. *International Journal of Mathematical Education in Science and Technology*, 36(7), 721-729. doi: 10.1080/00207390500270950.
- Barwell, R. (2005). Integrating language and content: Issues from the mathematics classroom. *Linguistics and Education*, 16(2), 205-218. doi: 10.1016/j.linged.2006.01.002.
- Bazeley, P., & Richards, L. (2000). *The NVivo Qualitative Project Book*. London, UK: Sage.
- Besterman, K., Williams, T. O., & Ernst, J. V. (2018). STEM teachers' preparedness for English language learners. *Journal of STEM Education*, 19(3), 33-39.
- Bishton, S., Gleeson, M., & Tait, C. (2009). The mathematics teacher as a teacher of language. In R. Averill, & R. Harvey (Eds.), *Teaching secondary school mathematics and statistics: Evidence-based practice* (pp. 159-171). Wellington, NZ: NZCER.

- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101. doi: 10.1191/1478088706qp063oa.
- Braun, V., & Clarke, V. (2012). Thematic analysis. In H. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D. Rindskopf, & K. J. Sher (Eds.), *APA handbook of research methods in psychology. Vol 2: Research designs: Quantative, qualitative, neuropsychological, and biological*. (pp. 57-71). American Psychological Association.
- Chappell, P. (2014). Engaging learners: Conversation - or dialogic-driven pedagogy? *ELT Journal*, 68(1), 1-11. doi: 10.1093/elt/cct040.
- Clarke, D. (2004). Patterns of participation in the mathematics classroom. In M. Hoines & A. Fuglestad (Eds.), *Proceedings of the 28th conference of the International Group for the Psychology of Mathematics Education* (Vol. 2, pp. 231-238). Bergen: PME.
- Clarke, V., & Braun, V. (2017). Thematic analysis. *The Journal of Positive Psychology*, 12(3), 297-298. doi: 10.1080/17439760.2016.1262613.
- Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education* (6th ed.). New York, NY: Routledge.
- Creswell, J. W. (2014). *Educational research: Planning, conducting and evaluating quantitative and qualitative research* (4th ed.). Harlow, UK: Pearson Education.
- Crosson, A. C., Hughes, E. M., Blanchette, F., & Thomas, C. (2020). What's the point? Emergent bilinguals' understanding of multiple-meaning words that carry everyday and discipline-specific mathematical meanings. *Reading & Writing Quarterly*, 36(2), 84-103. doi: 10.1080/10573569.2020.1715312.
- Chval, K. B., Pinnow, R. J., & Thomas, A. (2015). Learning how to focus on language while teaching mathematics to English language learners: A case study of Courtney. *Mathematics Education Research Journal*, 27(1), 103-127. doi:10.1007/s13394-013-0101-8.
- Davison, C. (2001). ESL in Australian schools: From the margins to the mainstream. In B. Mohan, C. Leung, & C. Davison (Eds.), *English as a second language in the mainstream: Teaching, learning, and Identity*. (pp. 11-39). London, England: Longman.
- Davison, C., & Ollerhead, S. (2018). Global developments in literacy research for science education. In K. S. Tang, & K. Danielsson (Eds.), *But I'm not an English teacher!:*

- Disciplinary literacy in Australian science classrooms.* (pp. 29-43). Springer. doi: 10.1007/978-3-319-69197-8.
- De Jong, E. J., & Harper, C. A. (2005). *Preparing mainstream teachers for English-language learners: Is being a good teacher good enough?* *Teacher Education Quarterly*, 32(2), 101-124.
- De Oliveira, L. C. (2011). In their shoes: Teachers experience the needs of English language learners through a math simulation. *Multicultural Education*, 19(1), 59-62.
- De Oliveira, L. C., & Civil, M. (2020). Introduction. In L. C. de Oliveira, & M. Civil (Eds.), *Teaching Mathematics to English Language Learners: Preparing Pre-service and In-service Teachers* (pp. 123-140). Palgrave Macmillan. doi: 10.1007/978-3-030-48355-5.
- DelliCarpini, M. (2015). Building bridges and crossing borders: Preparing secondary teachers for ELLs. Paper presented at TESOL 2015, Toronto, ON. Retrieved from https://www.tesol.org/docs/default-source/tesol-convention/tesol-2015-final-program_pages_web_lowres.pdf?sfvrsn=0.
- Denscombe, M. (1998). *The good research guide for small-scale social research projects*. Buckingham, UK: Open University Press.
- Di Pietro, G., Biagi, F., Dinis Mota Da Costa, P., Karpinski, Z., & Mazza, J. (2020). *The likely impact of COVID-19 on education: Reflections based on the existing literature and recent international datasets*. Luxembourg: Publications Office of the European Union.
- Diezmann, C. M., & Watters, J. J. (2001). The collaboration of mathematically gifted students on challenging tasks. *Journal for the Education of the Gifted*, 25(1), 7-31.
- Education Council. (2017). *Our Code, Our Standards: Code of Professional Responsibility and Standards for the Teaching Profession*. Wellington: Education Council.
- Education Counts. (2020). *School Rolls*. Retrieved from Education Counts: <https://www.educationcounts.govt.nz/statistics/6028>.
- Edwards, S. (2012). What do New Zealand secondary mainstream teachers know about their English language learners? *New Zealand Journal of Teachers' Work*, 9(2), 107-118.

- Edwards, S. (2014). Supporting English language learners: New Zealand secondary mainstream teachers' knowledge and use of recommended teaching resources and strategies. *New Zealand Journal of Educational Studies*, 49(1), 43-58.
- Fontana, F., & Frey, J. (2000). The interview: From structured questions to negotiated text. In N. K. Denzin, & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed., pp. 645-672). Thousand Oaks, CA: Sage.
- Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2015). *How to design and evaluate research in education* (9th ed.). New York: NY: McGraw-Hill Education.
- Franken, M., & McComish, J. (2003). *Improving English language outcomes for students receiving ESOL services in New Zealand schools, with a particular focus on new immigrants*. Wellington: Ministry of Education.
- Gibbons, P. (2003). Mediating language learning: Teacher interactions with ESL students in a content-based classroom. *TESOL Quarterly*, 37(2), 247-273. doi: 10.2307/3588504.
- Gibbons, P. (2007). Mediating academic language learning through classroom discourse. In J. Cummins, & C. Davison (Eds.), *International handbook of English language teaching* (pp. 701-718). Boston, MA: Springer.
- Gibbons, P. (2009). *English Learners, Academic Literacy, and Thinking: Learning in the Challenge Zone*. Portsmouth, NH: Heinemann.
- Gibbons, P. (2015). *Scaffolding language, scaffolding learning: Teaching English language learners in the mainstream classroom* (2nd ed.). Portsmouth, NH: Heinemann.
- Gleeson, M. (2012). 'Jack of all trades': The ambiguous role of the ESOL teacher in secondary schools. *Teacher Education Advancement Network Journal*, 4(12), 1-24.
- Gleeson, M., & Davison, C. (2016). A conflict between experience and professional learning: Subject teachers' beliefs about teaching English language learners. *RELC Journal*, 47(1), 43-57. doi: 10.1177/0033688216631221.
- Gough, J. (2007). Conceptual complexity and apparent contradictions in mathematics language. *The Australian Mathematics Teacher.*, 63(2), 8-16.
- González, G., & DeJarnette, A. F. (2012). Agency in a geometry review lesson: A linguistic view on teacher and student division of labour. *Linguistics and Education*, 23(2), 182-199. doi: 10.1016/j.linged.2012.02.001.

- Gustein, E. (2003). Teaching and learning mathematics for social justice in an urban, Latina school. *Journal for Research into Mathematics Education*, 34(1), 37-73.
- Gutiérrez, R. (2002). Beyond essentialism: The complexity of language in teaching mathematics to Latina/o students. *American Educational Research Journal*, 39(4), 1047-1088. doi: 10.3102/000283120390041047.
- Hammond, J. (Eds.). (2001). *Scaffolding: Teaching and learning in language and literacy education*. New South Wales, Australia: Primary English Teaching Association.
- Hammond, J., & Gibbons, P. (2005). What is scaffolding? *Teachers' voices*, 8, 8-16.
- Hammond, J. (2006). High challenge, high support: Integrating language and content instruction for diverse learners in an English literature classroom. *Journal of English for Academic Purposes*, 5, 269-283. doi: 10.1016/j.jeap.2006.08.006.
- Harper, C., & de Jong, E. (2004). Misconceptions about teaching English language learners. *Journal of Adolescent & Adult Literacy*, 48(2), 152-162. doi: 10.1598/JAAL.48.2.6.
- Harper, C., & de Jong, E. (2009). English language teacher expertise: The elephant in the room. *Language and Education*, 23(2), 137-151. doi: 10.1080/09500780802152788.
- Hébert, Y., Guo, Y., & Pellerin, M. (2008). New horizons for research on bilingualism and plurilingualism: A focus on languages of immigration in Canada. *Encounters in Theory and History of Education*, 9, 57-74. doi: 10.15572/ENCO2008.05.
- Irujo, S. (2007). So just what is the academic language of mathematics. *The ELL outlook*, 6(3), 1-6.
- Johnson, R. B., & Christensen, L. (2017). *Educational research: Quantitative, qualitative and mixed approaches* (6th ed.). Thousand Oaks, CA: Sage.
- Kersaint, G., Thompson, D. R., & Petkova, M. (2014). *Teaching mathematics to English language learners*. Routledge.
- Khisty, L., & Chval, K. (2002). Pedagogic discourse and equity in mathematics: when teachers' talk matters. *Mathematics Education Research Journal*, 14(3), 154-168. doi: 10.1007/BF03217360.
- Kibler, A. K., & Valdés, G. (2016). Conceptualizing Language Learners: Socioinstitutional Mechanisms and their Consequences. *The Modern Language Journal*, 100(Supplement), 96-116. doi: 0.1111/modl.12310.

- Kitchen, M., & Gray, S. (2012). Meeting the needs of English language learners in Aotearoa New Zealand schools. *Innovation in Language Learning and Teaching*, 7(2), 93-106. doi: 10.1080/17501229.2012.699529.
- Krashen, S.D. (1982). *Principles and practice in second language acquisition*. Oxford, England: Pergamon.
- Krashen, S.D. (1985). *The input hypothesis: Issues and implications*. London, England: Longman.
- Kvale, S. (1996). *Interviews: An introduction to qualitative research interviewing*. Thousand Oaks, CA: Sage.
- Kvale, S. (2007). Interview variations. In S. Kvale, *Qualitative research kit: Doing interviews* (pp. 68-77). London, UK: Sage.
- Lantolf, J. F. (2000). Introducing sociocultural theory. *Sociocultural theory and second language learning*, 1, 1-26.
- Latu, V. F. (2005). Language factors that affect mathematics teaching and learning of Pasifika students. *CITeseer*, 483-490.
- Lesser, L. M. (2020). Redesigning a statistics literacy course to help prepare pre-service teachers to teach (statistics to) English language learners. In L. C. de Oliveira, & M. Civil (Eds.), *Teaching Mathematics to English Language Learners: Preparing Pre-service and In-service Teachers* (pp. 27-46). Palgrave Macmillan. doi: 10.1007/978-3-030-48355-5.
- Leung, C. (2007). Integrating school-aged ESL learners into the mainstream curriculum. In J. Cummins & C. Davison (Eds.), *International handbook of English language teaching, Part I* (pp. 249–69). New York, NY: Springer.
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Newbury Park, CA: Sage.
- Lincoln, Y. S., & Guba, E. G. (1986). But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. *New directions for program evaluation*, 30, 73-84.
- Logan, J. K., & Kieffer, M. J. (2017). Evaluating the role of polysemous word knowledge in reading comprehension among bilingual adolescents. *Reading and Writing*, 30(8), 1687-1704. doi: 10.1177/0022487108322110.

- Lucas, T., Villegas, A., & Freedson-Gonzalez, M. (2008). Linguistically responsive teacher education: Preparing classroom teachers to teach English language learners. *Journal of Teacher Education*, 59(4), 361-373. doi: 10.1177/0022487108322110.
- McGee, A., Haworth, P., & MacIntyre, L. (2015). Leadership practices to support teaching and learning for English language learners. *TESOL Quarterly*, 49(1), 1-23. doi:10.1002/tesq.162.
- Mercado, C. I. (2001). The learner: “race,” “ ethnicity,” and linguistic difference. In V. Richardson (Ed.), *The Handbook of Research on Teaching* (4th ed.). Washington DC: American Educational Research Association.
- Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative Research: A Guide to Design and Implementation* (4th ed.). San Francisco, CA: Jossey-Bass.
- Ministry of Education. (1999). *Non-English-Speaking-Background Students: A handbook for schools*. Wellington: Learning Media.
- Ministry of Education. (2003). *Effective Literacy Strategies in Years 9 to 13: A Guide for Teachers*. . Wellington: Learning Media.
- Ministry of Education. (2006). *Making Language and Learning Work 1: Integrating language and learning in secondary Maths and Science*. Wellington.
- Ministry of Education. (2008a). *The English Language Learning Progressions Years 9-13*. Wellington: Learning Media.
- Ministry of Education. (2008b). *Working with English language learners: A handbook for teacher aides and bilingual tutors*. Wellington: Ministry of Education.
- Ministry of Education. (2015). *The New Zealand Curriculum*. Wellington: Learning Media.
- Ministry of Education. (2021, January 15). *Types of schools and year levels*. Retrieved from Ministry of Education: <https://www.education.govt.nz/new-zealands-network-of-schools/about/types-of-schools-and-year-levels/>
- Ministry of Education. (n.d.). *ESOL principles*. Retrieved from ESOL Online: <https://esolonline.tki.org.nz/ESOL-Online/Learning-about-my-students-needs/Knowledge-of-English-language-learning/ESOL-principles>.
- Mohan, B., Leung, C., & Davison, C. (2001). *English as a second language in the mainstream: Teaching, learning and identity*. New York, NY: Longman.

- Moschkovich, J. (2005). Using two languages when learning mathematics. *Educational Studies in Mathematics*, 64(2), 121-144. doi: 10.1007/s10649-005-9005-1.
- Moschkovich, J. N. (Eds.). (2010). *Language and mathematics education: Multiple perspectives and directions for research*. IAP.
- Moschkovich, J. N. (2012). Mathematics, the Common Core, and language: Recommendations for mathematics instruction for ELLs aligned with the Common Core. *Proceedings of the Understanding Language conference*. Stanford, CA: Stanford University Press.
- Moschkovich, J. N. (2013). Principles and guidelines for equitable mathematics teaching practices and materials for English language learners. *Journal of Urban Mathematics Education*, 6(1), 45-57.
- Murrey, D. L. (2008). Differentiating instruction in mathematics for the English language learner. *Mathematics Teaching in the Middle School*, 14(3), 146-153.
- Neville-Barton, P., & Barton, B. (2005). *The relationship between English-language and mathematics learning for non-native speakers*. Retrieved from Teaching & Learning Research Initiative:
http://www.tlri.org.nz/sites/default/files/projects/9211_summaryreport.pdf.
- Oliver, G. P., & Gregory, K. M. (2020). Engaging ELLs in mathematics learning through meaning-making activities. In L. C. de Oliveira, & M. Civil (Eds.), *Teaching Mathematics to English Language Learners: Preparing Pre-service and In-service Teachers* (pp. 123-140). Palgrave Macmillan. doi: 10.1007/978-3-030-48355-5.
- Oliveira, A. W., Meskill, C., & Yasrebi, S. (2020). Improving algebra teachers' ability to factor in language: Complementary expertise in action. In L. C. de Oliveira, & M. Civil (Eds.), *Teaching Mathematics to English Language Learners: Preparing Pre-service and In-service Teachers* (pp. 73-92). Palgrave Macmillan. doi: 10.1007/978-3-030-48355-5.
- Olson, M. R., & Truxaw, M. P. (2009). Preservice science and mathematics teachers discursive metaknowledge of text. *Journal of Adolescent & Adult Literacy*, 52(5), 422-431. doi: 10.1598/JAAL.52.5.6.
- Patton, M. Q. (1987). *How to use qualitative methods in evaluation*. Newbury Park, CA: Sage.

- Pereira, N., & de Oliveira, L. C. (2015). Meeting the linguistic needs of high-potential English language learners. *TEACHING Exceptional Children*, 47(4), 208-215. doi: 10.1177/0040059915569362.
- Ruiz, M. I., & Gallagher, M. A., (2020). Designing professional development to support teachers' productive beliefs, knowledge, and practices for teaching mathematics to English language learners. In L. C. de Oliveira, & M. Civil (Eds.), *Teaching Mathematics to English Language Learners: Preparing Pre-service and In-service Teachers* (pp. 47-68). Palgrave Macmillan. doi: 10.1007/978-3-030-48355-5.
- Rutherford, G. (2011). "Doing Right By": Teacher Aides, Students with Disabilities, and Relational Social Justice. *Harvard Educational Review*, 81(1), 95-119. doi: 10.17763/haer.81.1.wu14717488wx2001c.
- Schleppegrell, M. J. (2007). The Linguistic Challenges of Mathematics Teaching and Learning: A Research Review. *Reading & Writing Quarterly*, 23(2), 139-159. doi: 10.1080/10573560601158461.
- Schleppegrell, M. J. (2009). Language in academic subject areas and classroom instruction: What is academic language and how can we teach it? *The role of language in school learning sponsored by The National Academy of Sciences*, 1-39. Menlo Park, CA.
- Sharpe, T. (2008). How can teacher talk support student learning? *Linguistics and Education*, 19(2), 132-148. doi: 10.1016/j.linged.2008.05.001.
- Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information*, 22(2), 63-75. doi: 10.3233/EFI-2004-22201.
- Short, D., & Echevarria, J. (2004). Teacher skills to support English language learners. *Educating Language Learners*, 62(4), 8-15.
- Smith, L. M. (1978). An evolving logic of participant observation, educational ethnography, and other case studies. In L. Shulman (Ed.), *Review of research in education* (pp. 316-377). Itasca, IL: Peacock.
- Stacey, K. (2009). Professional development for bilingual tutors in New Zealand: A pedagogy of support. *TESOL in Context*, 2, 1-14.
- Spence, D. G. (2007). Supervising for Robust Hermeneutic Phenomenology: Reflexive Engagement. *Qualitative Health Research*, 27(6), 836-842. doi: 10.1177/1049732316637824.
- Stake, R. E. (1995). *The Art of Case Study Research*. Thousand Oaks, CA: Sage.

- Stake, R. E. (2006). *Multiple case study analysis*. New York, NY: The Guilford Press.
- Tan, M. (2011). Mathematics and science teachers' beliefs and practices regarding the teaching of language in content learning. *Language Teacher Research*, 15(3), 325-342. doi: 10.1177/1362168811401153.
- Thornton, C., Langrall, C., & Jones, G. (1997). Mathematics instruction for elementary students with learning disabilities. *Journal of Learning Disabilities*, 30(2), 142-149.
- Trahey, M., & Spada, N. (2020). Focusing on language and content with adolescent English language learners in the mainstream classroom. *Canadian Modern Language Review*, 76(3), 218-242.
- Tsui, A. (2001). Classroom Interaction. In R. Carter, & D. Nunan (Eds.), *The Cambridge Guide to Teaching English to Speakers of Other Languages* (pp. 120-126). New York, NY: Cambridge University Press.
- Turkan, S., De Oliveira, L., & Lee, O. (2014). Proposing a knowledge base for teaching academic content to English language learners: Disciplinary linguistic knowledge. *Teachers College Record*, 116(3), 1-30.
- Turner, R. (2011). Identifying cognitive processes important to mathematics learning but overlooked. *The Australian Mathematics Teacher*, 67(2), 22-26.
- Veel, R. (1999). Language, knowledge and authority in school mathematics. In F. Christie (Eds.), *Pedagogy and the shaping of consciousness: Linguistic and social process* (pp. 185-216). London, UK: Continuum.
- Victoria University of Wellington (2019). *Human Ethics Policy*.
- Villegas, A. M., & Lucas, T. (2002). Preparing culturally responsive teachers: Rethinking the curriculum. *Journal of Teacher Education*, 53, 20-32. doi: 10.1177/0022487102053001003.
- Walqui, A. (2007). Scaffolding instruction for English language learners: A conceptual framework. In O. Garcia, & C. Baker (Eds.), *Bilingual education: An introductory reader* (pp. 202-218). Clevedon, UK: Multilingual Matters.
- Wells, G. (2007). Who we become depends on the company we keep and what we do and say together. *Journal of Educational Research*, 46(1-2), 100-103. doi: 10.1016/j.jer.2007.07.010.

- Wong Fillmore, L., & Snow, C. (2000). *What teachers need to know about language*. Retrieved from <https://files.eric.ed.gov/fulltext/ED444379.pdf>.
- Yeong I, J., & Yu, J. (2020). Preparing mathematics preservice teachers for teaching emergent bilinguals through concurrent intervention. In L. C. de Oliveira, & M. Civil (Eds.), *Teaching Mathematics to English Language Learners: Preparing Pre-service and In-service Teachers* (pp. 9-26). Palgrave Macmillan. doi: 10.1007/978-3-030-48355-5.
- Yin, R. K. (2009). *Case study research: Design and methods* (4th ed.). Thousand Oaks, CA: Sage.
- Yin, R. K. (2012). Case study methods. In H. E. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D. E. Rindskopf, & K. J. Sher (Eds.), *APA handbook of research methods in psychology, Vol 2: Research designs: Quantitative, qualitative, neuropsychological, and biological* (pp. 141-155). Washington: American Psychological Association.
- Yin, R. K. (2014). *Case study research: Design and methods* (5th ed.). Thousand Oaks, CA: Sage.
- Yin, R. K. (2018). *Case study research and applications: design and methods* (6th ed.). Thousand Oaks, CA: Sage.

Appendices

Appendix 1: Ethics Approval



VICTORIA UNIVERSITY OF
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TE HERENGA WAKA

Phone 0-4-463 6028
Email judith.loveridge@vuw.ac.nz

TO	Sara McKee
FROM	Associate Professor Judith Loveridge, Convenor, Human Ethics Committee
DATE	18 October 2019
PAGES	1
SUBJECT	Ethics Approval Number: 27721 Title: How do mathematics teachers perceive the role of oral interaction in the learning of English language learners (ELLs) at senior level?* *NB: An amendment to change the parameters of the research from 'senior' to 'junior' has been approved by the ethics committee.

Thank you for your application for ethical approval, which has now been considered by the Human Ethics Committee.

Your application has been approved from the above date and this approval is valid for three years. If your data collection is not completed by this date you should apply to the Human Ethics Committee for an extension to this approval. Please make sure you do this prior to the expiry date of the approval as we are not able to extend applications for which the approval has expired.

Best wishes with the research.

Kind regards,

Judith Loveridge

Convenor, Victoria University of Wellington Human Ethics Committee

Appendix 2: Information and consent form for school principal



How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) at junior level?

INFORMATION SHEET FOR PRINCIPALS

I would like to invite your school to participate in this research project, as your school is secondary school with a high number of English language learners (ELLs). If you agree to this, and are happy for me to conduct my research, I will approach your teachers.

Who am I?

My name is Sara McKee, and I am a Masters student in Education at Victoria University of Wellington. I am also a secondary school teacher, teaching ESOL and Social Studies at a coeducational school, north of Wellington. This research project is work towards my Masters of Education thesis.

What is the aim of the project?

This project aims to investigate how teachers of mathematics and learners in junior secondary school (years 9 and 10) view the role of interaction in the learning of students who are English language learners (ELLs). The overall aim of this research is to find practical recommendations that busy secondary teachers can make in their teaching to make oral interactions more effective for ELLs. The Victoria University of Wellington Human Ethics Committee (application ID number 0000027721) has approved this research.

How can you help?

Your school is invited to participate in this project because you have a large number of ELLs, teach mathematics, and are a secondary school. If you agree that your school will take part, I will interview your teachers, observe classes and conduct focus group interviews with your students. As year 9 and 10 students are likely to be under 16 years of age, I will provide focus group students with an information sheet and consent form for their parents/caregivers. I will audio record the interviews with teachers and students consent, and write these up later. Your staff and students can choose to not answer any question or stop the interview at any time, without giving a reason. Your staff and students can withdraw from the study by contacting me at any time before 20th December 2019. If teachers or students withdraw, the information they have provided will be destroyed or returned to them.

The demands of participants:

Teacher/s:

There will be a pre observation interview with selected teacher/s. This will take approximately 30 minutes of time. This interview will be arranged at a time that is convenient for participants. There will be three hours of observation (per teacher) carried out in your school. There will be one post observation interview, which will take between 30-45minutes of your teacher/s time. This will be arranged at a time convenient to the participants. The intended date for research is Term 4, 2019.

Students:

I will observe your students in class for three lessons. After completing all observations, I will interview your students in groups. This interview will take approximately one hour.

What will happen to the information that is provided?

This means that the researcher named below will be aware of your staff and students' identity, as well as the name of the school but the research data will be combined and identities will not be revealed in any reports, presentations, or public documentation. This means that your staff, students and school will not be named in my thesis, and other publications.

Only my supervisors, and I will read the notes or transcript of the interviews. The interview transcripts, summaries and any recordings will be kept securely and destroyed on 20th December 2024.

What will the project produce?

The information from my research will be used in my Masters of Education thesis. Information gathered from this project may also be used for other publications (papers), presentations, professional development courses and seminars.

If you have any questions or problems, who can you contact?

If you have any questions, either now or in the future, please feel free to contact either myself, or my supervisors.

Student:

Name: Sara McKee
University email address:
mckeesara@myvuw.ac.nz

Primary supervisor:

Name: Dr Carolyn Tait
Role: Supervisor
School: School of Education,
Victoria University of Wellington
Phone: +64-4-463-9590
carolyn.tait@vuw.ac.nz

Co supervisor:

Name: Dr Margaret Gleeson
Role: Supervisor
School: School of Education,
Victoria University of Wellington
Phone: +64-4-463-5285
margaret.gleeson@vuw.ac.nz

Human Ethics Committee information

If you have any concerns about the ethical conduct of the research you may contact the Victoria University HEC Convenor: Dr Judith Loveridge. Email hec@vuw.ac.nz or telephone +64-4-463 6028.



***How do mathematics teachers and learners perceive the
role of oral interaction in the learning of English
language learners (ELLs) at junior level?***

CONSENT TO UNDERTAKE RESEARCH IN ORGANISATION (SCHOOL)

This consent form will be held for a minimum of five years.

Researcher: Sara McKee, School of Education, Victoria University of Wellington.

- I have read the information sheet and the project has been explained to me.
- I understand that:
- Teachers and students may withdraw from this study at any point before 20th December 2019 and any information they have provided will be returned to them or destroyed.
- The identifiable information that has been provided will be destroyed on 20th December 2024.
- Any information that has been provided will be kept confidential to the researcher and supervisors.
- The findings will be used for a Masters of Education thesis, but may also be used for professional development courses, conference presentations and research papers.
- The observation notes and recordings will be kept confidential to the researcher, and her supervisors.
- I understand that the organisation (school) will not be named or identified in any form of publication.

Signature of Principal:

Name of Principal:

Date:

Contact details (email address):

Appendix 3: Information and consent form for classroom teacher



How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) at junior level?

INFORMATION SHEET FOR TEACHERS

You are invited to take part in this research. Please read this information before deciding whether or not to take part. If you decide to participate, thank you. If you decide not to participate, thank you for considering this request.

Who am I?

My name is Sara McKee, and I am a Masters student in Education at Victoria University of Wellington. I am also a secondary school teacher, teaching English for Speakers of Other Languages (ESOL) and Social Studies. This research project is work towards my Master of Education thesis.

What is the aim of the project?

This project aims to investigate how teachers of mathematics in junior secondary school (years 9 and 10) view the role of oral interaction in the learning of students who are English language learners (ELLs). The overall aim of this research is to find practical recommendations that busy secondary teachers can use in their teaching to make oral interactions more effective for ELLs.

Time demands:

To investigate this, I will invite teachers and students to participate. There will be one initial interview (between myself and teacher participants). This will be audio recorded, and later transcribed. This initial interview should take no more than 30 minutes. After the interview, there will be three audio-recorded classroom observations. These observations will be in a junior mathematics class of your choice. Ideally, there will be at least five English language learners. During this time, I will also be taking narrative field notes of interactions happening in the classroom. These will be transcribed onto a password-protected computer, with originals being destroyed. I will then have one further interview with teacher participants, which should take no longer than 45 minutes and will be audio-recorded, and later transcribed.

The Victoria University of Wellington Human Ethics Committee (application ID number 0000027721) has approved this research.

How can you help?

You have been invited to participate because you are a mathematics teacher, teaching junior mathematics courses with English language learners in your classes. If you agree to take part, I will interview you at your school, or your location of choice. I will ask you questions about where you are up to in your courses, what assessments you are working towards and whether you have had any specific training for working with English language learners. The interview will take approximately 30 minutes. I will audio record the interview with your permission and write it up later. You can choose to not answer any question or stop the interview at any time, without giving a reason. You can withdraw from the study by 20th December 2019, or by contacting me at any time before. If you withdraw, the information you provided will be destroyed or returned to you. After this initial interview, we will then arrange a time for me to complete observations of you teaching your classes. After these observations, we will have another interview (at a time of your convenience), and I will ask you questions about different interactions between you and the English language learners in your class.

What will happen to the information you give?

This research is confidential. This means that the researcher named below will be aware of your identity but the research data will be combined and your identity will not be revealed in any reports, presentations, or public documentation.

Only my supervisors and I will read the notes or transcript of the interview. The interview transcripts, summaries and any recordings will be kept securely and destroyed on 20th December 2024.

What will the project produce?

The information from my research will be used in my Masters of Education thesis. It is possible that data gathered from this project will also be used to write papers, present at conferences or develop professional development sessions. A summary of findings may be given to the school's Board of Trustees. You can receive this information, if requested.

If you accept this invitation, what are your rights as a research participant?

You do not have to accept this invitation if you do not want to. If you do decide to participate, you have the right to:

- choose not to answer any question
- ask for the recorder to be turned off at any time during the interview
- withdraw from the study before 20th December 2019
- ask any questions about the study at any time
- receive a copy of your interview recording
- receive a copy of your interview transcript
- read over and comment on a written summary of your interview/observation notes

- be able to read any reports of this research by emailing the researcher to request a copy

If you have any questions or problems, who can you contact?

If you have any questions, either now or in the future, please feel free to contact:

Student:

Name: Sara McKee
University email address:
mckeesara@myvuw.ac.nz

Primary supervisor:

Name: Dr Carolyn Tait
Role: Supervisor
School: School of Education,
Victoria University of Wellington
Phone: +64-4-463-9590
carolyn.tait@vuw.ac.nz

Co supervisor:

Name: Dr Margaret Gleeson
Role: Supervisor
School: School of Education,
Victoria University of Wellington
Phone: +64-4-463-5285
margaret.gleeson@vuw.ac.nz

Human Ethics Committee information

If you have any concerns about the ethical conduct of the research you may contact the Victoria University HEC Convenor: Dr Judith Loveridge. Email hec@vuw.ac.nz or telephone +64-4-463 6028.



How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) at junior level?

CONSENT TO INTERVIEW AND OBSERVATION - TEACHER

This consent form will be held for a minimum of five years.

Researcher: Sara McKee, School of Education, Victoria University of Wellington.

- I have read the information sheet and the project has been explained to me. My questions have been answered to my satisfaction. I understand that I can ask further questions at any time.
- I agree to take part audio recorded interviews (before observation, and after observation).
- I agree to be observed in the classroom and for this to be audio recorded, and realise that the researcher is watching the class, and interested in the language that is used.

I understand that:

- I may withdraw from this study at any point before 20th December 2019, and any information that I have provided will be returned to me or destroyed.
- The identifiable information I have provided will be destroyed on 20th December 2024.
- Any information/data I provide will be kept confidential to the researcher and her supervisors.
- I understand that the findings will be used for a Masters of Education thesis, and other academic publications or presentations. I realise that I will never be named in any of these publications, but may be referred to as Teacher A or with a pseudonym.
- I understand that the observation notes and recordings will be kept confidential to the researcher, and her supervisors.
- I understand that organisational consent has been provided and the organisation (school) will not be named in any publications.

- I understand that the students that participate in this study have provided consent, and that they will not be named in any publications. They may be referred to by pseudonyms, or by generic terms, such as Student A, B, or C.

Signature of participant:

Name of participant:

Date:

Contact details (email):

Appendix 4: Information and consent form for students present during classroom observations



How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) at junior level?

INFORMATION SHEET FOR STUDENTS AND CONSENT FORM

You are invited to take part in my study. Please read this information before deciding whether or not to take part. If you decide to be in my study, thank you. If you decide not, thank you for thinking about it.

Who am I?

My name is Sara McKee, and I am a Masters student in Education at Victoria University of Wellington. I am also a secondary school teacher, and teach English for Speakers of Other Languages (ESOL) and Social Studies.

What is the aim of the project?

The focus of my project is interactions with English language learners in your mathematics classroom.

The aim of this project is to find strategies that your teachers (and other teachers) can use in their teaching to make talking in class more helpful for English language learners learning mathematics. To study this, I will observe your class and I will audio record the interactions you and the teacher have with English language learners.

This research has been approved by the Victoria University of Wellington Human Ethics Committee (application ID number 0000027721).

How can you help/what is your role?

I will observe your class for three lessons. I may not need to refer to you specifically in my research. You have been invited because you are a student in a senior mathematics class. I am solely focussed on students' and teachers' interactions about mathematics. If I need to refer to you, I will not use your real name. I will use a pseudonym (fake name), or refer to you as Student A, Student B etc.

What will happen to the information you give?

This research is confidential. This means that the researcher (me) will be aware of your identity (who you are) but the research data (information from you) will be combined and your identity will not be revealed in any reports, presentations, or public documentation or my Masters of Education thesis.

The narrative field note summaries and transcripts of audio recordings will be kept safe and destroyed on 20th December 2024.

What will the project produce?

The information from my research will be used in my Masters of Education thesis (my study), and publications in journals, presentations at conferences and professional development at schools. A summary of findings may be given to the school's Board of Trustees.

If you accept this invitation, what are your rights as a research participant?

- ask for the recorder to be turned off at any time during the observation
- ask any questions about the study at any time
- be able to read any reports of this research by emailing the researcher (me) to ask for a copy

If you decline this invitation, what will happen during the observation?

If you do not want to be part of this research, please tick **no** at the bottom of this form. You do not need to let me know your name, or any of your details. Your teacher will ensure that you are placed at a table far away from me. I will make sure that I do not audio record you during the observation. I will also ensure that I do not write any notes during the observation.

If you have any questions or problems, who can you contact?

If you have any questions, either now or in the future, please feel free to contact:

Student:	Primary supervisor:	Co supervisor:
Name: Sara McKee	Name: Dr Carolyn Tait	Name: Dr Margaret Gleeson
University email address: mckeesara@myvuw.ac.nz	Role: Supervisor	Role: Supervisor
	School: School of Education, Victoria University of Wellington	School: School of Education, Victoria University of Wellington
	Phone: +64-4-463-9590	Phone: +64-4-463-5285
	carolyn.tait@vuw.ac.nz	margaret.gleeson@vuw.ac.nz

Human Ethics Committee information

If you have any concerns about the ethical conduct of the research you may contact the Victoria University HEC Convenor: Dr Judith Loveridge. Email hec@vuw.ac.nz or telephone +64-4-463 6028.

Consent

Please circle one of the following, and return to your teacher in the envelope provided.

Yes, I agree to be in the research – if you circled yes, please write your first name _____

No, I do not agree to be part of this research

Date: _____

Appendix 5: Information and consent form for parents/caregivers of students present during classroom observations



How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) at junior level?

INFORMATION SHEET FOR PARENTS/CAREGIVERS OF STUDENTS IN THE CLASS DURING CLASSROOM OBSERVATIONS

Your child is in a class in which a research project is being undertaken, with consent from the school's Principal, and the classroom teacher. Your child is not a direct participant in this research, but may interact with students that are. As your child will not directly be in the research, but is under 16 years of age, I need you to know about it.

Who am I?

My name is Sara McKee, and I am a Masters student in Education at Victoria University of Wellington. I am also a secondary school teacher, teaching ESOL and Social Studies at another school. This research project is work towards my Masters of Education thesis.

What is the aim of the project?

This project aims to investigate how teachers of mathematics and learners in junior secondary school (years 9 and 10) view the role of interaction in the learning of students who are English language learners (ELLs). The overall aim of this research is to find practical recommendations that busy secondary teachers can make in their teaching to make oral interactions more effective for ELLs.

The Victoria University of Wellington Human Ethics Committee (application ID number 0000027721) has approved this research.

Please read the following information.

If you decide that I cannot make notes about their interactions with other class members, please return this consent form to me via email, or to their classroom teacher. In this case, I will not make any notes about things which they might say to the three focus students. If this is not returned within 48 hours, we will assume that you are happy for me to make brief notes about things your child might say with the three participants. Your child's name will not be used, and they will be referred to in generic terms, such as student A, or by using a pseudonym.

How can you help?

During my time observing the mathematics teacher, I will be audio-recording the teacher, and interactions which the teacher might have with English language learners. I will also be taking narrative field notes, which will describe the layout of the classroom, and these might indicate where certain students sit. I will make notes about how students interact together, and it is possible that your child's voice might be recorded, or make notes about the way they talk with

other students. However, I am not gathering data about your child, and will only make notes about their interactions if necessary.

What will happen to the information that is provided?

This research is confidential. This means that the researcher named below might be aware of your child's identity, but the research data will be combined and identities will not be revealed in any reports, presentations, or public documentation. If their identity is known, they will be referred to in generic terms, such as student A, student B or a pseudonym.

Only my supervisors, and I will read the notes or transcript of the focus group interviews. The interview transcripts, summaries and any recordings will be kept securely and destroyed on 20th December 2024.

What will the project produce?

The information from my research will be used in my Masters of Education thesis. Information gathered from this project may also be used for other publications (papers), presentations, professional development courses and seminars.

If you have any questions or problems, who can you contact?

If you have any questions, either now or in the future, please feel free to contact either myself, or my supervisors.

Student:

Name: Sara McKee
University email address:
mckeesara@myvuw.ac.nz

Primary supervisor:

Name: Dr Carolyn Tait
Role: Supervisor
School: School of Education,
Victoria University of Wellington
Phone: +64-4-463-9590
carolyn.tait@vuw.ac.nz

Co supervisor:

Name: Dr Margaret Gleeson
Role: Supervisor
School: School of Education,
Victoria University of Wellington
Phone: +64-4-463-5285
margaret.gleeson@vuw.ac.nz

Human Ethics Committee information

If you have any concerns about the ethical conduct of the research you may contact the Victoria University HEC Convenor: Dr Judith Loveridge. Email hec@vuw.ac.nz or telephone +64-4-463 6028.



***How do mathematics teachers and learners perceive the
role of oral interaction in the learning of English
language learners (ELLs) at junior level?***

**CONSENT FORM FOR PARENTS/CAREGIVERS OF STUDENTS IN THE CLASS
DURING CLASSROOM OBSERVATIONS**

This consent form will be held for a minimum of five years.

Researcher: Sara McKee, School of Education, Victoria University of Wellington.

- I have read the information sheet and understood the information sheet. I understand that I can ask questions at any time by emailing the researcher.
- I am aware that Sara McKee will be conducting a research project in my child's mathematics classroom.

I understand that:

- Identifiable information gathered by the researcher will be destroyed on the 20th December 2024.
- Any information my child provides will be kept confidential to the researcher and supervisors.
- I understand that the findings will be used for a Masters of Education thesis, and other publications.
- I understand that organisational consent has been provided and the organisation (school) will not be named in any publications.
- I understand that the researcher will not use my child's name in any publications, and that this will be replaced with a pseudonym or my child will be referred to in generic terms, such as student A.

Please only return this form if you **do not** give consent for your child's interactions to be recorded. In this case, I will ensure that I do not make narrative field notes about your child's interaction with the three participants that are of interest in this study.

Name of parent/caregiver: _____

Signature of parent/caregiver: _____

This form can be returned to the classroom teacher, or by emailing me, the researcher, Sara McKee
mckeesara@myvuw.ac.nz.

Thank you for taking the time to read this information.

Appendix 6: Information and consent form for ELLs



How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) at junior level?

INFORMATION SHEET FOR ELLs ABOUT CLASSROOM OBSERVATION AND FOCUS GROUP INTERVIEW

You are invited to take part in my study. Please read this information before deciding whether or not to take part. If you decide to be in my study, thank you. If you decide not, thank you for thinking about it.

Who am I?

My name is Sara McKee, and I am a Masters student in Education at Victoria University of Wellington. I am also a secondary school teacher. This research project is work towards my Masters of Education thesis. I am studying to become a better ESOL teacher.

What is the aim of the project?

The focus of my project is watching and listening to how teachers and students talk (interact) in year 9 or 10 mathematics classes. I want to see how your teacher talks with you, how you talk with your teacher, and how you to talk with each other (your classmates).

The aim of this project is to find strategies that your teachers (and other teachers) can use in their teaching to make interacting in class more helpful for your learning. To study this, I will ask teachers and students to be involved.

I will interview your teacher to find out what you are studying, observe you in class for three lessons, interview your teacher again, and finally, interview students in focus groups.

The Victoria University of Wellington Human Ethics Committee (application ID number 0000027721) has approved this research.

How can you help?

You have been invited because you are a student in a junior mathematics class and English is not your first language. If you agree to take part I will observe you in your class for three lessons, and interview you in a focus group. I will ask you questions about how you talk in class, with your teacher and with your classmates. I hope to find out what type of interaction is useful for you and your learning.

The focus group interview will take approximately 45 minutes to one hour. I will audio record this with your permission and write it up later. You can choose to not answer any question or stop the interview at any time, without giving a reason. You can withdraw from the study by 20th December 2019, or by contacting me at any time before. If you withdraw, the information you provided will be destroyed or returned to you. As part of the focus group, it will not be possible to withdraw the information you have provided up to that point, as it will be part of a discussion with other participants.

How much time is involved and how will this affect my classes?

There is very little time that is involved. I will observe you in class, for three lessons. I will then interview you in a group after all the observations. This will take approximately 45 minutes to one hour. If I need further information, I might email you (if you agree to be part of the study), but it is your choice whether you reply.

What will happen to the information you give?

This research is confidential. This means that the researcher (me) will be aware of your identity (who you are) but the research data (information from you) will be combined and your identity will not be revealed in any reports, presentations, or public documentation.

Only my supervisors and I will read the notes or transcript of the interview. The focus group transcripts, summaries and any recordings will be kept safe and destroyed on 20th December 2024.

What will the project produce?

The information from my research will be used in my Masters of Education thesis (my study). A summary of findings may be given to the school's Board of Trustees. You are welcome to have this information, if you like.

If you accept this invitation, what are your rights as a research participant?

You do not have to be in this study if you do not want to (you can say no). If you do want to be in this study you have the choice to:

- choose not to answer any question
- ask for the recorder to be turned off at any time during the focus group interview
- withdraw from the focus group while it is taking part, however it will not be possible to withdraw the information you have provided up to that point

- ask any questions about the study at any time
- be able to read any reports of this research by emailing the researcher (me) to ask for a copy.

If you have any questions or problems, who can you contact?

If you have any questions, either now or in the future, please feel free to contact:

Student:

Name: Sara McKee
University email address: mckeesara@myvuw.ac.nz

Primary supervisor:

Name: Dr Carolyn Tait
Role: Supervisor
School: School of Education, Victoria University of Wellington
Phone: +64-4-463-9590
carolyn.tait@vuw.ac.nz

Co supervisor:

Name: Dr Margaret Gleeson
Role: Supervisor
School: School of Education, Victoria University of Wellington
Phone: +64-4-463-5285
margaret.gleeson@vuw.ac.nz

Human Ethics Committee information

If you have any concerns about the ethical conduct of the research you may contact the Victoria University HEC Convenor: Dr Judith Loveridge. Email hec@vuw.ac.nz or telephone +64-4-463 6028.



How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) at junior level?

CONSENT TO PARTICIPATE IN CLASSROOM OBSERVATIONS AND A FOCUS GROUP INTERVIEW

This consent form will be held for a minimum of five years.

Researcher: Sara McKee, School of Education, Victoria University of Wellington.

- I have read the information sheet and the project has been explained to me. My questions have been answered. I understand that I can ask further questions at any time.
- I agree to take part in an audio recorded interview.

I understand that:

- I may withdraw from this study at any point before 20th December 2019, and any information that I have provided will be returned to me or destroyed.
- I can withdraw from the focus group while it is in progress, however it will not be possible to withdraw the information I have provided up to that point as it will be part of a discussion with other participants
- The identifiable information I have provided will be destroyed on 20th December 2024.
- Any information I provide will be kept confidential to the researcher and supervisors.
- I understand that the findings may be used for a Masters of Education thesis, and other publications.
- I understand that the observation notes and recordings will be kept confidential to the researcher, and supervisors.
- I understand that organisational consent has been provided and the organisation (school) will not be named in any publications.

Signature of participant: _____

Name of participant: _____

Date: _____

Contact details (email): _____

Please place this form in the **envelope** provided

Appendix 7: Information and consent form for parents/caregivers of ELLs



How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) at junior level?

INFORMATION SHEET FOR PARENTS/CAREGIVERS

Your child has been invited to take part in this research. Please read this information before deciding whether or not they can take part. If you decide to consent to their participation, thank you. If you decide they cannot participate, thank you for considering this request.

Who am I?

My name is Sara McKee, and I am a Masters student in Education at Victoria University of Wellington. I am also a secondary school teacher, teaching ESOL and Social Studies at another school. This research project is work towards my Masters of Education thesis.

What is the aim of the project?

This project aims to investigate how teachers of mathematics and learners in junior secondary school (years 9 and 10) view the role of interaction in the learning of students who are English language learners (ELLs). The overall aim of this research is to find practical recommendations that busy secondary teachers can make in their teaching to make oral interactions more effective for ELLs.

The Victoria University of Wellington Human Ethics Committee (application ID number 0000027721) has approved this research.

How can you help?

Your child has been invited to participate because they are learning mathematics in a year 9 or 10 class at school, and English is not their first language. If you agree to allow your child to take part in this research I will observe them in class for three lessons, and interview them in a group with other English language learners.

In the focus group I will ask your child questions about learning mathematics, and the types of interaction that are helpful for their learning. I will give your child a brief activity to fill out, asking them what types of interaction they enjoy most in the classroom. The focus group interview will be approximately 45 minutes to one hour. With permission from you, and your child, and other participants, I will audio-record the group interviews. I will then write a transcript later.

The information shared during the focus group is confidential. That means after the focus group, your child should not communicate any details to anyone, including you, about the other participants of the focus group and what they shared.

Your child can change their mind about taking part in the focus group at any time. They can also withdraw while the focus group is in progress. However, it will not be possible to withdraw the information they have provided up to that point, as it will be part of a discussion with other students.

What will happen to the information that is provided?

This research is confidential. This means that the researcher named below will be aware of your child's identity, but the research data will be combined and identities will not be revealed in any reports, presentations, or public documentation. Their identity will not be revealed, as they will be referred to using a pseudonym (fake name).

Only my supervisors, and I will read the notes or transcript of the focus group interviews. The interview transcripts, summaries and any recordings will be kept securely and destroyed on 20th December 2024.

What will the project produce?

The information from my research will be used in my Masters of Education thesis. Information gathered from this project may also be used for other publications (papers), presentations, professional development courses and seminars.

If you have any questions or problems, who can you contact?

If you have any questions, either now or in the future, please feel free to contact either myself, or my supervisors.

Student:

Name: Sara McKee
University email address: mckeesara@myvuw.ac.nz

Primary supervisor:

Name: Dr Carolyn Tait
Role: Supervisor
School: School of Education, Victoria University of Wellington
Phone: +64-4-463-9590
carolyn.tait@vuw.ac.nz

Co supervisor:

Name: Dr Margaret Gleeson
Role: Supervisor
School: School of Education, Victoria University of Wellington
Phone: +64-4-463-5285
margaret.gleeson@vuw.ac.nz

Human Ethics Committee information

If you have any concerns about the ethical conduct of the research you may contact the Victoria University HEC Convenor: Dr Judith Loveridge. Email hec@vuw.ac.nz or telephone +64-4-463 6028.



How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) at junior level?

CONSENT FOR YOUR CHILD TO PARTICIPATE IN CLASSROOM OBSERVATIONS AND A RESEARCH FOCUS GROUP INTERVIEW

This consent form will be held for a minimum of five years.

Researcher: Sara McKee, School of Education, Victoria University of Wellington.

- I have read the information sheet and the project has been explained to me. My questions have been answered. I understand that I can ask further questions at any time.

OR

- I need this form translated or interpreter (circle) Yes No
- The researcher will provide this service to me at no cost to me, and a time that is suitable for me.
- I would prefer to be emailed this information sheet Yes No
My email address is _____

Or

- I would prefer to be called at _____ (time) and my phone number is _____.
- I can ask questions about this study at any time by contacting the researcher or her supervisors.
- I agree that my child can take part in three classroom observations, and one focus group interview.
- I agree that the brief activity that my child does (where they discuss what types of activities they like in mathematics classrooms) can be used in the thesis, I understand that this will be unnamed, and have no identifiable information.

I understand that:

- Information shared by my child during the focus group is confidential and that they are not to share it with me or any friends or family. My child may not share any details about the identities or contributions of the other participants of the focus group.

- My child can withdraw from the focus group without needing to give a reason while it is in progress; however, it is not possible to withdraw the information they have provided up until that point as it is part of a discussion with other participants.
- The identifiable information my child has provided will be destroyed on 20th December 2024.
- Any information my child provides will be kept confidential to the researcher and supervisors.
- I understand that the findings may be used for a Masters of Education thesis, and other publications.
- I understand that organisational consent has been provided and the organisation (school) will not be named in any publications.

I do/do not (circle one) give consent for (name of child) _____ to participate in this research in classroom observations. If I do not consent, I understand that the researcher will not have any interaction with my child during the class, or make any observational notes about how they interact in their mathematics classroom.

I do/do not (circle one) give consent for (name of child) _____ to participate in a focus group interview.

Name of parent/caregiver: _____

Signature of parent/caregiver: _____

This form can be returned to the classroom teacher, or by emailing me, the researcher, Sara McKee mckeesara@myvuw.ac.nz.

Thank you for taking the time to read this information.

Appendix 8: Focus group rules



How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) in junior mathematics classrooms?

Focus group rules

- The information shared in this meeting is confidential. You should not discuss the opinions and comments made by other focus group participants with anybody outside this room. We would like you and others to feel comfortable when sharing information.
- You do not need to agree with others, but you should listen respectfully as others share their views.
- We would like to hear a wide range of opinions: please speak up on whether you agree or disagree.
- There are no right or wrong answers, every person's experiences and opinions are important.
- The meeting is audio recorded, therefore, please one person speak at a time.
- Please feel free to leave your phone on; it might be useful for you if you need to find an unknown word.

Appendix 9: Pre-observation artifact

Teacher A



How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) at junior level?

Pre-observation teacher interview:

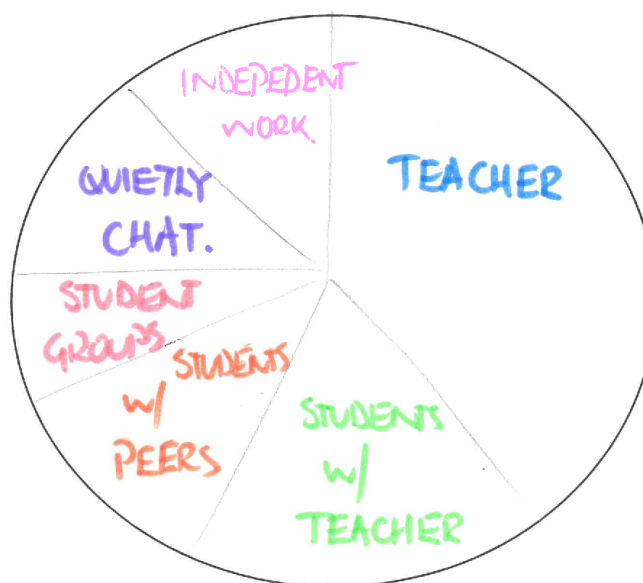
Thinking about interactions in the your classroom

Fill out the pie chart below, using the coloured pencils and label accordingly. Think about the following prompts (below).

Prompts:

- think about the time you spend as a classroom teacher talking
- the time students spend talking with you
- the time that students spend talking with one another about mathematical problems
- the time that groups of students might discuss problems
- the time students' quietly chat while doing their work
- the time that support staff (i.e. teacher aide's) spend talking with students
- the time students work alone independently
- other variables

Assign portions of the chart accordingly.



Teacher B



How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) at junior level?

Pre-observation teacher interview:

Thinking about interactions in the your classroom

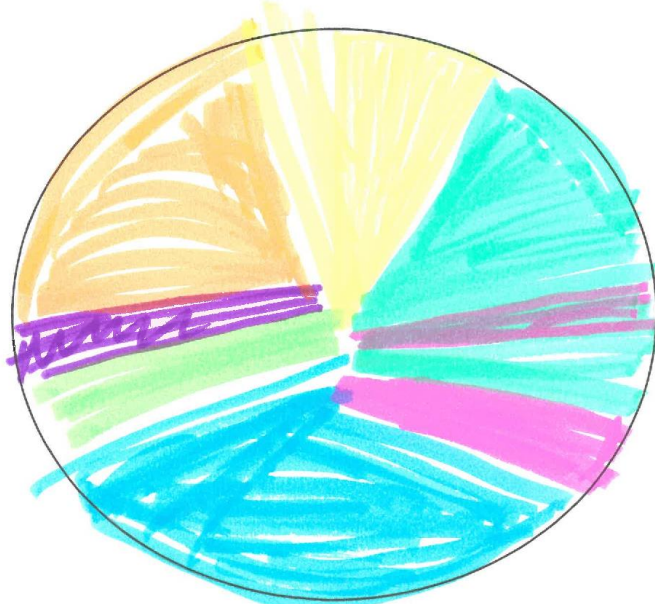
Fill out the pie chart below, using the coloured pencils and label accordingly. Think about the following prompts (below).

Prompts:

- think about the time you spend as a classroom teacher talking
- the time students spend talking with you
- the time that students spend talking with one another about mathematical problems
- the time that groups of students might discuss problems
- the time students quietly chat while doing their work
- the time that support staff (i.e. teacher aide's) spend talking with students
- the time students work alone independently
- other variables

— pairs
— groups

Assign portions of the chart accordingly.



Appendix 10: Student Artifact

Student 1, Classroom A



How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) at junior level?

Ranking activity

Instructions:

Please look at the list of activities below, and rank them in order of 1 – 5, using each number once. 1 – Your least preferred, 5 – Your most preferred.

- Working as a class 3
- Working independently 2
- Listening to the teacher solve a problem 5
- Working as a group (3 or more people) 4
- Working as a pair 1

Information about you:

What other subjects are you studying (please list here):

Science
English

DVCO
DTEC

Why are you studying mathematics:

Social Studies
PE/Health

Please choose a pseudonym (fake name) that you would like to be referred to in this study:

Cash Nasty

Please fold this up, and place in the envelope provided.

Student 2, Classroom A



How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) at junior level?

Ranking activity

Instructions:

Please look at the list of activities below, and rank them in order of 1 – 5, using each number once. 1 – Your least preferred, 5 – Your most preferred.

- Working as a class 3
- Working independently 5
- Listening to the teacher solve a problem 3
- Working as a group (3 or more people) 3
- Working as a pair 4

Information about you:

What other subjects are you studying (please list here): *Science, english, Social Studies*

Why are you studying mathematics: *Because I like it and it's fun. health, Dance*

Please choose a pseudonym (fake name) that you would like to be referred to in this study: *STUDENT A*

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Student 3, Classroom A



How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) at junior level?

Ranking activity

Instructions:

Please look at the list of activities below, and rank them in order of 1 – 5, using each number once. 1 – Your least preferred, 5 - Your most preferred.

- 5 ~~4~~ o Working as a class ____
- 4 o Working independently ____
- 1 o Listening to the teacher solve a problem ____
- 3 o Working as a group (3 or more people) ____
- 2 o Working as a pair ____

Information about you:

What other subjects are you studying (please list here):

Science, health, English, Art, Social and DVCO

Why are you studying mathematics:

cause it part of our core subjects

Please choose a pseudonym (fake name) that you would like to be referred to in this study: Timin

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Student 4, Classroom A



How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) at junior level?

Ranking activity

Instructions:

Please look at the list of activities below, and rank them in order of 1 – 5, using each number once. 1 – Your least preferred, 5 – Your most preferred.

- Working as a class 2
- Working independently 3
- Listening to the teacher solve a problem 4
- Working as a group (3 or more people) 5
- Working as a pair 5

Information about you:

What other subjects are you studying (please list here): English, Science, Social studies, health, P.E, dtech and Japanese

Why are you studying mathematics: To help me out in the future / to have more knowledge

Please choose a pseudonym (fake name) that you would like to be referred to in this study: V

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How do mathematics teachers and learners perceive the role of oral interaction in the learning of English language learners (ELLs) at junior level?

Ranking activity

Instructions:

Please look at the list of activities below, and rank them in order of 1 – 5, using each number once. 1 – Your least preferred, 5 - Your most preferred.

- Working as a class 2
- Working independently 4
- Listening to the teacher solve a problem 1
- Working as a group (3 or more people) 3
- Working as a pair 5

Information about you:

What other subjects are you studying (please list here):

english, maths, science, P.E, Health, social studies, art,
Why are you studying mathematics: DVC

Please choose a pseudonym (fake name) that you would like to be referred to in this study:

Student A

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