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LANGUAGE ISSUES IN MATHEMATICS CLASSROOMS: THE CHALLENGES IN USING ALGEBRAIC LANGUAGE IN KIRIBATI YEAR 12 CLASSROOMS

by

Uere Toorua

A thesis submitted in fulfilment of the requirements for the degree of Master of Arts in Education

School of Education

Faculty of Arts, Law and Education

The University of the South Pacific

December 2017

DECLARATION

Statement by Author

I, Uere Toorua, declare that this thesis is my own work and that, to the best of my knowledge, it contains no material previously published, or substantially overlapping with material submitted for the award of any other degree at any institution, except where due acknowledgement is made in the text.

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Statement by Supervisor

The research in this thesis was performed under my supervision and to my knowledge is the sole work of Mr Uere Toorua.

Date: 9th November, 2017

Name: Greg Burnett

Designation: Senior Lecturer

DEDICATION

I dedicate this to all high school Mathematics teachers who in turn dedicate themselves to students' learning.

ACKNOWLEDGEMENT

I thank all who in one way or another contributed in the completion of this thesis. First, I give thanks to God for protection and ability to do the work.

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ABSTRACT

This thesis reports on research examining the challenges in teaching and learning algebraic language in Kiribati Year 12 Mathematics classrooms. The study uses an interpretivist approach, that is, interviews and classroom observations as the main tools to collect the data from selected participants. The participants involved were Year 12 Mathematics teachers and students who live and experience daily the use of algebraic language in their teaching, learning respectively. An Assessment Officer from the Ministry of Education was also a participant. The data is analyzed thematically following qualitative procedures suggested by Braun and Clarke (2006). The findings show that there are seven dimensions to the challenges encountered by teachers and students when teaching and learning algebraic language. These dimensions include those at both classroom and school levels The thesis concludes with recommendations including the need for formal education training, conducting professional development, using a formalized balance bilingual approach and using contextual approaches in learning Mathematics. Areas for further research are also suggested including the possibility of investigating the perception of parents as well as teachers and students at primary and junior secondary levels.

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Introduction

> *"Students continue to struggle with problem solving tasks. These involve problems described (in English) using words ... It is very likely that the poor English skills of the students impede their ability to understand the actual tasks as the actual mathematical operations were straight forward."*
>
> *(Ministry of Education, 2016, p. 23)*

The statement above portrays the pragmatic experience of Kiribati secondary students in learning Mathematics by using English language. English skills (able to read and understand) need to be employed by students so that they can comprehend Mathematical tasks and perform appropriate calculations to execute correct answers. This is controversial as some researchers like Chard (2003) and Ferrari (2004) argue that English skill is not critical to understanding Mathematics, but instead teaching and learning Mathematics registers are important, as it exposes learners to the terms, symbols and syntax used for Mathematics learning. Nevertheless, Lesley Lee (Mathematics specialist) and Marylin Low (English specialist) in the Pacific region, argue that learning either language (English) or content (Mathematics registers and concepts) in isolation does not address the problem. The two have to be integrated since they are related (Lee & Low, 2007). This then will enable students to learn Mathematics best as they understand the language as well as the content which is perceived as the primary element in learning the subject. This study will investigate the difficulties in teaching and learning Mathematics in Kiribati based on Lee and Low (2007) premise concerning language and content.

This chapter introduces the study by outlining a number of contextual issues, including: Mathematics language and its uses in Pacific schools as well as the context of the study describing learning and teaching Mathematics in Kiribati. In addition, the following areas will also be outlined: the research focus; aim and

research questions of the study; assumptions of the study; rationale of the study; limitations of the study and some preliminary definitions.

Mathematics Language and Its Use

In the Pacific region, English language is currently a dominant language used in learning Mathematics. The dominant use of English originates in the colonial period where it was imposed to facilitate the colonial presence, especially in workplaces and schools (Burnett, 2002; Trinik, Meaney, & Fairhall, 2014). In schools, teachers and students have used English particularly for Mathematics, rather than their first language. This complies with education and language policies of many Pacific countries in contemporary times (Lee & Low, 2007). English in education also meets the pre-requisites of many Pacific workplaces (Teaero, 2009a) which heavily utilize English in terms of official communication. However, in terms of Mathematics learning, Bakalevu (1999) emphasises that the use of English complicates the learning and teaching of the subject. The complication arises when English words and expressions in Mathematics have a different meaning to their ordinary literal meaning. Table 1 below provides two examples of this.

Table 1 Examples of using vocabularies in English and Mathematics

Vocabulary	English literal meaning	Mathematics literal meaning
Differentiate	- Recognize or ascertain what makes (someone or something) different	- It refers to find out the gradient formula by applying operations.
Root	- Cause (a plant or cutting) to grow roots.	- Root of a number refers to a number multiply by itself and gives that number. E.g 3 is the root of 9 since $3 \times 3 = 9$

The problem is often made worse by Pacific teachers who use English language as a medium of instruction in their teaching but often rigorously follow a textbook, limiting their capacity to engage with students and to present concepts using a variety of linguistic structures (Trinik et al., 2014). In the case of the students, they

learn by following what the teachers instruct in the classroom despite the fact that they are learning words, phrases or sentences that are accompanied by Mathematical images that are difficult for them to identify and understand (Manu, 2005). As a result, monolingual students and teachers both struggle in learning and teaching Mathematics using English language only. This in consequence, contributes to lower achievement levels because teachers are not creating language rich classrooms but instead relying on what is in the textbook (Trinik et al., 2014). This then results in rote learning (Ministry of Education, 2008).

Context of the Study

In 2008, a national education summit was held in Tarawa, the capital of Kiribati, to discuss issues regarding the education system in Kiribati. In need of urgent reform were: the Mathematics curriculum, teacher qualifications and training, Mathematics and the social context and, learning Mathematics in the classroom (Ministry of Education, 2008).

Mathematics Curriculum

A Mathematics syllabus exists for each year level starting from elementary to the upper secondary school. The content for each level serves as a prerequisite for the next level (Ministry of Education, 2011). At the secondary level, a local syllabus is used for Years 7 to 11, whereas Year 12 to 13 use a syllabus developed by the *Secretariat of the Pacific Board for Educational Assessment* (SPBEA[1]) which is currently known as *Education Quality and Assessment Program* (EQAP). The Year 12 standards have been nationalized or coordinated by the Kiribati Ministry of Education since 2013, however the EQAP syllabus is still used.

In terms of this study, language differences exist between the Kiribati syllabus and Pacific regional syllabus. The Kiribati syllabus is significantly based on recalling or understanding skills where students are encouraged to learn formula, symbols and apply different operations in dealing with Mathematical problems (Ministry of Education, 2008). The Pacific regional syllabus, on the other hand, focuses more on applying Mathematical knowledge and an ability in practical situations, correcting

[1] This body is under the auspices of the *Secretariat of the Pacific Community* (SPC)

mathematical statements, processing information, making deductions and drawing conclusions (EQAP, 2008). This difference places a much greater demand on teachers and students at the Year 12 level compared to the Year 11 level. There is some anecdotal evidence to suggest that students drop out at the senior level because of this shift in syllabus focus. This syllabus shift, especially in Mathematics, acts as a filter in the learning process (Mayo, 1994) pushing out students from one level to the other. The merit based progression also weeds out students who struggle with the language required to be successful with the more conceptual Mathematics syllabus at the Year 12 level.

The way in which Mathematics is taught also plays a significant role in motivating students and shaping their thinking skills in the learning process (Ferrari, 2004; Taufe'ulungaki, 2009a). The Ministry of Education (2014b, p. 13) reports on the role of language as a motivational factor for students to attend school. It notes that previously students were reluctant to attend school because of English language. The report, however, does note some positive change, based on anecdotal evidence, after the new language policy reinforcing the use of bilingualism in schools was introduced. The new language policy was the output of the 2008 *National Education Summit* and is based on a maintenance model to ensure that students continue to strengthen their knowledge of their first language and culture as they learn about their world then build on their knowledge and understanding as they achieve high levels of proficiency in the second language (NCAF, 2011, p. 34). Learning Mathematics in a bilingual classroom may assist students learning in Mathematics enormously. Barnett, Yarosz, Thomas, Jung, and Blanco (2007), stress that bilingualism has *cognitive benefits*[2] when students switch from English into their local language to make meaning (Manu, 2005). The bilingual language policy indicates that English and Kiribati language have to be both used and interchanged strategically during the learning process. However in practice, Kiribati language is pre-dominant especially in rural schools (Ministry of Education, 2014b). Baker (2011) stresses that cognitive benefits come by students using a balance bilingual approach, that is, the use of English and Kiribati language strategically facilitated by the teacher.

[2] Pacific educators in New Zealand have long been strong advocates for bilingual education policy based on cognitive benefits for learning (McFall-McCaffery & McCaffery, 2012).

Teaching and learning resources are also crucial for the learning of Mathematics. As a result of the 2008 Education reform the Ministry of Education injected a greater amount of teaching resources into schools including those for the teaching of Mathematics (Ministry of Education, 2008, 2014a). Even though all resources are written in English the language difficulty for each school level was given consideration (Ministry of Education, 2014a). At the senior secondary school level, the key resource – the textbook, is from New Zealand.

In summary, the shift in syllabus emphasis from Year 11 to 12, the heavy reliance on English language, the potential for bilingual language policy and the appropriateness of resources are all fundamental curriculum issues impacting on how senior secondary students learn Mathematics.

Mathematics Teachers and Training

The capacity of teachers in teaching Mathematics is also perceived as crucial in the learning process. Teachers are expected to bridge the knowledge gap of Mathematics learners despite any circumstances in the wider system (Bakalevu, 2009). Most Kiribati Mathematics teachers especially, at elementary and junior secondary levels are undertaking upgrading training based on the newly introduced education framework for teaching and learning that has been endorsed for use in all Kiribati schools (Ministry of Education, 2014b). The training process is conducted by *Kiribati Teachers College* (KTC) under the direction of the *Kiribati Education Improvement Program* (KEIP) to outreach to teachers mainly in rural schools. The training is based on new pedagogical styles and techniques involving planning, teaching and assessment. The training also complies with the new bilingual language policy mentioned earlier.

As part of the training, the provision of English language is also under consideration to support the curriculum reforms and language policy (Ministry of Education, 2014b). *Teaching English to Speakers of Other Language* (TESOL) skills and the *Kiribati English Learning Program* (KELP) were implemented and conducted to train teachers to teach especially at year 5/6 and for junior secondary level (JSS). It has been reported, however, that KELP was not successful based on an insufficient budget by the Ministry of Education for replacement teachers. As a result, the

training ceased leaving about 400 teachers without the support to strengthen their own English language skills (Ministry of Education, 2014b, p. 36). There is an on-going need, for professional development for teachers in using English language so that teachers can comply with the bilingual language policy and also the new formative teaching pedagogies.

In terms of secondary school teachers, workshops have been conducted in all schools based on teacher performance standards credited to five main domains: teaching methods, assessment, learning environment, communication, and professionalism (Kiribati Ministry of Education, 2014). In terms of communication, language of instruction should comprise of 80% English and 20% for vernacular. This follows the language policy for bilingualism for senior high schools. The training of teachers is paramount in the government plan for the next four years 2016-2019. Part of this plan is to offer in-service scholarships to teachers to pursue higher qualifications at tertiary institutions and also to release funds from aid donors including *The Australian Department of Foreign Affairs and Trade* (DFAT) (previously known as AusAID) for conducting training within the country (Government of Kiribati, 2015).

Mathematics in Kiribati Social Context

It is highly likely that family social-economic circumstances and also location have an impact on learning English generally and also that used in Mathematics. Those students whose parents are employed in the public service and whose families have resided on South Tarawa where greater levels of English language usage are advantaged compared to students from Kiribati language-only outer islands (Burnett, 2013). Neville-Barton and Barton (2005) state English language is correlated with learning Mathematics especially in understanding word problems. Students who are exposed to greater levels of English language have an advantage over students who do not have the same exposure. Disadvantage in exposure to English language can create the gap in learning Mathematics and other subjects by students, especially those who are schooling in rural and some urban areas. The general educational statistics from Ministry of Education (2016) and the Ministry of Education (2013) show that urban schools are performing marginally better than rural schools overall. As suggested by Bakalevu (1999) and Devlin (2012) social and education policy

needs to address this language imbalance in the interests of equity and access to education and learning for all children.

Mathematics in the Classroom

Learning of Mathematics at the senior level is very functional in that teachers do not make allowance for slower learners. This is based on the assumption that those who have reached the senior level are perceived as capable. This alienates students who do struggle. In regard to the focus of this research, the language of Mathematics makes learning hard for such groups of students. Since Mathematics teaching utilizes a combination of ordinary English and Mathematics English it is very hard to comprehend especially for students who use English as their second language (Bakalevu, 1999).

Summary of Study Context

The study's contextual issues can be summarised in Figure 1 below. Many of these issues need to be addressed to support both Mathematics teachers and students in their teaching and learning respectively.

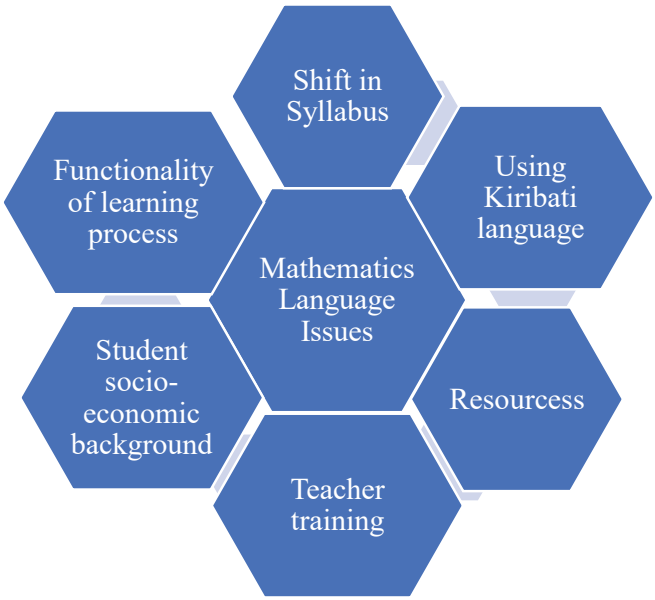

Figure 1 – Contextual issues related to the study

Research Focus

The context described above informs the focus of this research which is to explore the challenges of learning and teaching Mathematics at the senior secondary school in Kiribati. It is vital to carry out this research because of the continuous poor achievement of students in Mathematics.

As shown in Figure 2 below, students' performance by exam mark is consistently low over three recent consecutive years (Ministry of Education, 2013). The very low achievement (blue ones) is found in the exam marks more so than the overall assessment (red ones) which uses less rigid measures forms of assessment. The poor exam results can be taken as a reflection of comprehension of Mathematical languages by Year 12 students since the examination is written in English. Sitting such an examination requires that individual students to understand both English and the English of Mathematics to apply appropriate calculations and computations. This is done without the assistance of their peers or teachers who they often refer to when doing the "softer" classroom-based assessment.

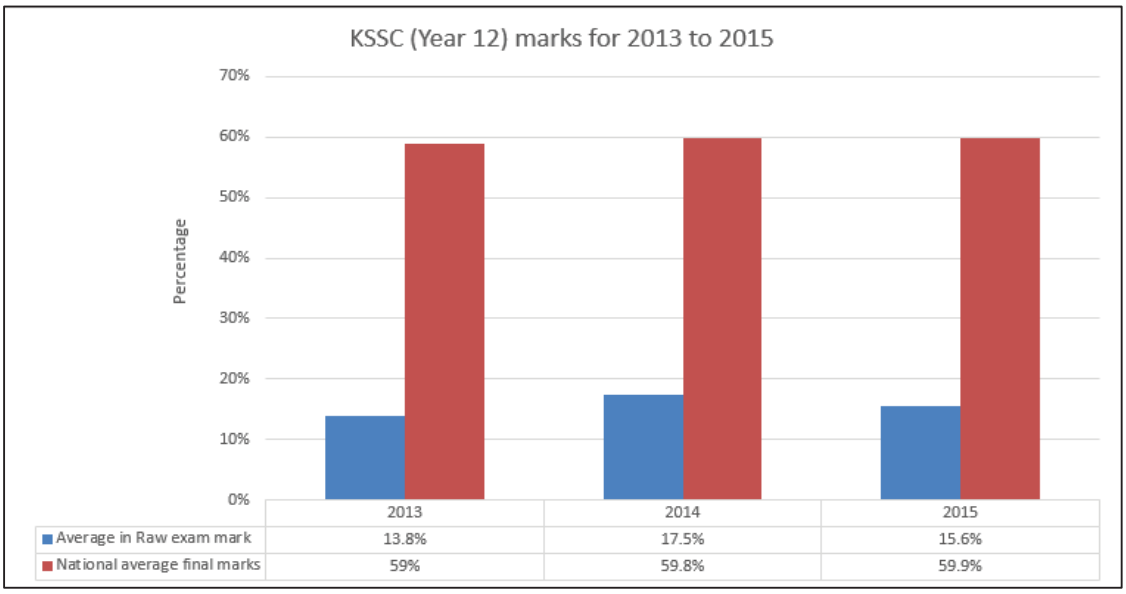

Figure 2: Kiribati Senior Secondary Certificate (Year 12 level) average marks in raw exam mark and in final marks (scaled) (Ministry of Education, 2017).

Aim and Research Questions

Based on the language issues in teaching and learning Mathematics, this research aims to investigate the challenges in learning and teaching algebraic language in Kiribati Year 12 classrooms. Algebraic language is the main focus because it is a prerequisite topic to further Mathematics topics such as: probability, geometry, calculus, trigonometry, and graphs and functions. All these require the fundamental skill in the algebraic register (Street, 1993; Trinik et al., 2014). To further guide the research, the following research questions have been developed.

Research Questions:

These research questions are generally from the research aim mentioned above.

i. What are the learning difficulties faced by Year 12 students in learning algebraic language?
ii. What are the teaching challenges encountered by Year 12 Mathematics teachers in teaching algebraic language?
iii. What are the possible ways to improve the learning of algebra in year 12 classrooms?

Researcher reflexivity

In this research, the researcher is an insider as he has experienced the problem of learning Mathematics language with students at the classroom level. The experience of the researcher has led to conducting this research seeking to understand the contributing factors that hinder the teaching and learning process and seek possible ways to address the problem. As an insider, there are advantages and disadvantages to be considered. The advantages include familiarity with the problem at the classroom level and the information collected from teachers and students can be weighed by the researcher as to its validity based on knowledge of the context of the school. The disadvantage, on the other hand, is a degree of potential bias when collecting data especially in knowing some of the teachers who are participants in this research. However, the overall the advantages in having a pre-existing professional relationship with participants outweighs the disadvantages. The data collected is considered richer as a result. As an insider, the research is carried out

reflectively so that the problems of learning and teaching are identified and addressed.

Assumptions of the study

To conduct this research there are two main assumptions being made. Firstly, the research is based on the premise that Year 12 students in Kiribati have English language as their second language and that this lies at the root of their problems in learning algebraic language. Secondly, is the premise that some teachers are not adequately trained to teach algebraic language effectively based on their relatively limited training and that they also have English as their second language.

Rationale for the Study

The study is significant at both the national and personal level. At the national level, the findings of the research addressed in helping students to learn effectively in Mathematics classroom since learning outcomes in the subject are poor compared to outcomes in other key learning areas. See Figure 3 below for evidence of this.

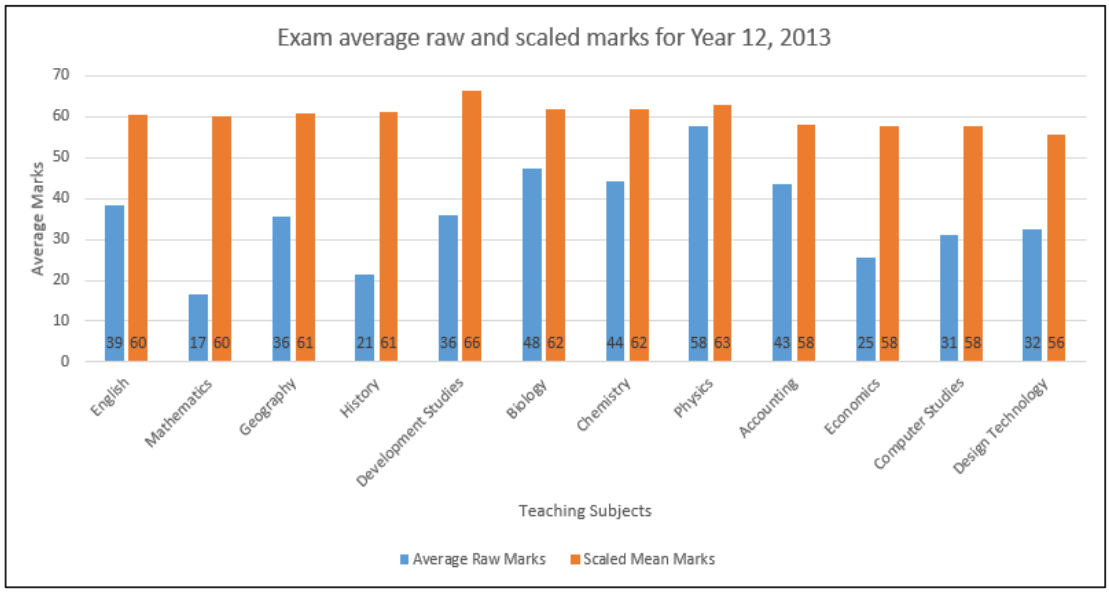

Figure 3: The differences in exam results between teaching subjects for Year 12 students for the year 2013 (Ministry of Education, 2013)

In addition, the findings of the research at the classroom level will provide a basis for teaching interventions. Moreover, the research will also assist the Ministry of Education (MoE) by providing data on the issues in learning Mathematics in order to bring about change. Lastly, the significance of Kiribati cultural pedagogical approaches (Teaero, 2007) in helping students to learn Mathematics will be evaluated.

The contribution of the study over a longer period of time may help to enable individuals to actively participate in problem solving (Bakalevu, 2009) especially with the two current issues of climate change and overpopulation (Siddle, 2014). A local understanding of the Mathematics involved in climate science is crucial in debates and decision making that are often dominated by non-I-Kiribati in other countries. Similarly with overpopulation, the understanding of Mathematical meanings of census reports, for example, may contribute to sustainable planning on how to deal with the problem. At the personal level, the findings will help my practice as a Kiribati secondary Mathematics teacher to understand the struggle of students in learning Mathematics and to provide necessary and appropriate change in my teaching style. In addition to that, carrying out this research will equip me with essential skills to conduct other research later on at the classroom level.

Limitations of the Study

There are two main limitations of the study. The first one is based on not liaising with *Curriculum Development and Resource Center* (CDRC) personnel to include their ideas in the study as they are the ones who designed the curriculum and accompanying language policy to be used in all schools. The second limitation concerns the students' family background. Family background, especially in terms of socio-economic status impacts on a young person's language development and engagement with school generally. Due to the focus of the study, such areas are not considered in great detail.

Preliminary Definitions

Algebraic language

Algebraic language refers to the terms, operations, symbols of Mathematics and problem solving that should be learnt by the students. The algebraic terms commonly used include *simplify, rational, real numbers, integers, expression, factorizing, inequalities, functions, indices, index and log form* among others. Further to this language are the operations and symbols of algebra involving *factorizing* ($\frac{dy}{dx}$), *integration* ($\int f(x)dx$), *inequalities* ($ax + b < c$) among others. With regards to problem solving, Wilson (2009) shows that problems involving one step, two steps or multi-steps problems (i.e problem that requires many steps to solve), especially word or story problems are also heavily language based and in turn create difficulty for English language learners.

Overview of the thesis

The study is organized into five chapters: introduction, literature review, research methodology, analysis and description of findings and discussion. The final chapter will outline implications and areas for future research. Chapter one includes the background of learning and teaching Mathematics in Kiribati. It also contains research focus, aim and research questions of the study, assumption of the study, rationale of the study, limitation of the study and preliminary definitions. Chapter Two provides a review of the existing literature on challenges in learning and teaching Mathematics from a language perspective. Chapter Three focuses on research methodology, framework and design, as well as the description of the school sites of research. Chapter Four contains the results and an analysis of the findings. The final chapter outlines the implications for learning and teaching Mathematics as well as future research on this topic.

CHAPTER 2

Literature Review

Introduction

Most of the tasks in learning and teaching Mathematics involve communication between teacher and pupils and between the pupils themselves. There is oral communication (speaking and listening) and written communication. Communication as a whole is crucial when learning Mathematics as it is a key factor in building understanding (Bakalevu, 1999; Boulet, 2007; Vygotsky, 1978). This, however, has to be used carefully because students' level of understanding is often at a complex stage when dealing with Mathematical words. Sometimes learning Mathematics is compared with learning a foreign language especially for those who are unfamiliar with its vocabulary (Chard, 2003) and grammar (Boulet, 2007). However, becoming fluent at speaking and writing as well as listening and reading can open up new possibilities for creating and communicating Mathematical ideas.

The chapter reviews the existing literature based on language issues in learning Mathematics. It includes: Mathematics and language; Mathematics issues in the Pacific and lastly possible solutions to the problem. The Mathematics and language section considers the problem of understanding Mathematical English, Mathematics written communication, oral Mathematics and writing Mathematically. In terms of Mathematics issues in the Pacific, the issue of curriculum is discussed, then followed by Pacific cultural silence and lastly quality Pacific teaching and learning issues. To improve issues related with Mathematics languages, there is a need for English skills to understand Mathematics, using a strategic balanced Bilingual approach and as well as Mathematics literacy.

Mathematics and Languages

As Mathematics has developed through history, Morgan (2005) reveals that Mathematicians have developed new vocabulary (or new meanings for old vocabulary), new notations and conventional styles of argument with which to think about and communicate new Mathematical ideas and ways of thinking. The process

of linguistic creation is still continuing. *Fractal* (a newly invented word) and *fuzzy logic* (a new application or extension of old words) are but two relatively recent examples. Boulet (2007) stresses that learning to understand the nature of Mathematical language and how to use it is an essential part of learning Mathematics because it is the heart of Mathematical activity.

The discussion below follows Morgan's (2005) ideas on communicating Mathematically. This includes the issues of using Mathematical English, Mathematics and written communication, talking and writing Mathematically.

Mathematical English

Some English vocabulary used in Mathematics may already be familiar to many children in their own social context, whereas others are unique to Mathematics. Morgan (2005) stresses that familiar English expression or words are those which have been *"borrowed"* from everyday English (e.g. *face, power, product, rational)* while words unique to Mathematics are words that are unlikely to be encountered outside the Mathematics classroom (e.g. *quadrilateral, parallelogram, hypotenuse)*. Unfamiliar words may cause difficulty for learners simply because of their unfamiliarity as well as being long, polysyllabic and difficult to pronounce and to spell. Few pupils or teachers bother to learn and familiarize themselves with the Latin or Greek roots of these words which might help in constructing, and remembering their meanings (eg. *Isosceles* from Greek *iso*-equal and *skelos*-leg; *tangent* from the Latin verb *tangere*-to touch). Borrowed "everyday" words on the other hand might be more familiar but can bring with them their own problems, simply because their Mathematical meanings are subtly different from their everyday meanings (Bakalevu, 1999; Chard, 2003; Morgan, 2005). This shows that Mathematical English, whether it is familiar or not, often hard to be understood and learned by students because it often incorporates hidden meanings (Manu, 2005) and graphic representations of the objects they label (Chard, 2003). Consider the Year 12 Mathematics activities shown in Figure 4 below to distinguish Mathematical expression based on familiarity of the language in the Kiribati context. This activity is based on the ideas of Ferrari (2004) who differentiates between familiar and unfamiliar words in Mathematics problems. The activity shows the case that even

when Mathematics English is easy to understand still needs a clear interpretation by students, that is, to understand the underlying images, and principles attached.

An example of word problem in Algebra

At the movies during the weekend, Arikate served ice creams to a group of children from a birthday party. Of the 9 he served, 7 wanted chocolate dipped while the other 2 wanted plain. If it cost a total of $19.25 with a chocolate dipped ice cream being 50 cents more than a plain one, calculate the cost of a plain ice cream.

Figure 4: This activity is an extract from an NCEA Level 2 Mathematics Handbook (Kane, 2010)from New Zealand which is currently used in Kiribati education at senior level

The activity is quite straightforward to understand from an English language perspective. To find the cost of each ice-cream is to apply a *division operation*, that is, the total cost of ice-creams divided by the total number of ice-creams. However, this is not the case since the costs of two type of ice creams are different. This is shown in the phrase "50 cents more than a plain one". Bakalevu (1999) stresses that mis-comprehension of the information is linked to 'relational sentences' and 'compare problems', and the use of logical connectives as common elements in Mathematical problem-solving. Relational sentences include three term series problems like the movie watching scenario above. Ferrari (2004) emphasises that to be able to execute proper calculations, students should be able to interpret the language and principles attached to it. Failure to do so, can lead to a false calculation and computation. Morgan (2005) generalizes that competent students in the subject can easily understand the language because they can interpret the question in a different way. Ferrari (2004) stresses that other pupils have a negative reaction toward such questions which can prevent them from attending to the "*pure*" Mathematical meanings. Rodd (2005) notes the same negative reaction when dealing with complex Mathematical languages, but he stresses it is much stronger in learners that have English as their second language. In Kiribati, this issue is widespread as all students have English as a second language but English language is normally used when learning Mathematics (Ministry of Education, 2011). The trouble is clearly shown by the Ministry of Education (2016) numeracy report showing that students do not fully understand the word problems or application questions even though the questions are straightforward.

To minimize the problem over non-familiarity with Mathematics language, Ferrari (2004) suggests that exposing learners to Mathematical language within the sphere of communication can help to develop their thinking skills so as to be familiar with the language and be aware of underlying principles and concepts. Rodd (2005) on the other hand, suggests bilingual development of concepts in numbers, shape and measurement, for monolingual learners, as it encourages mental flexibility as well as develops the pupil's self-confidence within the increasingly melded cultures of home and school.

Mathematics Written Communication

As part of Mathematical language, written communication is characterised by its use of symbolism and graphic components such as diagrams and graphs (Chard, 2003; Morgan, 2005). Such forms of communication are very powerful for expressing Mathematical ideas, however, they can also be obscure or confusing for learners who are not familiar with the conventions of the system. Such Algebraic symbolism and Graphs and Diagram used in Mathematics are discussed below.

Algebraic symbolism

To distinguish with other Mathematical topics, algebraic symbolism involves making explicit the relationships between the "*unknown or variable"* and the data of a problem, and then moves on to a relatively automatic manipulation of these in order to reach a solution (Crowley, Thomas, & Tall, 1994; Malisani & Spagnolo, 2009). Morgan (2005) adds that algebraic symbolism is used for expressing generalisations of Mathematical problems. For example:

$$\left(\frac{3}{4}+5\right)^2 \text{ or } \int_1^6 \frac{1}{x^2}dx \text{ or } \frac{6x+4}{7x^2-3}$$

Malisani and Spagnolo (2009) found that difficulty in learning algebraic symbols is based on the use of "*unknown variables*[3]" often represented by alphabetical or Greek letters which might lead to false interpretation and can blindly make a learner

[3] The *unknown variable* refers to an algebraic object that can be replaced by a number (Malisani & Spagnolo, 2009). For example, consider equation of $2x + 5 = 15$, where "x" is the *unknown variable* that replaces a number to satisfy the property of the equation.

execute false procedures or principles. Johnston-Wilder (2005) recorded some classroom interaction and activities using algebraic variables and he found that poor conduct of classroom discussion by the teacher can also make learning algebraic symbols difficult by not helping and encouraging students to learn to ask effective questions for themselves. The recorded work of students from Johnston-Wilder (2005) is shown Table 2 below.

Table 2.Examples of students' work using algebraic variables

Activity	Students' Responses	Reason suggested by students	Mathematical perspective
Expand the bracket of $(x + y)^2$	$x^2 + y^2$	Expanding the bracket where x and y share same power (Law of Indices)	Correct answer should be in the form of $x^2 + 2xy + y^2$
Solve the equation $2x = x + 2$	$x = x$	Taking 2 away from each side to give $x = x$	Correct answer should be $x = 2$

Each of these examples show that pupils have not understood something or perhaps the pupils know that there is a rule that can help but have not understood when this rule applies. This situation is similar to I-Kiribati secondary students. Some of them are not able to carry out the procedure using the principles taught. This shows that algebraic symbols need to be understood by students because it is also incorporated certain Mathematical rules. In such situations, Johnston-Wilder (2005) suggests using targeted open questions by the teacher especially with those students who are struggling to understand. However, Malisani and Spagnolo (2009) suggest using natural language enriched by arithmetic language to help students in their difficulties with algebraic symbols.

Graphs and Diagrams

In addition to algebraic symbolism, graphs, tables and diagrams are often used in Mathematics learning to communicate information that may not be available in any

other form. Morgan (2005) stresses that many secondary pupils do not read graphs in the conventional Mathematical way, that is, they attend to only a certain subset of the physical properties of the diagram and assume that, unless otherwise specified, orientation, size (and often other characteristics such as angle) are irrelevant. He explained that using the example of a distance-time graph shown in Figure 5 below.

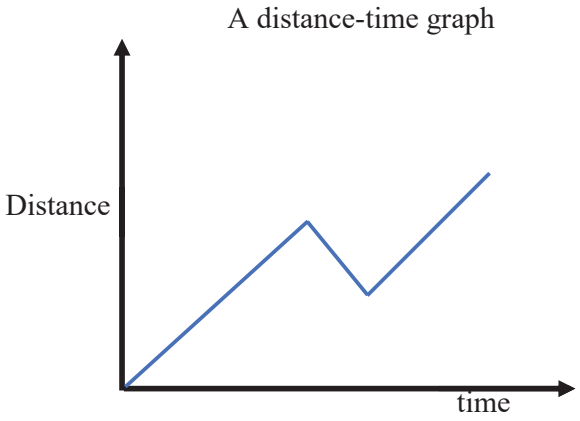

Figure 5: A distance-time graph used to study how students interpret graphs (Morgan, 2005)

Most students at the age of 13 to 15 read distance-time graphs such as the one above as the picture of a journey. Some describe it as "climbing mountains" while others describe it as "going up, going down, then up again". Their interpretation is determined from the orientation of the line going up and down which is not the actual case according to the context and meaning of the graph. This situation is very similar to the experience of I-Kiribati secondary students. They often interpret the graph, table, and diagram based on how they look at it without understanding the real meaning portrayed in the information. Anecdotally, they often incorporate their personal views and understanding from their prior learning when making their interpretation (Moschkovich, 2012).

Morgan (2005) stresses that there is a need to read the graph Mathematically as the graph is not a picture of a concrete object, but a representation of an abstract idea. Westwell (2005) states that trouble students have in terms of inadequate algebraic skills to interpret algebraic symbols, graphs, diagram and table can affect them in their later studies because such areas are generally used not only in Mathematics but

also in other disciplines to portray meaningful information. Therefore there is a need to develop student skills to interpret symbols, graphs, tables and diagram correctly using conventional ways of interpretation as suggested by Morgan (2005) so that they will be able to understand and identify the underlying meaning.

Talking Mathematics

With the important consideration of interactive discussion in Mathematics classrooms to address the problem of being unfamiliar with Mathematical language, Morgan (2005) stresses that there are also some issues identified that can hinder students from their learning goals. These issues are the responsibility of Mathematics teachers because they are the ones who facilitate the learning process. Pimm and Johnston-Wilder (2005) identify that the "unplanned teaching by telling" (p. 66) of the teacher leads to significant disadvantage in learning the subject because it stimulates rote learning where students become passive learners despite their misperceptions they have in their mind.

There are other different forms of teaching, *exposition* and *explaining*, which also might be considered *telling.* Exposition involves speaking directly to the students from a teacher's own Mathematical understanding. Explaining also often inadvertently turns into expositing. Using such forms of teaching are not always a problem to use, but they have to be used with care because too much exposition can have a rapidly deadening effect on the attention of students (Morgan, 2005). Even ten minutes of unbroken listening may be too much for some students (Pimm & Johnston-Wilder, 2005).

In the general Kiribati education context, teaching by telling is in most cases the preferred teaching style used by teachers not only in Mathematics but also in other subjects. If the type of teaching stimulates rote learning, as mentioned by Pimm and Johnston-Wilder (2005), then it might justify the concern of education stakeholders at *Kiribati Education Summit 2008* about rote learning which is happening in schools (Ministry of Education, 2008).

To address the problem, Morgan (2005) points out that discussion between students or between students and teacher can be a good way of exploring and developing

students' concepts and their awareness of relationships between different areas of Mathematics. By that, he suggests the proper planning by using higher-level questioning or interactive teacher-student and student-student discussion, with high expectations for students to think and contribute to the joint construction of the exposition of a topic. This is supported by Pimm and Johnston-Wilder (2005) who advocate for such questioning because it can help to identify areas that are not yet understandable by students during the learning process.

Writing Mathematically

In secondary school classrooms, very limited writing takes place when learning Mathematics. Teachers and students generally perceive that there is little need to write something since tasks involve proofing and the use of symbols, graphs, tables and diagrams. If there is writing needed, then it is mostly minimal (Docherty, Barakat, Kniveton, Mikati, & Khalifa, 2017). This kind of perception is very common where English is the second language. Students are reluctant to use English language, and when they do use it, it is mostly at lower level. This reflects findings from Docherty et al. (2017) with Mathematics teachers in Lebanon schools. The findings relate well to Kiribati education where the same perspective is also adopted by some teachers and also students. It is possibly based on the assumption that switching from English to the local language helps monolingual students to understand what to do compared to using English language only (Manu, 2005). From a common-sense perspective, if Mathematics teachers prefer not to use English in their teaching, then the chances of integrating writing into Mathematics is very low.

However, Wilcox and Monroe (2011) found that integrating writing and Mathematics into the learning process is essential and can help elementary students to internalise and extend their Mathematical skills in a way of writing out their thinking through the questioning mediation from the teacher. Bicer, Capraro and Capraro (2013) also supports the integration of writing in Mathematics at secondary school because it helps to develop students' understanding based on their own writing rather than merely reading or copying class-notes from their textbook or teacher. This shows that integrating writing and Mathematics can assist in developing students' skills in writing Mathematical definitions, procedures and

concepts. Ferrari (2004) adds that incorporating talking and writing together would help students to construct their thinking skills.

With all that, it seems that the issues related to Mathematics language is based on insufficient engagement of students with Mathematical English which can make them familiar with the use of the terms or language used. In addition to that, the use of unknown variables and symbols is also an issue where students can not attempt the question. This is similar with reading and interpreting graphs and diagrams where students do not read in a conventional way which is based on physical properties of the graphs.

In the next section, Pacific education issues are discussed to show educational and social factors that might contribute to the problem of learning Mathematics at the classroom level. These include curriculum development issues, school resources, cultural silence and quality teaching and learning issues.

Pacific Education Issues

Currently, most Pacific education systems are undergoing reform based on the perspective that there are factors hindering students' learning. In this section, the following are discussed as they impact on Mathematics teaching: Pacific education curriculum issues and development; a Pacific cultural silence in classrooms; and quality teaching and learning debates in the region. In terms of curriculum issues and development there has been a long running conflict of values and processes with introduced non-Pacific values and processes that has led to much debate and also a certain level of curriculum reform across the Pacific region. In terms of a Pacific cultural silence, students' silence in the classroom can be misinterpreted, thus creating confusion especially for teachers. By this, the silence is discussed in reference to Pacific culture, how it is used and perceived at community level and then related to the classroom situation. Lastly, in terms of teaching and learning, there exists a long running tension between advocacy for a student-centred approach to learning in regional teacher education programs and an entrenched teacher-centred practice by many teachers in the region. Tensions over introduced educational ideas; Pacific cultural influences on students' learning behaviour; and

what constitutes quality teaching and learning all have a bearing on how students learn in senior secondary Mathematics classrooms in Kiribati.

Education Curriculum Issues and Development

There is an ongoing debate in Pacific education about students' learning where *I-matang* (western) ideas and values are considered as key contributors to learning difficulties (Taufe'ulungaki, 2009a; Teaero, 2009a; Thaman, 2009b). The argument is based on underlying values from developed countries which have become integrated into Pacific curriculum and education policy and influence Pacific students to learn foreign ideas (Taufe'ulungaki, 2009a). Thaman (2009b, p. 15) stresses that in many developed countries, such as the US and Australia, core values integral to national identity and culture, such as self-respect, patriotism, liberty, justice to name a few, are incorporated into their education curriculum. Unfortunately, this is not the case in most Pacific education curricula which still incorporates colonial values rather than the core values of the people who inhabit the islands. Thaman (2009b) stresses that the use of English language in school curricula is the main non-Pacific values incorporated in Pacific curriculum. Pacific values are rarely included due to curricula not emphasising Pacific languages. Therefore, since unique Pacific values are not necessarily integrated into curriculum, learning problems for students emerge (Bakalevu, 2009; Taufe'ulungaki, 2009b; Teaero, 2007; Thaman, 2009b). In terms of Kiribati, there is anecdotal evidence that the use of English language in school affects students attendance (Ministry of Education, 2014b). In New Zealand, McFall-McCaffery and McCaffery (2012) relate the concerns of many Pacific parents about the use of English language that negatively affects their children's learning in New Zealand. There is a need to incorporate Pacific values and process into the curriculum, so that Pacific students do not suffer (Barton, 1995; Mayo, 1994) and face disadvantage in their education journey (Thaman, 2009b).

From a Mathematics perspective Bishop (1990) has identified three underlying values such as: rationalism, objectivism and control, that contribute to the problem of learning Mathematics by students. The consequence of such non-Pacific values has been shown in a study conducted by Alison Jones comparing learning between *Pakeha* (European) students and Pacific Island students in New Zealand (Mayo,

1994). Jones found that the behavior and perception of *Pakeha* students is culturally more acceptable in Mathematics classrooms compared to the behaviour and perceptions of Pacific Island students. This is evidence that values incorporated into the New Zealand curriculum reflect *Pakeha* culture and values and thus makes learning difficult for Pacific students. Bakalevu (2009) stresses that the power and status of Mathematics which is characterized by abstractness and independence, and a lack of a human face has created difficulties for students to conceptualize, relate to and make sense of the subject. Following this she advocates the use of a Pacific Mathematical ideas which emphasises counting, measurement, shapes, angles, designing and money transactions as well as Pacific first languages in schools so that learners can learn best in a way that they find familiar and can make sense of their learning within their experiences (Bakalevu, 1999, 2009).

There has been a gradual reclaiming of Pacific education priorities with many countries revising and renewing their education systems. This shift has been documented by Puamau (2005) showing that Kiribati, Fiji, Palau, Republic of Marshall Islands, Samoa, Tonga, Cook Islands, Niue, Nauru, Tokelau and Tuvalu are progressing to review and renew their education systems in the light of the impact of forces such as colonialism, globalisation and educational aid. There has been a desire to maintain control and ownership of their education systems and in particular the content and processes of learning. Key shifts in the areas of: pedagogy; organisational structure; management culture; and approaches to assessment and evaluation have been noted (Puamau, 2005).

Teaching and Learning Resources

Availability of school resources such as teaching and learning materials are considered as one of the challenges faced by most Pacific schools especially in schools located in rural and isolated areas. Lingam and Lingam (2013) stress the vital contribution of school resources is that teachers alone, no matter how well-prepared they are, may not be able to provide an enriching learning and teaching experience to students. This is based on the fact that school resources such as good-quality, up-to-date textbooks, infrastructure and library facilities are needed to support and extend teaching and learning. The necessity of teaching and learning materials availability such as textbooks and other curriculum materials may assist to

facilitate teaching and learning. In addition, utilizing suitable resources also can stimulate teaching and learning through organized activities to extend students' understanding of various concepts taught in the classroom, prior to or during and after the learning process. Vaka'uta (2012a) adds that teaching and learning materials are vital for enhancing learning process, however, those materials need to be meaningful and worthwhile to the teacher and students of a particular context that is familiar and relates to their experience, beliefs, values, attitudes and knowledge so that learning and assisting students is more meaningful and may provide the ownership in the learning. Booth (1998, cited by Lingam & Lingam, 2013) stresses that poor or inadequate resources in the school are the most discouraging aspect of the classroom especially in a classroom that is enclosed and there is no space to perform any activities other than general chalk and talk/teacher-centred strategies. Apart from that, Goos and Bennison (2007) argue that the use of technology, Mathematics computer software and Computer algebra system (CAS) calculators assist high school Mathematics teachers, regardless of experience, to explain complex key concepts. The use of technology can stimulate students' learning and also to provide a clear picture of the concepts and how they are related to the real world. With that, students can develop their knowledge of Mathematical language.

In Kiribati, teaching and learning materials are a considerable challenge for most schools especially senior secondary schools as the government does not provide such resources. It is the obligation of the school to provide their own resources from their budget each year. In most cases, the schools are operating with limited resources. In Mathematics classrooms as an example, the teacher has the prescribed textbooks (New Zealand Mathematics textbooks) and in most cases, they used to photocopy the pages of the textbook and make hand-out as their teaching resources during the lesson while others write everything on the blackboard.

Teacher Quality

Teacher quality is a big challenge in the Pacific because most teachers do not meet minimum standards to carry out effective teaching and learning at the classroom level (Vaka'uta, 2012a, 2012b). Vaka'uta (2012a) stresses that much of the inequality experienced in the provision of Pacific education and in learning outcomes is caused by differences in teacher quality. Quality teacher refers to a

person who has competence and confidence in the content and methodology of their subject, are positive in their attitudes towards themselves, their students, their profession and community, and can communicate with students effectively in the language of instruction (Vaka'uta, 2012b). In some Pacific countries like Palau, Republic of the Marshall Islands and Yap in the Federated State of Micronesia, governments perceive that the pathway to achieve teacher quality is in-service training at the tertiary level through scholarship programmes and also in conducting professional development allowing teachers from remote communities to gather in a central location to attend courses and workshops (Heine & Emesiochl, 2007). In terms of Mathematics language, Bakalevu (1999) stresses the importance of having formal training to provide skills to teachers not only to know the content of Mathematics but also the context to ensure their students can understand Mathematical language based on familiar contexts. This will enable students to understand technical terms correctly and see the relationship between the language and the Mathematical concepts. A study from Nigeria by Abe (2014) shows the importance of having education qualifications when teaching Mathematics as it contributes to students' academic achievement. In terms of teacher's experience, Rice (2010), on the other hand shows that the length of experience Mathematics teachers have correlates with teachers' confidence in teaching Mathematics.

For professional development, Dayal (2013) stresses that conducting regular professional development can also provide further skills to teachers to address Mathematics problems including algebraic language encountered in the learning process. Thompson (1992, cited by Dayal, 2013), stresses that engaging Mathematics teachers in teacher professional development will provide positive change in Mathematics teachers' beliefs and perceptions and to teach algebraic language according to a student's style of learning.

In Kiribati, a holistic view of teaching quality considers four main areas namely: school resources to support the implementation of teaching and learning; infrastructure within the school to support teachers and students during the learning process; professionalism of teachers to teach effectively; and teacher-student ratios (Ministry of Education, 2014a). In Kiribati teaching and learning resources, professionalism of teachers and teacher-student ratio are common problems. In most

schools, teaching and learning materials are scarce even some teachers do not have prescribed textbooks. This affects the learning of students in a way that their learning is restricted to what the teacher writes on the blackboard. In terms of teaching professionalism, some secondary school Mathematics teachers still need formal teacher education (Ministry of Education, 2014a) to complement their Mathematics degree. In addition to that the attitude of some teachers is also a problem as they sometimes discourage students from asking further questions. This also might affect learning as students are not motivated in the learning process as they know that the teacher is not ready to help them with their problems. In terms of teacher-student ratios some secondary schools, have a ratio of 1:30 which is more than the capacity of a teacher to manage the class. In addition to that, class size in high schools is a particular problem in church high schools. Such schools are obligated to enrol children from their congregations regardless of academic merit especially in Year 10 up to Year 12. Further research is needed to confirm what appears to be the case anecdotally that this can make teaching challenging because of unwanted behaviours from the students (Blatchford, Bassett, & Brown, 2011) which in turn to hinders Mathematics teachers from carrying-out a more interactive teaching approach which could assist students with algebraic language. However, Chapman and Ludlow (2010) and Maples (2009) stress that large class sizes do not necessarily affect student achievement. Maples (2009), in one study, indicates that students in large classes (25 or more students) actually have a significantly higher mean score in reading and Mathematics than students enrolled in small size classes (15 or less students) and a slightly higher mean score than students enrolled in medium size classes (16 to 24 students). Chapman and Ludlow (2010), on the other hand, stress that student attendance to classes exerts a negative influence on student learning, but not class size.

Pacific Cultural Silence

Silence in the Pacific can be considered a cultural norm that can have various meanings in different contexts. It is often a key feature of Pacific students' classroom behaviour. Nabobo-Baba (2005) has documented instances of silence in Fijian social life including: in village meeting, ceremonies, church, fishing and hunting grounds, family, and in holy places. She adds that silence can also be made

as a form of resistance, disagreement and opposition toward decision making, when people are excluded from activities, conversations or events and ceremonies, fear, and also when the custom is broken e.g woman swearing and yelling at someone or her children. In the Kiribati context, *kainabwaabu* (being silent) can also be seen in similar occasions to those described by Nabobo-Baba (2005). In a learning context, *kainabwaabu* has different meanings such as high levels of respect to *Boto*. *Boto* is a person who is the source of particular knowledge or skills that have been inherited from his/her ancestors. Passing knowledge from *Boto* to someone requires passive listening and silence so that every objective of the learning is achieved, and also allows time for the learner to assimilate the learning concepts with what is already known for decision making. When there is a conflict or difference of knowledge, then the learner can question *Boto* to expand his/her existing knowledge or accommodate new knowledge. This means that silence is not always about *kabitaia* (limited knowledge) but means something else from the learners' perspective like respect. Traditionally, having *wanawana* (being wise) is knowing when, where and how to speak or be silent in various contexts (Teaero, 2009b). Thaman (2009a) emphasises that Pacific Island learning culture largely determines children's behaviour and their ways of thinking and learning, which in turn influences their achievement in formal education.

Within the formal learning sphere, Tuafuti (2010) found that being silent in the classroom is determined from cultural principles experienced by students in their communities. In the case of Year 13 Pacific students in New Zealand, she stresses that silence occurs for different reasons including: low self-esteem; the enforced use of English language; lack of understanding of the issue discussed; respect; and resistance. Low self-esteem is often related to shy behaviour perceiving that others might mock if the presentation of answers is wrong. Secondly, the use of English language contributes to silence because it is not the preferred language of students to express their ideas. Thirdly, is the lack of understanding on the issue being discussed during the learning process. This is often related to the use of English language or the complexity of vocabulary used which confused students. If they do not understand anything being discussed, they prefer to keep silent. Showing respect on the other hand also can result in silence in the classroom so that *Palangi* teachers do

not ask or challenge Pacific students during the learning process. Lastly there is student resistance about decision making in the classroom.

In Mathematics learning in Kiribati some of these factors identified by Tuafuti (2010) are relevant. I-Kiribati students keep silent in the classroom to show their ultimate respect to the teacher, and by that they prefer to sit very still and talk only minimally back to the teacher (MEYS, 2014). In addition, their silence can also indicate shy behaviour not to be mocked by others during the lesson. In some cases, some students dislike Mathematics because of it abstractness (Barton, 1995), nevertheless, it is a compulsory subject and a gateway towards higher education level. They feel forced to learn it and so resist some concepts to learn.

As a teacher, it is vital to be conscious of students' silence so that their learning is not isolated (Tuafuti, 2010). In Kiribati Mathematics classrooms some students are forced to learn despite their resistance toward the subject. In some cases, students keep silent in the classroom to show their ultimate respect to the teacher, but if the teacher asks them questions, they may feel shy to respond as they know that being *kabitaia* can bring humiliation. For whatever reason, being silent in the classroom affects the use of language during the learning process, so as a teacher, it is vital to be conscious of students' silence.

Pacific Teaching and Learning Quality Issues

As discussed earlier, most Pacific education systems are addressing to some extent non-Pacific values and processes that have been long incorporated into curriculum since colonial times (Puamau, 2005). This is with a view to elevating the teaching and learning quality to improve students' learning outcomes (Bakalevu, 2009; Teaero, 2009b; Thaman, 2009b). As part of the shift in approaches, traditional ways of teaching and learning namely a general *teacher-centred approach* is considered a threat to student learning because the control is with the teacher and it tends to treat students as individuals rather than social beings. This contradicts views on how Pacific people learn using cooperation, imitation, observation, and trial and error (Mel, 2009; Taufe'ulungaki, 2009b; Thaman, 2009b). There is a need to shift to a more interactive learning (Thaman, 2009b) that is based on constructivism in the learning process, in this case *student-centred approach*, involving active interaction

and communication with peers and the teacher (Beuka, 2007; Kaei, 2007). There is a strong belief about the approach that it will equip Pacific leaners and teachers with the skills for life-long learning, as well as produce more adaptable and marketable leaners for the local, Pacific and global workplaces (Beuka, 2007). In the Kiribati context, a *student-centred approach* is the current preferred teaching and learning approach suggested in the *National Curriculum and Assessment Framework* to be used in all schools around the country (Ministry of Education, 2011).

However, there is a body of criticism of the student-centred approach that needs to be considered. Schweisfurth (2011) argues that the approach should not be perceived as a solution to a learning problem but rather a preferred alternative. Carter (2009), goes so far as to argue the approach is seen as a neoliberal approach to pedagogy used by capitalist countries such as United States, England and Australia to disseminate a certain ideology globally through their educational aid programs. She stresses that the nature of the approach can indirectly produce a certain kind of people (responsible individuals) in future that can work for themselves within society (social citizenship) under an umbrella of democratic governance within a capitalist economy. Carter (2009) argues the approach is not necessarily meant for improving learning outcomes, but to constitute children in certain desirable ways. Carter (2009) emphasises that using a traditional *teacher-centred approach* is not to be automatically dismissed since many Asian countries, known for this type of pedagogy, have the highest achieving students according to International Student Assessment results (PISA) (see OECD, 2016). This suggests that there is no universal teaching or learning approach but a more contextualised approach fits within the social and cultural context of the learning. Schweisfurth (2011) also critiques the overall learner centred approach believing that individual autonomy and constructivism in developing countries, can be in conflict with cultural aspects of learning that favour collectivism and respect for elders. In addition to that, the implementation of the approach is often difficult because it incorporates theoretical ideas or policies to be followed for effective implementation.

As a way forward Schweisfurth (2011) suggests a *learning-centred approach*, that is, using what works to help pupils to learn rather than a purely *student-centred approach*. In this approach, teachers are also fundamentally considered as learners,

where they can make changes to their pedagogy according to their students' needs and circumstances. In some cases, a teacher centred approach may be more appropriate than a learner centred approach and vice versa. It does not require teachers to follow a certain universal practice to make their teaching successful. What then works best for learners is determined by teachers. In learning Mathematics, the learning-approach is relevant because in reality Mathematics learning requires multiple pedagogies to teach and learn different concepts.

In summary, Pacific education has challenges that relate to learning Mathematics. Such challenges include the conflict of ideas and values incorporated into Pacific education curriculum, the scarcity of resources in schools, the quality of teachers to teach and make learning effective, student silence in the classroom and Pacific teaching and learning quality based on a preferred teaching approach. These challenges are happening at the school level and thus affect the learning of Mathematics in the sense that they contribute to the Mathematics syllabus used, the resources in terms of teaching and learning materials like textbooks and computers, the classroom size, the profession of the teacher to teach effectively to different students based on their abilities, the problem of students especially those who always keep silent in the class and lastly is the convenient and contextual teaching approach. There are a number of ways in which these challenges could be addressed. These are discussed in the next section of this chapter.

A Tentative Framework for Learning and Teaching

Seeking possible alternatives to address the issue of using algebraic language in Mathematics classrooms requires choices depending on the context of the learning. The literature indicates that there are some particular teaching and learning strategies that need to be exercised accordingly to bring about change. For instance, Morgan (2005) stresses that using Mathematical language orally and in writing to communicate in the classroom need to be consistently practiced throughout the learning so that students may be familiar with the language as well as applying appropriate formula or principles that need to be used. In this section, some possible teaching strategies to address the problem of using algebraic language are discussed. Such ways include: the need for English skills to understand Mathematics language and to some extent the use of bilingualism when monolingual Kiribati students learn

Mathematics using English language. In addition to that, Mathematics literacy is also discussed in terms of using vocabulary, visual elements, unknown variables and symbols.

English Skills in Mathematics

Learning Mathematics language in a second language such as English makes learning harder especially for monolingual students because they are required to learn both languages: English language (familiar with the use of English for understanding Mathematics) and Mathematics language (the use of special terms, symbols and syntax). Lee and Low (2007) stress that being an English learner and a Mathematics language learner makes learning Mathematics challenging. Barwell (2002) and Morgan (2005) stress that students who learn Mathematics using English language need English skills to understand the subject literally especially by reading, listening and writing in Mathematics language. Barwell (2002) argues that English provides the means for students to think about Mathematics, because without it, students would not be able to attempt the Mathematical tasks. In Kiribati Mathematics classrooms, this has been reported by the Ministry of Education (2016, p. 18) where it shows that lack of English skills among students affects their ability to understand Mathematical problems especially when the problem to be solved is couched in written or spoken English. In terms of this research, from a language perspective students are not able to understand Mathematical problems for two main reasons: the use of English language and the complexity of Mathematical language. Morgan (2005) suggests that if students were engaged with such languages consistently in their everyday activities, they then would be familiar with the vocabulary and understand them accordingly with appropriate principles required.

In addition to that, Lee and Low (2007) indicate that there is a need for the integration of English and Mathematics content in Pacific schools as it would assist both teachers and students to learn Mathematics as a whole. An integration programme, namely PRIME – *Pacific Region Integrated Mathematics and English* (Lee & Low, 2007), allows the use of English language to be learned by students so that they will not only understand Mathematical vocabulary, semantics and symbols, but also hear and use them in the construction of their own Mathematics content knowledge. This confirms that English language is used for understanding English

of Mathematics or Mathematics language by students (Morgan, 2005) in addition to the learning of Mathematics content. This makes language planning for teachers a routine aspect of lesson-planning and teaching and learning of Mathematics. The programme suggested by Lee & Low is based on the idea of Mohan (1986, 1990, 2001, cited by Lee & Low, 2007) that linguistic content is inseparable from linguistic expression. This offers the notion of knowledge structures as an organising framework for language and content integration. The programme, however, promotes culturally contextualized teaching practices and pedagogies including student grouping strategies; active participation in concrete task-based or experiential activities, inquiry-based learning; graphic organisers; and a whole language approach that takes advantage of the learner's communicative environment which favours bilingualism.

Bilingualism

Literally, bilingualism refers to the use of two languages from different contexts or domains (Baker, 2011). In this research, bilingualism refers to the use of two languages: Kiribati and the English of Mathematics language which is used at senior secondary level in teaching and learning Mathematics. Baker (2011) elaborates that identifying who is bilingual is too simplistic since the use of the two or more languages varies depending on how people use them. Some speak a language, but do not read or write in that language. Some listen with understanding and read a language (passive bilingualism) but do not speak or write that language. Some understand a spoken language but do not themselves speak that language. Baker (2011) stresses that people's bilingualism must take into account the four language abilities - listening, speaking, reading and writing. Baker adds that under the umbrella of speaking, the language used for thinking may be a fifth area of language competence where a person is not actually speaking, listening, reading or writing. It is suggested that the fifth area of language is worth differentiating from actual speaking as it raises the dimension of the ability of bilinguals to use both languages as thinking tools. This is what Cummins (1984, cited in Baker, 2011) expresses as cognitive competence in a language. That is, the ability to use one or both languages for reasoning and deliberation. There are clear cognitive benefits for learners in being bilingual. The Leo Pasifika Coalition in New Zealand, for example, have

strongly laid claim to these benefits within the Pasifika population in New Zealand schools (McFall-McCaffery & McCaffery, 2012).

In Mathematics, there are researchers who consider the use of bilingualism as an alternative teaching method especially for monolingual students who are learning the subject using English language. Those researchers include Barwell (2002), Manu (2005) and Moschkovich (2012) where they stress that a bilingual approach assists students to learn about Mathematical discourses used in the classroom. Barwell (2002) stresses five research findings concerning bilingual learners in the mainstream where those findings can be specifically related to Mathematics. Those five findings are listed below.

1. Bilingualism makes an advantage out of using a home language in Mathematics lessons. This is based on the sharing of ideas between students using the same-language and also allowing parents to be involved and support their children in their Mathematics learning.
2. Supporting students to develop the Mathematical aspects of their home language is likely to have a positive effect on their Mathematical English, that is, the vocabulary and syntax.
3. Mathematics teachers should not assume that a student who appears to communicate effectively in *everyday* English will have the necessary proficiency to communicate at the same level in Mathematics. The demands of Mathematical English are higher than those of everyday English and students may need to be supported to develop the necessary proficiency using bilingual resources.
4. The use of bilingualism can also relate school Mathematics to learners' out of school contexts in a sense that all community work can be interpreted Mathematically by students. For instance, asking students to bring and explain Mathematical games from home or more involved work such as asking learners to investigate the use of Mathematics in the home or community and prepare a report about their findings. The report could be written in more than one language and could be supported by the use of writing frames.

5. Learning a language and becoming bilingual is also about learning and living in different societies and cultures. It is not just about acquiring a new language, but also about understanding another culture, and developing another identity. In learning Mathematics, bilingual students are learning how to be a learner of Mathematics as much as learning how to do and talk about Mathematics.

The research findings show that the use of bilingualism at the school level can extend the knowledge of a student in that the student can use their first language as a supporting or alternative language in learning Mathematics. However, the ultimate work of teachers is to use both of the languages in the learning process so that students in turn are able to use them accordingly. Baker (2011) stresses that students who are exposed to a balanced bilingual approach, that is, the use of two languages effectively, develop mental flexibility. Like McFall-McCaffery and McCaffery (2012)and Garcia (2009) also refers the cognitive benefit of bilingualism. More specifically, Garcia (2009) uses the term "cognitive advantage" showing that bilingual children are more facile at concept formation and have greater mental flexibility compared to monolingual children. This is related to meta-linguistic awareness, that is, the ability to treat language as an object of thought. Bilingual children have greater word awareness and are more willing to change the name of objects than monolingual children. For instance, bilinguals tend to respond to meaning whereas monolinguals tend to respond to sound. Baker (2001, cited in Garcia, 2009) stresses that bilingual children's cognitive functioning appears to impact not only their language knowledge, but also their critical thinking and sociolinguistic development in many aspects of their education and lives in general.

In learning Mathematics languages, the use of bilingualism can enable students to switch between the two languages to make deep meaning and understanding about Mathematical problems. Manu (2005) has shown that bilingual Tongan students in Mathematics classrooms often make switches between English and Tongan language to achieve growth in their Mathematical understanding. Manu (2005) adds that language switching can be a resourceful tool for conveying Mathematical meanings among individuals: a tool that bilingual teachers are advised to consider using in appropriate contexts. Moreover, he mentions that the ability to distinguish

Mathematical understanding from English language understanding offers a significant contribution to understanding the teaching and learning of Mathematics in a bilingual situation. This would allow educators to see what appropriate action(s) should be taken, and what appropriate forms of language switching can overcome such language or Mathematical obstacles. In addition to that, Fasi (2009) shows that the use of bilingualism in school level Mathematics helps students who have low competence in both languages: English and, in the case of his research, Tongan. Fasi (2009) found that as Mathematics problems were verbally translated into Tongan with the aid of contextually familiar resources and examples, those students who had low competence in both languages matched or even exceeded those students whom had high competence in both languages. The use of bilingualism in Mathematics classrooms is considered as an alternative method to teaching and learning in the Pacific not only for the provision of Pacific language and culture (Taufe'ulungaki, 2009b), but also to provide better understanding in using Mathematical language (Bakalevu, 1999; Fasi, 2009; Manu, 2005).

Mathematics Literacy

The term Mathematics literacy has emerged from the New London Group's concept of multiple literacies in response to rapid social and technological change that is happening globally (Cope & Kalantzis, 2009). From a literacy perspective, multiple literacies is a crucial step for literacy pedagogy in an ever changing environment. In Mathematics, however, Mathematics literacy is also identified in relation to learning, teaching and understanding Mathematical concepts at a classroom level and also at the community level. At the community level, Mathematics literacy is defined as an individual's capacity to identify and understand the role that Mathematics plays in the world, to make well-founded judgments, and to engage in Mathematics in ways that meet the needs of that individual's current and future life as a constructive, concerned and reflective citizen (Stacey, 2010). The definition is based on the general ontological perspective that individuals in all walks of life need Mathematical literacy, to different degrees in different occupations and life choices. Put simply, at the classroom level it is the ability to read, write, speak and listen to Mathematics with understanding (Leibowitz, 2016). This definition contributes to the holistic definition of Mathematics literacy suggested by Stacey (2010).

Leibowitz stresses that traditionally, it was assumed that students could apply general reading and writing skills and strategies to any Mathematics content area. Strategies specific to Mathematical literacy development were not a focus, however, research has since indicated that disciplines differ extensively in their fundamental purposes, symbolic artefacts, traditions of communication, and use of language, suggesting that a generalist approach to developing Mathematical literacy may be ineffective. As a result of these findings, there has been increased emphasis on identifying disciplinary literacy practices and developing instruction that supports students in acquiring discipline-specific skills. Through disciplinary literacy practices, students uncover the meaning behind the terminology and symbols used in the discipline, and learn to view the subject matter from an insider's perspective because most Mathematics classrooms demand the use of Mathematical languages. Mathematics literacy then is considered as an alternative to understanding Mathematics.

As Mathematics literacy skills should be formed through a disciplinary-specific approach, various strategies for strengthening Mathematical literacy have been developed. In Mathematics, where words, symbols, and diagrams hold implicit and explicit meanings that students must connect and translate, there is a need for constant literacy instruction that is embedded into classroom routines. Leibowitz (2016) stresses that this can be done through discourse moves such as waiting for students to respond after asking a question, re-voicing a student's response to provide clarification or expansion, inviting students to participate by sharing varied solutions, probing students' thinking, and creating opportunities for students to engage with another's reasoning. In addition to that, students must be taught to read through a Mathematical lens, and to attend to the precision of meaning that each word and symbol represents. A teacher can also use direct Mathematical vocabulary instruction, allowing students to create informational posters and memory guides, and various reading strategies, including the preview, predict, read and review strategy and the concept card strategy (see examples in Leibowitz, 2016).

With all that, Mathematics literacy is also considered as an alternative to learning Mathematics language by involving students in Mathematical discourses and also to teach students to read through a Mathematical lens to attend to the precise of

meanings of words or symbols used. In general, it is about reading, listening, writing and understanding Mathematics languages that have explicit embedded principles and rules.

Conclusion

There are challenges faced by both teachers and students at the classroom level which relates with the school and education system at a broader level. The existing literature indicates that problems within an education system in a particular country contribute to problems at the school or classroom level. From a much broader perspective, the education curriculum is a problem that affects students learning as it was designed not from a Pacific context but from outside the Pacific. In Mathematics, there are suggestions that using a more localised way to do Mathematics by counting, designing, determining angles and so forth which are much more familiar to Pacific students and therefore more effective. However, this is not realistic as the contents of old syllabus of Mathematics are hard to shift. The problem affects both teachers and students in a way that teachers heavily rely on the textbook as an important teaching resource because all the topics covered are not from Pacific communities. For students, they need a lot of commitment and effort to be familiar with the terms plus the rules incorporated.

In addition to that, the introduction of new teaching strategies and techniques to teachers for example, teacher-centred to student-centred approaches is also problematic. Vaka'uta (2012a) stresses that if teachers do not understand and have opposite ideas about a new program, then they would not have confidence to implement the program. , At least initially at the point of change this could lead to confusion in algebra lessons as teachers and learners take on their new roles in the teaching and learning relationship.

Moreover, the availability of school resources is a problem that also affects teaching and learning as teachers are limited by the resources available within the school. Students, on the other hand, are possibly learning concepts superficially as their activities are limited based on the resources used by the teacher. Apart from that, the qualification of the teacher is also a problem as some teachers need professional development or further training on how to teach students.

Apart from that, cultural silence in the classroom can also be considered as a problem. Teachers should be aware that students who remain silent in the class need to be sensitively nurtured. Certainly I-Kiribati teachers are aware of the meaning of the silence but their teacher education and professional development tells them to expect student answers and so many teachers are conflicted. This affects students when they cannot ask questions in front of the class. Mathematical language is also a problem in that it incorporates familiar and unfamiliar terms, also the use of unknown variables and symbols which often incorporate formula or rules. Teachers are encouraged to engage students in interactive discussion in Mathematics through the talking and writing process. The research methodology of the research is presented next.

Chapter 3

Research Methodology

Introduction

This chapter will discuss the study's research paradigm, methodology and method along with ethical issues and data analysis procedures which have assisted to provide a comprehensive account of the challenges in teaching and learning algebraic language in Kiribati Year 12 classrooms. This research is conducted within an interpretivism paradigm using a phenomenological approach to collecting data concerning the problem of learning algebraic languages in secondary school Mathematics classroom in Kiribati. This chapter discusses the purpose of using interpretivism as a research paradigm as well as the phenomenological research approach. Within the phenomenological approach, there are two methods used to collect data: one-on-one interviews and classroom observation. Such methods are used to provide an understanding of the problem being investigated which is the challenges in teaching and learning algebraic language in Year 12 classrooms. In each method, there were some issues as well as ethical considerations discussed when they were conducted. Thematic analysis is used to analyse all the collected data. The analysis follows six procedures consistent with (Braun & Clarke, 2006) typology to ensure that themes identified are showing and providing an accurate understanding of the problem in learning and teaching algebraic language.

Research Paradigm

In most cases, people who have different views about the reality or issue, must have different experiences which guide their thinking and reasoning to perceive phenomenon from different angles (Bhattacherjee, 2012; Slavin, 2007). The problem in learning Mathematics, as an example, may be perceived by parents as the problem of the Mathematics teacher, whereas the Mathematics teacher may perceive that the problem is associated with student's behaviour and dislike of the subject. Having different perspectives about the issue is associated with a personal paradigm (Bhattacherjee, 2012). By definition, paradigm is a worldview (Creswell, 2012) or "coloured glass" (Bhattacherjee, 2012; Groenewald, 2004) that governs how we

view the world and how we structure our thought about what we see in the world. This study took a largely interpretivist paradigm which is described next.

Interpretivist Paradigm

This project adopts an interpretivist paradigm where the problems of teaching and learning algebraic language at the senior secondary level are looked at through the "coloured glass" of the teachers and students most closely involved (Lather, 2006). Bhattacherjee (2012) adds that this worldview has a core belief that reality is socially constructed by those who live with it. This means that the problem in Mathematics, in the case of this research, is shaped and constructed by Mathematics teachers and their students because they share, experience and live with the problem. Hence, they are the ones who understand the problem better. This is well supported by Willis (2007) who stated that the view from a group of people who are experiencing the problem often provides a more comprehensive understanding of the problem. Based on such views, the interpretive paradigm has been utilized to gain a better understanding of the problem or challenges in learning algebraic language in Kiribati Year 12 classrooms.

Lather (2006, p. 37) stresses that there are multiple methods used to understand the truth from an interpretive perspective, including Naturalism, Constructivism, Phenomenology, Ethnography, Symbolic/interactionism and Interpretivist mixed methods. Some researchers perceive that interpretivism can also be considered as a research method (Bhattacherjee, 2012; Willis, 2007). This research utilizes phenomenology as a research methodology because it is used as part of the interpretative paradigm to understand the problem at the classroom level from the perspective of Mathematics teachers and their students who experience and live with the problem. This is described next.

Phenomenology as a Research Methodology

Phenomenology is used in this research to describe and interpret the experience of Mathematics teachers and students about the problems in learning algebraic language. By definition, phenomenology is concerned with the study of experience from the perspective of the individual, where taken-for-granted assumptions and

usual ways of perceiving should be suspended (Bhattacherjee, 2012; Lester, 1999). Slavin (2007) stresses that people's perspectives are legitimate, even if they are quite different. In this research, phenomenology is used not only to describe the problem from the perspective of participants but also to interpret the data (Lester, 1999; Mertler, 2016; Slavin, 2007). This methodology includes *pure* phenomenology (to describe) and *hermeneutic* phenomenology (to interpret) the perspectives of teachers and students. Bhattacherjee (2012) reveals that phenomenology, as well as hermeneutics and critical social theory can form part of the interpretive technique to study the subjective nature of people's experience. Because people's perspectives are evolving, phenomenology can be classified as qualitative research (Lester, 1999). With all that, this research uses a phenomenological approach guided by an interpretive paradigm to understand the problem.

How does Phenomenology Work?

Slavin (2007) stresses that a phenomenological study works from the beginning of the research until the presentation and description of the data. It often begins with a situation where the researcher has the personal experience and wishes to understand it from other's perspectives. In this case, the researcher is seeking to identify phenomenon and individuals who live with it to share their experiences. To be able to attain these experiences, interview (Bhattacherjee, 2012; Mertler, 2016; Slavin, 2007) and observation (Bhattacherjee, 2012) are the data collection tools used. Participants selected for the research should be representative of the community. This is to attain a variety of perspectives about the phenomenon. Throughout the data collection, researchers will attempt to identify common themes that arise in the participants' interviews. With that, researchers can construct a narrative describing how the phenomenon is experienced by the participants in the study, focusing on common themes. Groenewald (2004) stresses a similar procedure saying that a phenomenological approach starts with a synopsis of the research paradigm, then a description of the research participants, followed by the data-gathering methods, where after data-storage methods are outlined. Thereafter follows an explanation of the presentation the data. Considering both the views of Slavin (2007) and

Groenewald (2004) about how phenomenological research works the procedure for this research is outlined in Figure 6 below.

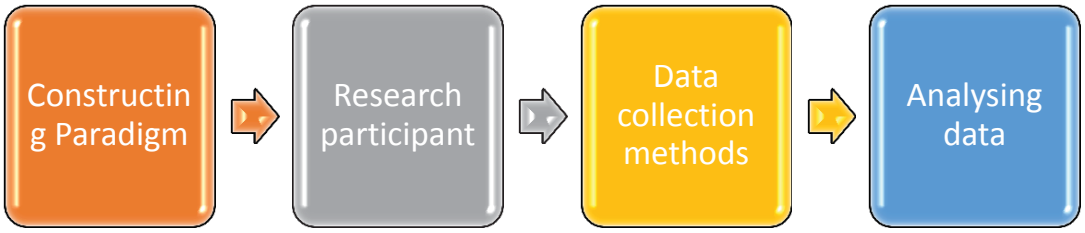

Figure 6. Phenomenological research procedure. Source: (Groenewald, 2004; Slavin, 2007)

The procedure constructed above outlines the overall process of this research particularly in identifying participants, data collection, analysing data and presenting data. The sections discussed below follow the order of the phenomenological procedure starting from research participants, data collection methods, and analysing data.

Research Participants

This research employed a purposeful sampling technique to recruit a heterogeneous group of participants who are "information rich" about the problem being investigated in this research (Creswell, 2012). In this case, senior secondary school Mathematics teachers, Year 12 students and an Assessment officer were chosen as participants in this research. Mathematics teachers and their students were selected intentionally (Mertler, 2016) based on the fact that they were living with and understanding the problem of learning and teaching algebraic languages whereas the Assessment Officer was selected based on his experience as the Year 12 Mathematics examiner and his knowledge and understanding of the Year 12 Mathematics syllabus. Teachers and students were selected from four different schools located in South Tarawa: Such schools were also selected purposefully based on their enrolments and representation of different religious communities in

Kiribati. There were three Mathematics teachers and four students selected from each school. The selection of teachers was based on their experience in teaching (long service: 4+ years of teaching) and gender, whereas students were selected based on their level of academic ability from School Assessment by Head of Mathematics Department. Tables 3 and 4 below give a summary of participants and also codes used in analysing data obtained from them.

Table 3: Teachers' background

School	Gender	Code Name	Experience
High School 1	2 females and 1 male	KTF1	- One year of teaching experience
		KTF2	- Four plus years teaching experience
		KTM	- One year of teaching experience
High School 2	1 male	MTM	- Four plus years teaching experience.
High School 3	2 females and 1 male	STF1	- Four plus years teaching experience
		STF2	- Four plus years teaching experience
		STM	- One year of teaching experience
High School 4	2 females and 1 male	WTF1	- Began teaching in 2017
		WTF2	- Four plus years teaching experience
		WTM	- Began teaching in 2017

Table 4: Students' background.

School	Gender	Code Name	Level of Abilities (low, average, high)
High School 1	2 females and 2 males	KSF1	low
		KSF2	average
		KSM1	high
		KSM2	low
High School 2	2 females and 2 males	MSF1	high
		MSF2	low

		MSM1	average
		MSM2	average
High School 3	4 males	SSM1	high
		SSM2	average
		SSM3	low
		SSM4	average
High School 4	3 females and 1 male	WSF1	low
		WSF2	high
		WSF3	low
		WSM	average

The selection of teachers and students was made by school principals and also Heads of the Mathematics Departments in each school in accordance with the criteria mentioned earlier. A total of 27 participants were involved in this research. Each of the participants was interviewed and observed except the Assessment Officer who was interviewed only.

Research Methods

In this research, one-on-one interview and classroom observation were the two methods used to obtain participants' perspectives about the challenges in learning and teaching algebraic languages. Creswell (2012) emphasises that interview and observation are the most common methods used in qualitative research to seek in-depth information from participants. Within the sphere of phenomenological research, one-on-one interview and observation are considered to be the most convenient and appropriate tools to gain people's in-depth perspectives (Bhattacherjee, 2012; Lester, 1999; Slavin, 2007).

One-on-one Interview

It is a kind of interview which involves each participant at a time to respond to open-ended questions asked by the researcher. This type of interview is ideal for interviewing participants who are not hesitant to speak, who are articulate, and who can share ideas comfortably (Creswell, 2012). It often takes time to administer, but it

has the advantage to gain and seek in-depth experience and perspective from participants (Mertler, 2016).

In this research, the one-on-one interview was carried out according to Kiribati traditional protocols commonly in place between people and families within the community when discussing important and sensitive matters. *Taona-tabon-inaaim* is a Kiribati protocol that determines how a one-on-one interview takes place. Korauaba (2012) in his research defined *Taona-tabon-inaaim* as a special visit from someone to a house to discuss essential, and sometimes sensitive matters. Because the discussion involves sensitive matters there are proper and orderly procedures to be adhered to, but the procedure may change depending on the situation. The common and simple procedure is shown in Figure 7 below within the context of how one-on-one interview session was carried-out (this is shown with * sign)

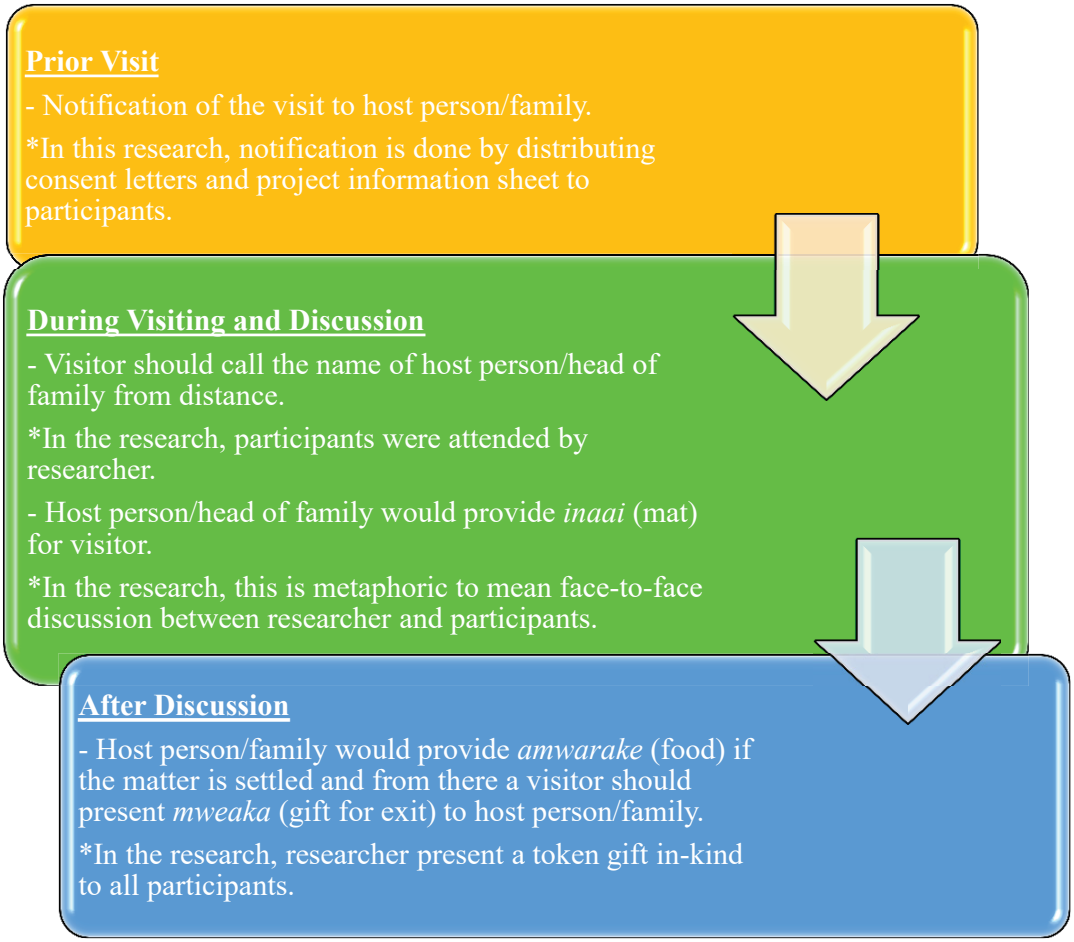

Figure 7. *Taona-tabon-inaaim* procedure in Kiribati context (Korauaba, 2012)

By following the traditional procedure of *Taona-tabon-inaaim*, interview sessions were conducted according to the three stages mentioned above, that is prior to interview, during and after the interview session. Following the order produced a positive reaction from participants in the way that they were willing to participate.

Pilot Interview Question

To ensure an accurate understanding of the problem from the perspective of participants, a pilot testing of the open-ended interview questions was conducted. This is exactly what Creswell (2012) reveals about a pilot test of a data collecting instrument which is to make changes based on feedback from a small number of participants. The pilot testing was conducted in Fiji and employed one Kiribati Year 12 student and one Kiribati Mathematics teacher who were continuing their studies in senior secondary school and The University of the South Pacific respectively. These participants drew on their previous experiences in Kiribati to respond to the questions. The pilot was carried out using the one-on-one interview session procedure mentioned earlier. Participants were notified about the session with the information sheet about the research. From there, participants decided their free time for the session. The sessions were conducted in private. The sessions were recorded using a recording device. Both the sessions lasted for about 40 to 50 minutes.

After the sessions, the participants received a token gift. As a result of the pilot testing some additions were made to the original questions. Some hints were added to questions for students, while five items or questions were added to questions for teachers; three of them focus on the culture of silence and the rest were based on the problem of Mathematical symbols. Such areas were considered relevant to this research in a way that the teacher considers that the algebraic language refers to Mathematical terms (words), but not symbols. In addition, the pilot helped the researcher to decide what would be appropriate probing questions under the main question to ask each participant. For instance, one main question for the student was based on the likeness of application problems in Mathematics. The students responded to the question but seemed to keep more information hidden about the unlikeness of the application problem. However, some of the information was shared when probing questions were asked directly pointing to some of the factors that contribute to the problem like teacher preparedness, teaching methods, her

participation in the class and English skills. The final open-ended interview questions for both teachers (see Appendix A), students (see Appendix B), and Assessment Officer (see Appendix C) are included at the end of this dissertation.

Actual Interview session

The actual interview sessions were conducted from 12th to 30th June 2017 in the four selected schools. On the first day, the researcher visited all the schools to distribute participant consent letters plus project information sheets. The information sheet contained the detail of the research plus the responsibility and some ethical detail for participants. In High School 2, the school clerk was responsible to coordinate the procedures needed in this research for having information and also taking out participants during the session. In the other three schools, Heads of Mathematics Departments coordinated the research procedures in their respective schools.

The sessions were conducted on the second day starting from High School 1, then High School 2, followed by High School 3, then after High School 4 and the last session was with the Assessment Officer. The sessions were conducted accordingly based on the preferences of teachers in each school. Each interview with students lasted for approximately 30 to 40 minutes, whereas for teachers and the Assessment Officer, it took about 40 to 60 minutes. All the sessions were conducted in private place using Kiribati language for both teachers and students. Most teachers who participated in this research were female, while for students most of them were male (refer to Table 3 and 4). In some schools, finding a private place for conducting the sessions was a problem and this might have made some participants talk less openly about the issues.

Classroom Observation

Observation was also employed in this research to observe some of the classes of each teacher from the selected schools to gather information about how teachers teach Mathematics using Mathematical languages and how students learned them. Creswell (2012, p. 213) defines observation as a process of gathering open-ended, firsthand information by observing people and places at a research site. The researcher in this research played the role of a nonparticipant observer by sitting on

the periphery, that is, the back of the classroom (Creswell, 2012), to watch and record the teaching and learning process within the 45 minutes period. Each teacher was informed about the classroom observation and he/she decided when they were ready to be observed. In some schools, teachers were anxious for classroom observation because the researcher brought along the appraisal form which was required and part of monitoring process in the school. The observation guide used is provided in Appendix D and based on the use of algebraic languages in teaching and how students learn those key terms.

Ethical Considerations

Ethical considerations throughout this research were paramount to ensure that all participants including the research remained safe. Bhattacherjee (2012, p. 137) defines ethics as conformity to the standards of conduct of a given profession or group. Such standards are often defined at a disciplinary level using a professional code of conduct which is enforced by the School or Institution. In simple terms, it is based on the expectation that the research should be grounded on honesty, trust and fair judgement, especially as people are involved in the research (Wiersma & Jurs, 2009). Creswell (2012) states that the treatment of research participants historically has brought attention to the establishment of ethics to protect participants. To protect participants, there are considerable principles established. These include participant consent, anonymity of participants and confidentiality of participant identity, and honesty in analysing and reporting data (Bhattacherjee, 2012; Creswell, 2012; Wiersma & Jurs, 2009).

In this research, one-on-one interview sessions and classroom observations were conducted ethically following the procedures of *taona-tabon-inaim*. Firstly, there were letters written to the Ministry of Education (MoE) and Secretary for Education in church schools to seek their approval to conduct this research. After attaining approval from MoE and Church school administrations, consent letters and information sheets were given to participants in the four selected schools. The information sheet states the purpose of the research, and ethical part of the research including the confidentiality of information, anonymity of participants and the significance of their participation (Wiersma & Jurs, 2009). Teachers, in this case,

decided when to conduct their interview and observation sessions, whereas for students, Mathematics Department Heads decision was based on their timetable.

All the interview sessions were conducted in a place out-of-hearing to ensure that information shared was genuine. Before the session, ethical procedures were discussed again to remind the participant followed by the signing of the confidentiality form by both researcher and the participant. This confirmed the partnership and protection of participants. During the interview, a recording device was used to record the conversation, however the name and age of participants were not asked. At the end of each session, the participant was given a one-off token gift to show appreciation.

In the case of classroom observation, teachers, as mentioned earlier, decided when the researcher could visit their classroom. Before the observation, most teachers explained the purpose of the observation to students. During the observation, the researcher presented himself as an outsider to observe and record how the teacher and students interacted using the algebraic language of Mathematics.

Apart from ethical procedures in conducting interviews and classroom observations, the confidentiality of the data was maintained. When not used the recording device and its files, the interview questions and other research materials such as observation records were kept in a safe and locked place not accessible to others except the researcher. In addition to that, the identity of participants was also safeguarded. All the interview sessions were transcribed by two people who were trusted by the researcher. They were required to sign a confidentiality form before commencing work.

Transcription of Data

Transcription of data is considered an important part of the research as it might make false interpretation of data when it is done with the personal experiences of transcribers. This situation is described as misrepresentation of data resulting from the transcription decision (Tilley & Powick, 2002) of transcribers. In this research, the process of transcription was carried out twice. The first round was conducted by the trusted transcribers while the second round was conducted by the researcher.

This is done to ensure that all the information converted from tape recording to text genuinely represents the participant's point of view and also enables the researcher to "hear" what the participant had to say (A. Baker & Charvat, 2008).

In the second round of transcription, the researcher made minor additions to the text. The interview with the Assessment Officer was transcribed by the researcher as time was short for transcribers to do it. In addition to that, most of the data were transcribed not word by word but in reported speech. An example of this is as follows:

> "Student said that the teacher often distributes hand-outs to them to read and take notes out from it, and if he/she has a question(s), then he/she can ask the teacher".

In the actual conversation, the student said:

> "my teacher often distributes the hand-out for us to read and to take note out from it. If I have questions, then I can ask the teacher".

In this research, writing in reported speech is not a problem because it does not alter the meaning of the information portrayed by participants. However, where there is a need for a direct quote of conversation in the analysis, then the researcher refers to the actual recording.

Thematic Analysis

This research used a thematic approach to analyse all the collected data from participants. Braun and Clarke (2006) describe thematic analysis as a method for identifying, analysing and reporting patterns (themes) within the data. Creswell (2012), in a similar way, refers to thematic analysis as a process about describing and developing themes from data to make an interpretation. The two definitions provide a clear understanding and interpretation of thematic analysis as a method used in any phenomenological research to arrive at answers to key research questions. Themes are essentially considered as the main part of the method. Braun and Clarke (2006) states that the theme captures something important about the data in relation to the research question, and represents some level of patterned response

or meaning within the data set. In addition, a theme is also an idea that might be given considerable space in some data items, and little or none in other, or it might appear in relatively little of the data set. This means that a theme is not necessarily dependent on a quantifiable measure but rather whether it captures something important in relation to the overall research question. With that, the fair judgement of the researcher is crucial to be in place to identify patterns/themes and reporting them to the reader.

Moreover, thematic analysis is flexible to use within qualitative research and not bounded to any theoretical frameworks or method used. This means that thematic analysis can be used in any qualitative research despite the underpinning framework used. In some cases like other qualitative analysis: narrative analysis and grounded theory, they are bound to a certain theoretical framework or method (Braun & Clarke, 2006). In addition to that, thematic analysis is also perceived as a foundational method for qualitative analysis because most of the qualitative analysis involves identifying common themes or patterns within data, which is derived from thematic analysis (Braun & Clarke, 2006; Creswell, 2012). Based on features of thematic analysis like identifying themes or patterns within the data as a way to interpret and understand experience of people and also with the consideration as a foundational method for qualitative analysis, it is used as a method to analyse all the data obtained from Mathematics teachers, their students and the Assessment Officer.

How does Thematic Analysis Works?

There are a number of different procedures to carry out thematic analysis. In this research, the six step procedure by Braun and Clarke (2006) is used. The procedure is based on doing the analysis manually which requires a lot of work to go through each of the steps. Figure 8 below illustrates the procedure accordingly.

Figure 8. Thematic analysis procedure (Braun & Clarke, 2006).

This research followed the six procedural steps above to analyse the data. Each of the phases are discussed below.

Familiarisation with the data

This phase is an essential part as it provides a better understanding about the data being collected from participants. It is provides a better understanding in such a way that the researcher familiarises himself with the data by transcribing all the audio or visual recordings or repeating a reading of the data in an active way that is searching for meanings, patterns and so on (Braun & Clarke, 2006).

In this research, the transcribed information was checked with the actual audio-recording for more information. This was based on validating and getting more understanding from the data. As part of the process, classroom observations were also used to make sense of some of the information shared in the interview session.

This was the longest phase of thematic analysis because it involved a lot of work to understand the data.

Generating initial codes

Cross-checking of interviews (from audio-recording device) helped to generate an initial list of ideas about what is in the data and what is interesting about them (Braun & Clarke, 2006).

In this research, generating codes involved the use of highlighter pens and hard copies of transcribed data. The highlighter pen was used to highlight similar points identified in two or more data transcriptions. There were 16 sets of transcribed data for the students, 10 for teachers and one for Assessment Officer. To manage the coding process, the three data sets from the three sets of participants were coded separately. The generated codes for students and teachers were recorded in a separate sheet.

Searching for themes

In this phase, themes were generated based on the careful interpretation of initial codes identified earlier. In this research, repetitive data as well as information that appeared infrequently were considered as a theme. Constituting repetitive data as a theme follows a *semantic approach* whereas making themes from information relatively presented by participants follows a *latent approach* (Braun & Clarke, 2006; Javadi & Zarea, 2016).

In a *semantic approach* the themes are detected at "surface or semantic appearance" and the researcher is obligated not to look after something beyond what the participant has said or what is written in the text (Javadi & Zarea, 2016, pp. 35-36). Using this method, the data are explained based on patterns that exist in the data and are organized in the forms of content, summarized or interpreted meanings. Here efforts are made to theorize the importance of patterns and their wider meanings (Braun & Clarke, 2006). A *latent approach* on the other hand involves deeper interpretation for detecting and testing beliefs, presumptions and conceptualization for forming semantic content of the data and with a level of the researcher's

interpretation (Javadi & Zarea, 2016, p. 36). This means that the theme detected not only as it shows pattern, but also convey realistic perspective of participants about the challenges in learning and teaching Mathematics.

Using the two approaches for identifying themes, the following seven themes emerged: *Teacher Quality, Student learning*, *Algebraic language*, *Teaching and Learning resources*, *Class size, Mathematics Assessment* and *Mathematics syllabus issues*. These themes are going to be discussed in the next chapter.

Reviewing and presenting themes

In this phase, the themes identified were reviewed to ensure that they had evidence from the data and also that such themes represent the voices of the participants regarding the research problem (Braun & Clarke, 2006; Javadi & Zarea, 2016). Javadi and Zarea (2016) stress the two processes: internal homogeneity and external heterogeneity to ensure that themes are constructed independently and there are no overlaps between them, and also, they have supporting evidence from the data. Finalising all the themes enables the presentation and interpretation of the themes to show the main challenges in learning and teaching algebraic language at Year 12 classroom.

Conclusion

The interpretive paradigm was used to guide this research, that is, to interpret and understand the problem associated with teaching and learning algebraic languages in senior secondary schools in Kiribati. The paradigm is based on the perspectives of Mathematics teachers and their students plus an Assessment Officer involved in Mathematics education in Kiribati. All participants shared their views and experiences about the research problem via one-on-one interviews and classroom observations. In addition to that, the methods were conducted ethically in a way that information shared was kept confidential and analysed accordingly. Participant identity was anonymous and code names used in the discussion of all data. The responses and experience of participants were analysed thematically following the six procedures guided by Braun and Clarke (2006).

CHAPTER 4

Findings and Discussion

Introduction

There were 29 participants involved in this research - 12 Mathematics teachers, 16 Year 12 students and an Assessment Officer. The transcripts from the 29 interviews were analysed using thematic analysis using the five principles by Braun and Clarke (2006). From the analysis, there are seven significant themes emerging that are linked to the teaching and learning of algebraic language in Year 12 Kiribati Mathematics classrooms. The seven themes include: *Teacher Quality, Student learning*, *Algebraic language*, *Teaching and Learning resources*, *Class size, Mathematics Assessment* and *Mathematics syllabus issues*. In this chapter each theme is expanded upon and discussed in relation to key Mathematics and other related research and debate.

Teacher Quality

The data suggests that teaching experience, formal teacher education qualifications and ongoing professional development are all linked to quality teaching and in particular the teaching of algebraic language at the senior secondary level in Kiribati.

There were experienced and non-experienced Mathematics teachers who participated in this research. Experienced Mathematics teachers are those considered to have at least five years of teaching experience, whereas the non-experienced teachers are defined as those who have two years of experience at the most. Three of the senior Mathematics teachers interviewed did not have a formal teacher education qualification and neither did they engage in any teacher professional development programs. However, in the interviews they themselves openly admitted this as an area of weakness and felt the need to undertake a program of formal teacher education and also to be part of teacher professional development in their respective schools. It is considered, therefore, that obtaining a formal teaching qualification and taking part in teacher professional development would have a positive impact upon

the effectiveness of Mathematics teachers to teach algebraic language in the Year 12 classroom.

Teaching Qualifications

In relation to obtaining formal teaching qualifications, the teachers perceived many advantages to be gained. This included understandings about student learning, teaching methods and techniques to make Mathematics lessons fun. It is believed that Mathematics would be made easier if at least some formal teacher education takes place:

> "I did not have a teaching background when I started to teach. With that, my teaching style was based from my own high school experience. However, after undertaking some education courses at the local campus of the University of the South Pacific[4] (USP), I began to realize that being a teacher is not about teaching students only, but to know and understand what to teach and knowing students individually as well as their differences in their learning capacities, and also how to teach them accordingly" (STF 1).

> "I took some short summer courses offered from USP based on teaching…those courses are providing essential skills about grouping in the classroom and also some skills on new teaching strategies such as making games which are also appropriate in Mathematics learning" (STF 2).

The above views show positive reactions toward the fragments of formal teacher education some of the teachers have completed at USP. Teachers believe that the courses provided essential skills which Mathematics teachers were not familiar with before. In some cases, Mathematics teachers experienced "burn-out" in their teaching because students seemingly showed little interest in learning with the common traditional teaching style used, that is, standing in front of the students and explaining the notes.

[4] This is a Pacific regional university that offers teacher education programs.

> "Before taking courses at USP, I used to dominate the class by explaining the notes in front of the class like a boss. I noticed that my students were struggling in Mathematics … sometimes I was in bad mood and easy to get angry with students because I felt that I could not shoulder my tasks to ensure that students achieved the expected learning objectives at the end of the class. However, after taking education courses, I felt that working in groups was lessening my teaching load as students were learning with their peers under my supervision as a facilitator" (STF 2).

In several cases, some Mathematics teachers were fearful to make positive changes in their classrooms because they felt they did not have sufficient skills. In the case of two experienced teachers, their formal education studies provided the skills that they had been searching for to address the problems they were facing in their classrooms. In terms of algebraic language, there are some Mathematics education courses offered by USP which provide skills that teachers felt have helped them with Mathematics language at the classroom level.

> "Taking one curriculum course known as ED250 at the local campus of USP, provided some important knowledge on how to teach Mathematics which also included Mathematical languages" (STF 1).

> "Curriculum courses offered at USP such as ED250 and ED350 are also providing the knowledge and understanding of Mathematical languages such as unknown variables (using letters to represent unknown values) and also to use models to add or subtract values*"* (KTM).

Some Mathematics teachers, especially those who did not have an education background, acknowledged that involvement in this research made them think for the first time about the need for further knowledge and understanding about algebraic language. Their experience to date had been based on the concept of "procedure[5]" which they considered important to be mastered by students. However, after conducting the interview session, they began to understand that Mathematics

[5] The concept of "procedure" refers to the working-out structure (step by step) of any Mathematics concept.

language is also as vital alongside of "procedure" in teaching and learning Mathematics. This indicates that undertaking formal study to obtain a teacher education qualification by experienced Mathematics teachers is essential as it provides skills to understand how to teach algebraic language at senior secondary school.

In the literature based on teacher education, Bakalevu (1999) emphasises that undertaking formal training would provide skills to become competent teachers not only to know the content areas of Mathematics but also the context, including the need for the specialist linguistic resources involved (p.65). This is to ensure that students understand the Mathematical text based on familiar contexts and thus be able to consider the technical terms correctly and see the relationship between the language and the Mathematical concepts. In relation to teaching qualifications, Abe (2014) argues that there is a significant difference in student achievement between Mathematics teachers who hold teacher education degrees and those who do not in developing countries. The scores of students taught by formally qualified teachers is much higher than those taught by non-formally qualified teachers. There is a positive correlation between Mathematics education qualifications among teachers and student achievement in Mathematics in developing countries where formally qualified teachers are in the minority. In this research, it is speculated that this could be the case in Kiribati.

Professional Development

In terms of teacher professional development, it seems that most Mathematics teachers, including experienced and non-experienced, perceived that on-going school-based professional development is also vital to assist with Mathematics teaching issues confronted at the classroom level. In this research, teacher professional development is considered, for example, as short workshops conducted at school either by someone from the local Kiribati primary teacher training college or from the Ministry of Education. In Kiribati, school involvement in professional development is varied based on the school calendar. Some schools provide professional development opportunities whereas other schools do not.

In schools that conducted professional development, Mathematics teachers mentioned that there is a need for Mathematics-teacher professional development to be conducted as most of their workshop development is based on non-subject specific issues such as lesson planning, assessment and other matters.

> "There is no specific professional workshop in Mathematics conducted in Mathematics, but most of them were based on how to make lesson plan, how to create marking procedures, and some other matters" (KTF 2).

> "There is no teacher professional development workshop focus on teaching Mathematics registers, however I have the feeling that if it is conducted, then it would assist me to teach Mathematics" (WTF 2).

However, there were teachers that spoke of some professional development conducted in their schools as assisting them to teach Mathematics language:

> "We have professional development conducted in school which was based on *Sheltered Instruction Observation Protocol* (SIOP). In that, we are urged to have content and language objectives in our classes to ensure that students achieved those objectives…To teach Mathematics language, key words (Mathematical key-terms) were written down at the beginning of the lesson with learning objective and students should understand such key words at the end of the lesson" (MTM).

In some cases, there was professional development conducted only once a year.

> "At the beginning of last year, there was a workshop conducted…as I remember the workshop also covered how to communicate and how to deliver Mathematics in the classroom, and also giving guidance on how to assist students if they have their problems" (STM).

In other cases, schools did not have professional development at all. This led Mathematics teachers to apply their own personal experience either from their previous work or from their own high school experience as a teenage student to teach Mathematics:

> "There is no teacher development workshop conducted in the school this year, however, I used my skills from USP to teach Mathematics. One of them is using Blooms Taxonomy which is helping me to teach Mathematics language to express the key concept clearly, so that students achieve the intended learning objectives" (WTF 1).

The findings indicate that Mathematics teachers are clear about the need for teacher professional development that is focussed only on Mathematics so that it can directly assist the teachers to teach algebraic language.

Again, the need for teacher professional development by Mathematics teachers was further highlighted when some teachers treated the research interview sessions as a form of professional development. In the interviews, there was a strong sense of teachers raising their concerns and issues about teaching Mathematics. Some raised their concerns about their students, while some others sought a better approach to teaching Mathematics at the Year 12 level. This further reinforces the need for on-going Mathematics professional development for both experienced and non-experienced Mathematics teacher who do not have a teaching qualification.

Afamasaga-Fuata'i (2002) and Dayal (2013) both support the need for conducting regular Mathematics based professional development workshops in schools to gain further skills so that teachers can address particular problems relating to Mathematics teaching including that of algebraic language. Thompson (1992, cited by Dayal, 2013), stresses that belief that engaging Mathematics teachers in teacher professional development will (Blatchford et al., 2011)provide positive change in Mathematics teachers' beliefs and perceptions and to teach algebraic language according to a student's style of learning (Dayal, 2013).

Responses from students tended to reinforce the teachers' views on their own lack of formal training and ongoing professional development. Students clearly distinguished the experienced teachers over non-experienced Mathematics teachers in the classroom. This distinction was based upon the professional skills, confidence and expertise to handle and conduct lessons in a clear and understandable way. Students considered non-experienced Mathematics teachers to have some issues based on their teaching methods and their skills to handle and administer the

learning process at the classroom level. The views below show the students concerns:

> "Sometimes we have different Mathematics teachers and this is not good for me because some of them can make learning easier to understand the concepts whereas others they cannot" (WSF 2).

> "My new Mathematics teacher normally instructs us to read the notes based on page numbers she has given us and then she explains…the teacher is too slow to teach" (KSM 1).

> "Most of the time, my Mathematics teacher is talking fast when explaining the notes. With that, I have to visit him in person and ask him to repeat what he was explaining" (WSF 1).

The students' comments above refer to non-experienced Mathematics teachers. Although proactive and committed in their work, there is a need for professional development so they can teach effectively. Sometimes new teachers lack confidence and skill to handle the class even though they have a teaching qualification. Clearly, in Mathematics or in any subject, the experience of the teacher also contributes to the learning of students.

In the literature, Dayal (2013) reveals that the length of experience Mathematics teachers in Fiji have correlates with teachers' confidence in teaching Mathematics to Year 11 and Year 12 students. This means that longer-experienced teachers are more mature and confident compared to new graduate teachers to teach Mathematics. This include the skills to administer the class, selection of the best teaching methodology to teach Mathematics and so forth. This is reflected in the views of Kiribati Year 12 students' responses about their teachers and their experience to teach effectively in Mathematics classrooms. The data from this project concerning length of experience needs to be tempered by other studies outside the Pacific. Rice (2010), for example, shows that the impact of teacher experience at the high school level upon students' Mathematics achievement is less definitive compared to elementary and middle school teachers and their students' achievement. However, Rice's (2010) assertion is based on the inconsistency of results from the two case studies involved in the

research. This research, based on student perspectives, supports the argument that the length of experience Mathematics teachers have correlates with teachers' confidence in teaching algebraic language.

The perspectives concerning Mathematics teachers from the teachers themselves as well as from students were mostly affirmed by the researchers' classroom observations. Many of the teachers appeared to lack confidence in their teaching when observed. They tended to teach lessons quickly and not give time for the students to learn the concept themselves. In addition to that, some teachers tried to use English as their means of communication in the classroom, however, some of the instructions given to the students were not clear. Even the researcher at times did not understand what the teacher was talking about. Moreover, one of the experienced teachers, when making an evaluation of the class, found out two of her examples (related to a class activity) were not logical. This made the students confused when they did their activities. Most teachers taught concept procedures and had to provide much assistance to students to clarify what needed to be done in the activities. The Assessment Officer said that Mathematics teachers lack the content of Mathematics to really teach it effectively and that makes students confused. This includes algebraic language, for example, in multiplication of rational numbers, most teachers urged students to take the "reciprocal of the divisor". This adds to the load of students to remember, when in fact, such rational numbers can be divided accordingly without taking the reciprocal.

$$\frac{a}{b} \div \frac{y}{z} \approx \frac{a \div y}{b \div z}$$

In addition to that, teaching of application questions (also known as word problems) to students is also not easy because most Mathematics teachers could not solve the problem themselves. In most cases, teachers attempted first the questions and later in the classroom introduced some of the questions which were solvable by the teacher in so doing leaving behind some difficult questions. This shows that Mathematics teachers still need further support, in the form of professional development, to be confident when teaching.

In summary, it seems that teachers believe that formal teacher education and professional development will have a positive impact on the capacity of teachers to

teach algebraic language in Year 12 classroom. Some unqualified teachers are currently undertaking their formal training at USP but are motivated to do so by their own interest. Professional development, perhaps more contingent upon Ministry of Education provision still needs to be conducted continuously so that it may assist all Mathematics teachers in the classroom.

Student Learning

A second theme has emerged from data concerning student related learning issues. Teachers perceived a lack of basic skills and student commitment in the learning process are some of the challenges to the effective teaching of algebraic language. Students themselves also mentioned a similar set of challenges. Both teacher and student responses here tended to be supported by the researcher's in class observations. These challenges contribute specifically to student confusion about algebraic language and an inability to internalise algebraic rules and procedures.

Learning basic skills

Most Mathematics teachers showed that some students did not understand basic skills when they were in lower forms. With that, students often get confused with Mathematics language and rules learned at the Year 12 level. Some of the confusing theoretical concepts are: subtraction of rational numbers that involve unknown variables[6]; identifying formula from a graph; finding the x and y intercepts; solving quadratics using specific rules; cubic; logarithm exponential equations; indices law; finding the distance using distance formula and so forth. Most students find it hard to attempt such questions as they do not really understand the basics especially the rules to execute solutions. The perspectives of three teachers are shown below:

> "Some of my students were attending school for the sake of their ages, but indeed they did not understand basic Mathematics skills" (STF 1).

> "Students have a problem in Mathematics language because they did not learn much of the basics" (KTF 1).

[6] The *unknown variable* refers to an algebraic object that can be replaced by a number (Malisani & Spagnolo, 2009). For example, consider equation of $2x + 5 = 15$, where "x" is the *unknown variable* that replaces a number to satisfy the properties of the equation.

> "Some students often struggle with the terms: "expanding", "solving", "simplifying", because they did not understand such terms from Junior high school level" (KTF 2).

Teachers made the assertion that when students understand well basic algebraic concepts at the lower school level, then their learning at senior secondary level would not be as challenging as most of the terms used at the higher level derive from those used at the lower level. Some terms common at the lower and upper level are: "simplifying", "more than", "at least", "at most", "less than", "as twice as", "triple", "exceed", "share", "times", "greater than", "equivalent" etc.

The assertion made by teachers about the need for early basic skill development is well supported by the students themselves in their interviews. Some students explained that Mathematics was their problem at the lower school level and since then they are not able to tackle problems at the senior secondary level.

> "When I was in lower forms (Junior secondary school), Mathematics was my problem and still now I am struggling to learn it, because there are a lot of formulas and methods needed to apply to execute the right answer" (WSF 2).

> "When I was in Form three and Form five (Year 9 and Year 11), Mathematics was my problem" (SSM 3).

Some students understand that learning basic skills at lower school levels is important, thus they want to advise their younger peers that they should learn basic skills first.

> "My advice to young colleagues is to learn basic skills because they are important" (KSM 3).

> "My advice to my young colleagues is not to skip their school levels because learning basic skill is very important in Mathematics" (SSM 1).

These students' opinions show that learning basic Mathematics skills including key terms, formulae and procedures, is essential as it makes students more confident and minimises confusion when they are at the upper senior secondary school level.

Classroom observations also affirmed that some students have not learned basic skills well. They still need teacher assistance to re-explain algebraic rules to go on with their activities. In this research, solving a quadratic equation by using either a factorizing method or a quadratic formula still confused students. Some students understood the concept but they had forgotten how to find the solution using the two rules. Hence, they need assistance either from the teacher or their peers to remind them how to solve it. In addition to that, some students did not know some algebraic rules to evaluate the definite integral by expanding first the function $f(x) = x(2x + 2)$ in the activity shown below.

$$\int_1^2 x(2x+2)dx \equiv \int_1^2 2x^2 + 2x\,dx$$

Some students could not identify the similarities between the mixed fraction and improper fraction especially when the answer given is in fraction form.

$$\frac{5}{3}\ and\ 1\frac{2}{3}$$

Classroom observations also noted that students who did not do well or were struggling in Mathematics were those who lacked basic knowledge.

This shows that Year 12 students still lack in algebraic basic skills which they are supposed to learn at lower school levels. This is very similar to the findings of Dayal (2013) in Fiji schools where he stresses that students who have reached high school level are still lacking understanding of Mathematics basics such as numbers and shapes. One main factor in Fijian students' lack of basics is the examination-oriented nature of school learning which required teachers to teach the prescribed syllabus in a given timeframe and prepare students to sit for the national examination at the Year 12 level. In his research, however, he adds that superficial learning of students in algebraic language from lower schools does not allow them to master and achieve basics. This is based on the

type of learning they were exposed to which was often shaped from the two Kiribati national examinations that exist at lower and middle high school levels.

Students' Low Level of Commitment

Apart from learning basic algebraic skills, low levels of student commitment to learning are also perceived by Mathematics teachers as a problem in teaching algebraic language. Some teachers believed students showed no interest in learning Mathematics as they did not play their part during lessons, after school hours with homework and sometimes missed a lot of classes. Below are the concerns of teachers about low levels of student commitment to their Mathematics learning:

> "My students did not understand the algebraic language because they did not study" (KTF 2).

> "In Mathematics, a lot of practice is needed to understand the concept, but some students do not do their part to do their practice … another problem is the absence of students from Mathematics classes, normally five to six students can miss classes. With that, I have to repeat again the lesson to ensure they achieved the same learning objectives as others" (WTF 1).

> "Some students did not want to participate in the learning process, they always remain silence and sometimes they can disturb other students when I explained the note, or leave the classroom" (WTF 2).

The concern of teachers show that they believe there is a low commitment shown by students to learn algebraic language which indicates the low interest of student towards the subject. Teachers also stressed that low commitment of students to their assigned tasks creates gaps in understanding Mathematics language as they missed or did not want to practice so that they can be familiar with the concepts. Here, it shows that *teachers believe* that students should take more responsibility for their learning in order to understand Mathematics language under the guidance of the teacher.

The concerns of teachers tended to be affirmed by the students' own statements concerning the part they played in the learning process as expected by the teacher.

> "My teacher sometimes gave us hand-outs to read and to make our own notes out from it but I could not read it because I was lazy" (KSF 2).

> "Some of my friends did not play their part to practice in Mathematics. With that they often get confused" (KSM 3).

In the classroom observations, low levels of student commitment were evidenced by some students who sat at the rear of the classroom where they were seen by the researcher to discuss other matters with each other apart from Mathematics. In addition to that, some students were seen by the teacher not attempting their activities at all whereas others pretended to do their tasks when the teacher approached them to see what they were doing. The occurrence was also noted by Ferrari (2004) and Rodd (2005), that is, students can often have a negative reaction toward complex Mathematics questions when they do not understand.

Dayal (2013) stresses that the main reason students lack interest is their difficulty in understanding Mathematics language and how to relate it to the concepts they are learning. Bakalevu (1999) stresses that Mathematics language is complex to understand because it often incorporates hidden images (Manu, 2005) and graphic representations of the objects they label (Chard, 2003). It is quite likely that these are the reasons behind what the teachers perceive to be some students' lack of interest in Mathematics.

Algebraic Language

Apart from student engagement issues, the complicated nature of algebraic language is also perceived by both teachers and students as a challenge to teaching and learning algebraic language, however, the emphasis here is much more on students' learning than the way teachers approach the teaching of algebraic language. There are two main challenges related with teaching and learning algebraic language. These are application problems, or in other words Mathematical problems put in

writing, and the use of key algebraic words required to teach Mathematics at the senior secondary level. These two sets of problems are discussed in details below.

Application Questions

Application questions in Mathematics involve extended verbiage portraying real-life situations which require Mathematical rules to be applied to supply reasonable solutions or answers. These sorts of problems have long been an attempt to contextualise otherwise abstract Mathematical processes in order for greater student understanding (Bakalevu, 1999). The main problem faced by students in working out application problems is the use of English and the translation of English sentences into Mathematics statements.

Mathematics teachers revealed that the lack of understanding English sentences and the difficulty of translation of the English into Mathematics sentences prevents students from performing well at senior high school level. In regard to the use of English, students lack understanding of the unfamiliar vocabulary that is used. This vocabulary, however, also serves as the key idea in the question. This creates confusion because students are not able to make connections between information given in the question and the meaning of the entire question. The perspectives of teachers concerning the issue are shown below:

> "Using difficult and hard vocabulary in word problems often makes students confused in identifying the exact meaning of the problem. With that, they have to keep on asking questions about what and how to do the question" (STF 2).

> "Teaching word problems is difficult for me because students are not able to understand and do their own work unless I assist them for literal meanings of the question so that they can understand and go on with the class activities ... I normally give examples on word problems but when it comes to students to do on their own, they cannot do it" (KTF 1).

> "I noticed that their problem is based on the comprehension of meaning so once I made the translation to Kiribati language, then students

> understood and could do the task on their own. From that, I suggested that understanding English sentences or vocabularies used is their main problem" (STM).

Most teachers made the assertion that the problem is based on a lack of understanding of English vocabulary which makes students confused with application questions. With that, some Mathematics teachers find it hard to teach application question as students could not independently do their own tasks but ask for assistance just only for the meaning of the question. This lack of basic English skills finds resonance in Bakalevu (1999) and Trinik et al. (2014) who state that learning Mathematics in English creates serious cognitive difficulties. With that, there is a need for teachers to build up conversational language as well as knowledge of the Mathematics register because student's construction of knowledge depends on oral explanations and interactions with the teacher. In this research, however, Mathematics teachers show that they were using English language a medium of instruction in the class. However, this made students confused and not able to understand concepts, hence they switched to Kiribati language to explain class-notes. This relates to the use of bilingualism by Baker (2011). It seems that bilingual approaches are used in Kiribati Senior Secondary Mathematics classroom by teachers but it is not well planned. Baker (2011) argues that the use of bilingualism, or more specifically "translanguaging" (p.229) is effective when it is well planned in the learning process as it allows students to associate their first and second language to comprehend the meaning of the question in any problem-solving questions.

However, with regard to the lack of student's ability to translate the English statement to Mathematics, the problem is based on understanding key words or sentences that can directly translate to Mathematical representations in terms of numbers, signs and unknown variables (letters).

> "The major learning challenge faced by students is word problems where students could not translate the problem to a Mathematical statement" (MTM).

> "In word problems, understanding English is the main problem as student could not interpret the question for exact meaning. Some students who

> have the ability to interpret the question, their problem is to construct Mathematics formula that made up of letters (unknown variables)" (STF 1).

Some of the confusing key words emerging from the interviews by students which they hardly translate them into Mathematical statements are: "as twice as"; "depreciate", "is proportional to"; "fewer than"; "of"; "reciprocal"; "integration" and "differentiate". In some cases, students could not understand to then associate information given in a question to in turn identify a formula. One of the experienced Mathematics teachers stressed that in a question that involves "relations" and "comparison", for example, a movie watching scenario. Some students were not able to relate the several pieces of information, that is, the cost of the ticket, the number of people (adults and children) and the amount spend in the movie, to formulate the equations required. Bakalevu (1999) stresses that mis-comprehension of the information mainly in the form of 'relational sentences' and 'compare problems', and the use of logical connectives are common elements in Mathematics problem-solving. Relational sentences include three term series problems like the movie watching scenario.

The statements made by teachers on the application problem is well supported with the data from the students indicating that they too face those challenges. Students show that their problem with application questions are from understanding English vocabularies and finding the appropriate formula to use. Below are some views from the students about application questions.

> "Sometimes I hate application questions especially when unfamiliar English vocabulary is used…the other problem is finding the appropriate formula to use" (MSM 1).

> "I like application questions if they are easy to understand, but if it is complicated to understand then I don't like them … they complicated to understand because the English vocabulary used is not familiar" (SSM 1).

> "I do not like application problems because I cannot follow the instructions especially if the question is too big and involving many concepts" (KSF 2).

The views above show that the difficulty of application questions by students is related to the use of English and also finding the appropriate formula. In addition to that, the dislike of application questions is also shown by students during the interview, where some students pretended to like the kind of question, but later on they admitted that they disliked the type of question. Other students, when asked about application questions, showed uncomfortable impressions.

In the classroom observations, none of the classes attempted to do application questions, instead only wordless and direct questions. This possibly indicates that students are not well engaged with application problems in their daily class-activities. This is likely a factor that leads to student lack of understanding in application questions. The Assessment Officer, indicated that the problem with application questions is caused by teachers. Most of them did not want to include application questions in their daily class activities. This was due to some Mathematics teachers' inability to solve some application questions. He added that the common practice is that some Mathematics teachers often limit the number of application questions based on questions that can be attempted by the teacher. With that, it shows that Mathematics teachers are also contributing to student difficulty in solving application questions.

This reluctance on the part of teachers indicates that the challenges in teaching and learning application questions is based on the use of unfamiliar English vocabulary and the translation of English words or sentences to Mathematical statements. Such challenges would improve if Mathematics teachers did not avoid the use of application questions in their daily class-activities. This is to make students familiar with and engage with application questions. As stated in Chapter One all primary school teachers have undergone English language testing in relation to their teaching and for some extra support has been given (Ministry of Education, 2014b). This, however, did not extend to secondary school teachers.

In the literature, Bakalevu (1999) stresses similar findings in regards to the translation of real-life contexts to Mathematics learning as the main challenge in teaching and learning application questions. She added that the translation is often associated with the comprehension of the question and mis-understanding often leads to incorrect translation. In this research, students found it hard to comprehend the question resulting in confusion for translation. In addition, some students may comprehend the question but their problem is translation. Translating real-world contexts shown in the question to Mathematics statements is challenging. Bakalevu (1999) identified that the main cause of confusion with application problems is related to the unfamiliar context used in the question. To be able to understand the Mathematical text, the reader has to have a context for it and thus be able to consider the technical terms correctly and see the relationship. If the student is not able to read the appropriate assumptions derived from the context of the situation, then it leads to frustration and possible mis-comprehension. This is likely the case in Kiribati because the NCEA Mathematics textbooks from New Zealand are used in most schools which means that every word problem used in the Kiribati classroom is based on New Zealand contexts. With that, Bakalevu (1999) argues that using our own context in Mathematics can better assist students to more easily understand the problem. Bakalevu's assertions, while valid, are somewhat idealistic, as will be seen in the section on resources that follows. It would take a major resourcing effort to produce teaching material at the senior secondary level that contextualised senior Mathematics in Kiribati. Overall these findings reflect the large body of literature calling for more structured bilingual approaches to teaching (C. Baker, 2011). The problems described by both teachers and students here are perhaps typical of the challenges of all English as a Second Language (ESL) contexts.

Algebraic Key Words

Apart from application questions, the closely related issue of key algebraic words is also perceived as another challenge to teaching and learning senior Mathematics. Key algebraic words are those that incorporate specific Mathematics rules. Some key words identified in the interviews are *simplifying*, *solve*, *quadratic and cubic factors*, *expansion*, *factors*, *reciprocal*, *rational expression* and *evaluate*. The challenge is based on the rules incorporated with such key words. Some key words

involve long procedures and different concepts to supply the answer, whereas some involve symbols and unknown variables.

Mathematics teachers indicate that students often get confused with key algebraic terms that normally require long procedures to supply the answer. Two experienced teachers mentioned that *rational expression* or *equation* posed a challenge for students as they require long procedures to supply the answer and also because they involve unknown variables.

> "To solve a rational equation, students should also have learned about *reciprocals* to eliminate either *numerator* or *denominator* from both sides of the equation, so that they can calculate the value of unknown variable" (MTM).

> "One of the difficult tasks in algebra is rational expression where students are required to apply multiple concepts including: *lowest common factor*, *collecting like terms*, *addition* or *subtraction* and *multiplication* and *division* to supply the answer" (KTF 2).

In addition to that, some Mathematics teachers stressed that students could not carry-out the expected rule for a concept and often misinterpreted and interchanged rules from one concept to the other.

> "Some of my students interchanged the rule of one concept to the other, like if they asked in the question to *solve* a quadratic equation, they did the *factorizing* rule. In some cases, students applied the *expansion* rule when asked to *solve* equations or expression" (STF 1).

> "Some students when asked to *simplify*, instead they applied *solving* rule, whereas if they asked to *solve*, instead they were *expanding*" (WTF 1).

One possible cause of the problem is related to student issues discussed earlier in terms of their low level of commitment to their studies and also lack of learning basic skills as some algebraic key terms were also learned at the lower secondary school levels.

From the student perspective, similar problems and challenges which were revealed were associated with the key words and their incorporated rules.

> "In algebra, I still have a problem to understand some of the rule for key words like *expansion*, *solving power equation*, *quadratic equation*, *simplifying*, and also the use of *unknown variable*" (WSF 1).

> "Some algebraic key words that I still confuse are *logarithm* and *power equation* because they have long procedure to follow to compute the answer" (KSF 1).

> "For the key term *expansion,* I did not understand how to apply if there are rational equations given that need to be solved using expansion rule" (SSM 3).

> "*Determinant* is one of the key term that I still confuse with because the required rule is different with what I have learned at lower high school level in matrix. Here, I learned that it is working with quadratic equation" (MSM 1).

The main problem here is understanding the rules incorporated with the key algebraic words as some key words require many steps to solve and involve other concepts before reaching the solution. Solving power equations, for example, require different concepts including *logarithm properties*, *elimination of multiplicative terms*, and *addition* or *subtraction*. If students do not comprehend logarithm properties, then they will not be able to solve power equations. Indeed, students can easily confuse the rules because they are overwhelmed with many rules to apply. This is also the case with using symbols where some students revealed that they can confuse the symbols because of the large number number learned at the Year 12 level. With that, some students interchange the working out of one symbol with another symbol.

Classroom observations, support the problem with students and key algebraic terms used. In one class, students asked the teacher to re-explain how to solve quadratic equations using the factorizing method as they forgot the procedure. In another

observation, students asked how to get $2x^2$ from rational expression $\frac{4x^2}{2}$ as they did not understand when the teacher showed the detailed working out on the board. This type of activity requires students to understand division of numbers. However, the unknown variable "x" is involved which makes students confused (Lee & Low, 2007). However, some students from other classes are confused with the symbols used like $t_2 = (t_1)^2 - t_1$. To find the terms in a recursive sequence requires the substitution rule. With that, it shows that students still have a problem with some of the key algebraic words based on their incorporated rules.

In the literature, Bakalevu (1999) stresses that Mathematics language is a kind of hybrid language that is made up of ordinary English (OE) and Mathematical English (ME). Mathematical English comprises the Mathematical register and the language of symbol notation. Manu (2005) adds that Mathematics language is a language that incorporates meaning and rules, which means that every key word in Mathematics normally incorporates certain rules that students should learn in the classroom to understand. For instance, if students are asked to *simplify the expression*, then students should apply *like terms* to make the addition and subtraction of the terms in the expression. Insufficient knowledge on *like terms* may affect the working-out as there are also principles that should be followed. The data shows that students have problems in understanding algebraic key terms especially with their specific rules, which makes them confused and also interchange rules. Bakalevu (1999) also addresses that as Mathematics language uses English, then monolingual students like Kiribati students are likely to experience difficulty with the language of Mathematics texts and discourses. The problem encountered by Kiribati Year 12 students as learning Mathematics language requires skills to comprehend English and also the ability to execute appropriate rules to each key word. This problem has been well documented in the research literature.

Teaching and Learning Resources

The lack of teaching and learning materials, for example, a basic Mathematics textbook in some schools, is perceived by Mathematics teachers and students as a challenge to teaching and learning algebraic language. It is a challenge because a textbook is perceived as a tool to assist teachers to overcome the problems

associated with a limited time span in class. Additionally, the unavailability of textbooks makes the learning of students bounded by what the teacher has provided in the classroom. Conversely, if textbooks are available and used by teachers and students in the learning process, then teachers can overcome their time issues and students can learn beyond what the teacher has prepared for them. It is noted that only two schools use a textbook or hand-out for teachers and students. The other schools have only a few textbooks available for use by teachers only. This section discusses further the challenges related to the lack of textbooks and by extension teaching resources generally.

In some schools, the availability of textbooks is a problem. In some cases Mathematics teachers can only share one textbook among themselves. This can affect teachers, especially new teachers, in teaching Mathematics as they are not yet familiar with teaching the Mathematics syllabus. They might only use simple and straight forward questions but use limited application questions which is the main weakness of students. In some cases, teaching without the textbook can severely hinder students from learning the Mathematics course set for Year 12 levels.

It is also noted that some teachers perceive the textbook as an important teaching tool because it can assist teachers with their issue of limited time in the class. One of the new Mathematics teacher stressed that the textbook was needed by the students as sometimes they were not able to understand the concepts explained in the classroom due to the limited number of examples and activities used otherwise. She said:

> "Sometimes when I explain the notes on the blackboard using few examples, students did not understand and need more examples and activities to do. However, due to the time-span of a period, I can use at most 3 examples with few activities. Having the textbook by students can assist in showing multiple examples and activities" (KTF 1).

The above view indicates that time is a concern as it is inadequate for teachers to fully explain the concepts using many examples and more activities. However, the textbook or hand-outs (copied from textbooks) can provide more examples and activities as an addition to what the teacher provided in the class. Moschkovich

(2012) supports the use of textbooks as they can expose students to a kind of language that was not used by the teacher in the instruction or in test item. The link Moschkovich (2012) makes between the textbook and language in particular is significant in terms of this study.

In schools, the duration of the lesson is varied. Some use forty-five-minute periods while others use one hour. Most teachers stress that one period is not sufficient to carry-out interactive learning with students. However, if textbook or hand-out is used, it can provide more time to carry-out interactive learning to assist students with their challenges. Two Mathematics teachers revealed that using textbooks or hand-outs can provide more time to engage with students:

> "Having textbooks by students can contribute to efficient learning in a way that there is no need to write the notes on the blackboard but just to discuss the main point and then the activities" (KTF 1).

> "Currently, I am using the blackboard when teach Mathematics … this is consuming time because I have to take notes and then explain leaving about 20 minutes or less for students to do their class-work. However, when I use hand-outs, it gives more time to explain the notes and engage well with students" (STF 1).

The most common teaching method used by Mathematics teachers in this research is *teaching by telling*. It is a type of teaching perceived by Pimm and Johnston-Wilder (2005) which sometimes might leads to significant disadvantage in learning Mathematics as it stimulates rote learning where students become passive learners. It is commonly accepted as the only teaching method to use in such circumstances can also be unreliable. This lack of resources often leaves teachers no choice but to write again on the blackboard.

The views of teachers showed that the textbook is one of the important teaching and learning resources needed to assist Year 12 Mathematics teachers to provide more examples and activities for students. They also are beneficial from a time frame point of view. The teachers' emphasis on textbooks, however, indicates old traditions of teaching: teaching by telling (Pimm & Johnston-Wilder, 2005) and

indicates a need for more interactive learning or a *student-centred approach* which is currently urged by many Pacific educators (Beuka, 2007; Kaei, 2007). As mentioned by Booth (1998, cited in Lingam & Lingam, 2013) the poor or inadequate resources in the school is the most discouraging aspect of the classroom especially in a classroom that is enclosed and there is no space to perform any activities other than general chalk and talk/teacher-centred strategies.

Further to the above it is also significant that other teaching and learning resources such as computers, calculators and the internet were not mentioned by Mathematics teachers. Reasons for this need to be investigated further but it is possibly because of their limited opportunity to attend professional development programmes about using a variety of teaching and learning materials (Trinik et al., 2014). Additionally it might be due to those resources being not available in schools. Goos and Bennison (2007) argue that the use of technology, Mathematics computer software and Computer Algebra System (CAS) calculators assist high school Mathematics teachers, regardless of experience, to explain complex key concepts. The use of technology can stimulate students' learning and also to provide a clear picture of the concepts and how they are related to the real world (Ontario Ministry of Education, 2004). With that, students can develop their knowledge of Mathematical language.

Apart from the teachers, the students also expressed a greater need for textbooks or hand-outs to help them understand algebraic key-words. Some students who do not have access to textbooks or hand-outs mentioned that their learning is based only on what the teacher has prepared for them in the class. In addition, they believed that reading from the textbook or hand-out would enable them to understand the concepts if they could not understand what the teacher has explained.

> "We don't have textbooks or handouts, we are depending on the teacher's notes in the class" (WSF 1).

> "Currently, we do not have a textbook to use, and this makes me rely more on what the teacher has prepared for us in the class. In my opinion, if there is a textbook, then it would assist us to understand the concepts as there are more activities provided" (SSM 1).

The above views show that student learning is often limited to what the teacher has prepared for the class. In some cases, the notes from the teacher are too brief, with few examples and activities, due to limiting duration of the lesson session. This can lead to some students misunderstanding what the teacher has explained. They need more examples or explanation from the teacher so that they can fully understand the concepts involved. Having the textbook or hand-out can enable students to read and do the activities according to their individual learning pace during or after the class itself.

Students from schools who have textbooks also revealed a positive reaction toward textbooks as they provide extra notes, examples and activities apart from what has been prepared by the teacher. However, some students revealed that they have a problem with the content used, mostly in word problems or application questions as they could still not readily understand:

> "The textbook really helps me to clarify whatever I got confused with when the teacher explained the note. However, some of the problems, especially in word problem questions, content used I am not familiar with and makes more confusion" (MSM 1)

> "We all have textbooks: *Theta* textbook[7]. In my perspective, it is good to have this textbook, in a way that there are many examples to follow. However, the problem is that most questions are associated with a foreign country, which is indeed quite hard to follow and understand" (MSM 2).

The problem is based on the context as *Theta* (Barton, 2011) is a prescribed textbook for Year 12 students with a lot of New Zealand content. Some of the word problems are based on a New Zealand context and include movie-watching questions, shopping questions, withdrawal of cash from ATM machine questions and so forth. Those types of questions can be understood by some students who are schooling on Tarawa as some of the said social practices are being introduced, but

[7] It is a New Zealand Mathematics textbook by David Barton which is currently used at Kiribati Year 12 Mathematics classroom.

those from rural parts of Kiribati find it hard to understand. Bakalevu (1999, 2009) stresses that all use of language has a context and the context is a useful bridge between the text and the situation in which the text occurs to enable students to understand the text and interpret its meaning. If students are not able to bring to the passage appropriate assumptions derived from the context of the situation, then there will be challenges in learning. This will lead to frustration and possible miscomprehension. With that, Vaka'uta (2012a) stresses that teaching and learning materials need to be meaningful and worthwhile to the teacher and students of a particular context. They need to be familiar and relate to their experience, beliefs, values, attitudes and knowledge so that learning and assisting students is more meaningful and may provide them some ownership in their learning. In this research, it seems that students, even though they have textbooks, still have a problem interpreting word problems because of the unfamiliar context used. Nevertheless, overall the use of textbooks does facilitate the learning of algebraic language at the senior secondary level.

During the classroom observation, it was noted that there was a difference of time allocation for teaching between Mathematics teachers from schools that used textbooks or hand-out and schools that do not. Teachers who do not use textbooks or hand-outs often spend more time writing detailed notes followed by the activities on the blackboard. This often led to unfinished work in the classroom by the teacher and students. However, those who used textbooks or hand-outs spent less time writing only the summary of the concepts and so had more time for discussion of the notes and clarification. This might reflect the planning of lessons by the teacher, however, the use of textbook or hand-out by students also plays a role in making learning more efficient and manageable. This observation affirmed the concerns of teachers about time available and how textbooks can assist in the development and expansion of student algebraic vocabulary.

In addition to that, it was also observed that in some classes, teachers used few activities during the lesson which made some students, especially the more capable ones, to ask for more activities. In one case, however, the Mathematics teacher used the blackboard for notes and activities but somehow forgot one example on how to determine the turning points of a cubic function. After the class, she realized that

and said that she would explain that in the next class. This indicates that student learning is based solely on the planning of teachers when there is no hand-out or textbook. Rightfully or wrongfully the textbook or hand-out, can compensate for the shortcomings in teaching such as those described earlier in this chapter.

In the literature, Lingam and Lingam (2013) stress that teachers alone, no matter how well-prepared they are, may not be able to provide an enriching learning and teaching experience to children. Reliance on them alone may inadvertently have a negative impact on the students to reach their full potential unless complementary action is taken with the provision of school resources such as good-quality, up-to-date textbooks, infrastructure, library and ICT facilities. In terms of textbook, Lingam and Lingam (2013) added that in rural schools in Fiji, textbooks used were either out-dated or not available in sufficient numbers. This limits student access to substantial up-to-date subject content knowledge in comparison with their counterparts who have access to more advanced and recent publications in urban areas of the country. This supports the findings identified in this research about the need for textbooks by high school Mathematics teachers in Kiribati. However, as mentioned earlier there is a need to consider the context used in the textbook as in most parts of the Pacific there is not the capacity to produce contextualised resources, especially for a specialised curriculum area as senior Mathematics. Bakalevu (1999, 2009) supports the use of familiar Pacific contexts in Mathematics teaching and learning so that it can enable students to connect their understanding of the text and its meaning. Vaka'uta (2012a) also supports the learning to be contextualized so that students may feel ownership of learning. Information Communication Technology might be a more realistic support for learning (Lingam & Lingam, 2013) in Mathematics (Goos & Bennison, 2007).

Class Sizes

Class size also emerges from the interviews as one of the challenges faced by Mathematics teachers and students affecting the teaching and learning of algebraic language. It is a challenge because larger classes tend to facilitate unwanted behaviours from students and also hinder the implementation of one-on-one teaching which is perceived by Mathematics teachers as an effective teaching pedagogy for learning algebraic language. This section outlines in some detail the problems

associated with class size in Year 12 Maths classrooms and how it is affecting the teaching and learning of algebraic language.

Mathematics teachers from two of the sample schools revealed that class size is one of the problems affecting the teaching and learning of algebra. More specifically the large number number of students could not be catered for and assisted within the given time of the one-hour period:

> "In my class, there are forty-nine students. This is beyond my capacity to cater and assist students within a class session especially those who really need my assistance to clarify more about the Mathematics concepts or rules because most of the time not only one student can ask questions" (WTF 1).

> "One of the challenge is based on how to deliver the lesson to cater for many students in a class. Working with each student is not sufficient" (STM).

> "Currently I have fifty-three students in a classroom. In my class, I tried my best to assist students who were genuinely need the assistance, but sometimes some were unattended" (WTM).

The perspective of teachers shows that the number of students in their classes is beyond their capacity to assist each student in the classroom even though there were students that genuinely need assistance from the teacher. This shows that assistance depends on the choice of the teacher in the learning process. The data from students' perspectives shows that those students who are often off-task in the learning process were the ones who are often selected by the teacher. As mentioned by Blatchford et al. (2011), large class size leads to different teaching and learning problems including dealing with unwanted behaviours. The unwanted behaviours are mostly concerned with on and off-task students especially from the lower achieving students. With that, teachers can not readily implement one-on-one interactions with students or adopt creative teaching styles but to teach the whole class and make limited choices as to who to assist students during the lesson. This in turn likely to affect teaching of algebraic language

In terms of teaching algebraic language in large classes Mathematics teachers found it difficult to cater to the needs to assist students independently. They considered that their assistance during activity time in lessons is crucial to bridge the gap in the students understanding. However, this is not the case in large classes as the teacher cannot assist all students but only some depending on his/her choice (Blatchford et al., 2011). Mathematics teachers felt smaller classes would affect their instructional practices by facilitating the increased use of small group instructional arrangements, hands-on activities, one-on-one instruction, and differentiation of instruction. Fuller and Kapakasa (1991, cited in Schweisfurth, 2011) stressed that teachers with more training and less crowded classrooms more often believe that pupils should be asked questions and become more active participants in class.

In terms of the students' perspectives, most did not indicate that crowded classrooms affect their learning of algebraic language directly. However, they expressed some negative views of large classes (Blatchford et al., 2011) including disturbance to learning and being off-task in the learning process. Two students stated:

> "During the learning process, the teacher always asks questions to my other colleagues who seemed not to focus in the class" (SSM 1).

> "In Mathematics class, sometimes I did not concentrate on what the teacher explained as I was distracted by my friends" (WSM 2).

The statements above indicate that off-task behaviour in the learning process and disturbances in general during the learning prevent some peers from focusing on their learning and distracting others. According to Blatchford et al. (2011) these can often be students from lower achieving groups who often spend more than twice as much time off-task in large classes as they would in classes of a more manageable size.

In terms of classroom observation, it was noted that most of the lessons observed were fully attended by students. In those classrooms, there were students often sitting at the rear of the classroom who distracted their peers when the teacher explained the notes. As discussed previously in this chapter some students gave the appearance of being on-task when the teacher approach them, but were observed

off-task from the beginning of the class till the end. According to Blatchford et al. (2011), large class sizes in high schools tend to allow low achievers to be off-task in the classroom whereas high and middle achievers remain on-task passively listening to the teacher.

With that, it is quite likely that large class sizes are affecting the teaching of algebraic language as there are many students to assist and cater for their individual needs. Smaller class sizes means that teachers can assist students on an individual basis. However, this was not mentioned directly by teachers, perhaps because the problem is not caused at the classroom level but at an administrative level. Students also did not directly mention class size affecting their learning, but only described some identified characteristics including disturbance and off-task during the class. Such student behaviours were also observed in the classroom observation session by the researcher. Blatchford et al. (2011) argues that behaviours such as these hinder students learning to the best of their ability. However, the perceptions of the teachers contradicts to dome extent and Maples (2009) who argues that large classes do not always affect student achievement They argue that large classes can actually assist students to have a significantly higher mean score in Mathematics compared to students enrolled in small or medium size classes. Chapman and Ludlow (2010) argue that student attendance to class is a more significant determinant of academic achievement than large class sizes. In this research, student attendance is also noted as a problem. Regardless this could indicate the need for professional development so that teachers are equipped with skills for classroom management and pedagogical techniques.

Mathematics Assessment

Using different vocabulary, symbols or questions in Mathematics assessment practices which are never used in daily classroom activities is perceived by teachers and students as a problem in the teaching and learning of algebraic language. It is a problem because it can lead to student confusion. In turn they do not perform the appropriate calculations even though the question is derived from the same learning outcomes and learned daily by students. This is of great concern because assessment is the means used to monitor student achievement. This section examines the

problem of using unusual vocabulary, symbols and questions in any Mathematics assessment, exam assessment and common assessment task.

Exam Assessment

In Kiribati Mathematics classrooms and in any other academic discipline it is very common that prior to the formal assessment used, either school based or external exams, teachers and students attempt any past test or exam questions prior to the actual assessment date. It is common because teachers and students know questions used in the assessment can be written repetitively, even though they can be written differently compared to the daily activities in a classroom. One of the teachers shared a typical scenario where students in the classroom try to attempt any given exercise, however, if the same concepts appears in the exam assessment but are written even slightly differently, then students fail to complete the question correctly:

> "In my perspective, students did not have problems with questions in class, however, in the exam assessment if the same concepts are used but written differently, then students cannot understand and sometimes they guess or neglect the question altogether" (STM).

This data shows that the issue is not necessarily about non-alignment of test items with learning outcomes (Biggs, 1996), but the writing of the item in a different way never used in class. This is exactly the problem which was reported by the Ministry of Education (2016) where lower secondary school students could not attempt questions in the 2015 national examinations even though the question was relatively straight forward. The problem in part is linked to a lack of English understanding (Lee & Low, 2007; Ministry of Education, 2016) and insufficient familiarity with key terms and concepts (Ferrari, 2004; Morgan, 2005) if they are couched in only a very slightly different way. If students are able to understand English and are familiar with the key terms and concepts then they should be able to comprehend the questions even if the question is written differently. One common question that is often used in test or examination papers but never used in class is the type of question that incorporates different concepts from different topics in Mathematics. For example, a geometry question that requires algebraic skill to find the area or

formulating equations. Such a question that combines different mathematics strands is rarely used in class as most of the teaching focuses narrowly on specific topics. Rarely is Mathematics presented within a broader multi-strand context.

The views of Mathematics teachers align with the Assessment Officer (AO) who stressed a similar set of issues. He did not talk specifically about using different vocabulary, symbols or questions between classroom activities and external exam assessment, but he stressed that there is a need to limit a kind of question that involves different concepts from different topics as it makes students confused. The AO argues for separating different topics with their questions in the exam, however, such a change needs to be approved first by the Ministry of Education. This alternative means students can focus more on specific concepts and rules rather than confusing them with different concepts, rules and symbols. It does seem, however, from the AO's point of view a more integrated form of Mathematics teaching, one that might be argued as more authentic and real world in nature, is sacrificed for the sake of students limited English:

> "In the assessment exams, straight forward questions from learning objectives will be used consistently and not using type of questions that involves three or more learning outcomes" (AO).

> "… there is a need to separate different topics in the exam so that students may not confuse but familiar with the rules and concepts required. This has to be approved first from Ministry of Education" (AO).

In terms of application questions, the AO stressed that it is the main concern with most students that they do not understand the questions in a national assessment. In these cases at least there is a need for minimizing the use of lengthy word questions to a more specific question.

> "When word problems used in the exam assessment, some students were guessing showing that they did not understand the question. With that, there is a need for limiting the number of word problems so that students are not guessing" (AO).

The perspective of the Assessment Officer shows that questions used in the exam assessment seem hard for students especially questions that incorporate different concepts and word problems. With that, there is a need to limit the use of such questions, but to be specific and separate to topics. This perspective is significantly linked with the perspective of Mathematics teachers about using different vocabulary and questions in the exam assessment.

Common Assessment Task

The problem of using different vocabulary, symbols or questions in exam assessment is also present in school via using common assessment task. The task is prepared at the Curriculum and Assessment Office and teachers are expected to administer and mark the task under examination conditions. Students are required to do these assessments as they contribute to their final marks for their selection to Year 13. In terms of this assessment, one student from the high achieving group revealed that there was a symbol appearing in a question in a recent exam that he was not familiar with and he claimed he did not learn in class:

> "One of the problems I experienced was from the Internal Assessment test where some symbols like $\frac{dy}{dx}$ and the type of questions used ... I never learned them in our class activities" (KSM 1).

The student expressed that after consulting the teacher about the symbol, he understood that the symbol $\frac{dy}{dx}$ was similar to $f'(x)$ which they normally used in class. Here it shows that the student and his peers were disadvantaged by what was a random switch in Mathematical expression (Chard, 2003; Ferrari, 2004). This indicates that students need to be familiar with different symbols but with the same meaning in their everyday Mathematics learning. This is well supported by Barwell, Leung, Morgan, and Street (2002) who stress that teachers must explain the meanings of Mathematical terms and key concepts and sort out ambiguities, so that students will more likely understand and differentiate similar terms and symbols. If the concepts and symbols are not explicitly taught, then students might easily get confused. This is likely the case with Year 12 students when confronted with the problem of using different symbols or vocabulary in school-based assessments. With

that, there is a need for the cooperation of teachers to plan their language choices carefully.

In the literature, the problem of using different vocabulary, symbols or questions in school-based and external assessments have been well considered. Chard (2003) argues that if students are familiar with and understand the terminology then they can execute any problem they encounter even though the questions are written differently. In addition, Ferrari (2004) stresses that an understanding of the terms and symbols and their uses has to be developed via Mathematics discussion in the class and more specific approaches to teaching. This would play a major role in assisting students to develop linguistic skills that are essential to understand and communicate Mathematics, if not to develop Mathematical thinking. It is indeed the responsibility of Mathematics teachers to create Mathematics discussion (Ferrari, 2004; Moschkovich, 2012) and also to expose students to the differences in vocabulary, symbols and terms so that they are able to tackle any Mathematics problems (Barwell et al., 2002) related to algebraic languages.

Mathematics Syllabus Issues

The current Mathematics syllabus is also perceived by participants as a factor which makes the teaching and learning of algebraic languages at the Year 12 level challenging. The current Year 12 Mathematics syllabus (EQAP, 2008) used is a regional standard syllabus authored by the *Educational Quality and Assessment Program* (EQAP). Teachers indicated several specific issues. Firstly is the number of learning outcomes to teach and learn. Secondly, and perhaps more significantly, is the mis-match between the national Kiribati Year 11 Mathematics syllabus and the Year 12 EQAP Mathematics syllabus. There are concepts not introduced at all in the Year 11 syllabus but are covered in Year 12. These two issues are discussed below.

A Sense of Overloading in the Year 12 Syllabus

The content of the Year 12 EQAP Mathematics syllabus is perceived in terms of the quantity of learning outcomes to be met in teaching algebraic language. It becomes challenging in that very little time is available for all the required outcomes to be

given adequate coverage. As will be explained later in this section, there are also learning gaps that exist between the Year 11 and Year 12 syllabus meaning that there are new concepts that have to be introduced in Year 12. This also exacerbates the time challenges. Teachers, however, tend to just keep on teaching despite confusion from the students. This is demonstrated by one of the teachers as follows:

> "One of the problems is the syllabus for Form 6 levels. There are many learning outcomes to be covered. In class we need time to discuss forth and back on different and new concepts and rules, but as there are many learning outcomes to cover, we have to keep moving forward" (WTF 2).

In teaching and learning algebraic language, students need time to comprehend concepts (Chard, 2003; Ferrari, 2004) through class activities and discussions (Morgan, 2005; Moschkovich, 2012), however, it seems not to be the case in Year 12 Mathematics classrooms as teachers are under pressure to simply teach the subject just for the sake of completing the syllabus. As a consequence, it is likely for students to have difficulties (Stabback, 2016) in later Mathematics topics which requires algebra. This is also the case noted during classroom observation sessions where students were easily confused with the algebraic operations required in another topic like geometry, statistics and probability. One indicator showing that the Year 12 syllabus is overloaded with learning outcomes is the running of special or remedial classes (Mbugua, Kibet, Muthaa, & Nkonke, 2012). This is also mentioned by one of the teachers. He indicated that he normally conducted special classes during weekends in order to finish up with what he was supposed to complete within the week.

> "Normally, I run special classes to finish up with what we left in which we suppose to complete for that week" (STM).

This demonstrates that teachers are under pressure by time and scheduling to ration the learning outcomes weekly so that they can manage all learning outcomes on time. This will likely affect student learning and mastery of algebraic language because the learning is superficial and insufficient for them to become familiar with the terms and concepts in the classroom. In this case, teachers feel a need to review

the content of the national Year 12 Mathematics Syllabus to make it more achievable.

Gap between Year 11 and Year 12 Syllabi

In addition to the perceived overloaded syllabus, is the mis-match between the Year 11 and Year 12 syllabus (EQAP, 2008; Ministry of Education, 2008) which affects students learning as they move from one level to the next (Mayo, 1994). Strangely this issue was not mentioned by teachers but by the Assessment Officer. The Officer stressed that there are new key topics introduced in the Year 12 syllabus that are not covered in the Year 11 syllabus. Such topics include *Calculus* and *Sequence and Series*. These topics require skills of algebra to determine a solution.

> "There is a gap that exists between *Kiribati National Certificate* syllabus (Year 11) and the *Senior Secondary Certificate* syllabus (Year 12). In the language, there are so many new terms introduced in KSSC syllabus like *differentiation, integration*, etc" (AO).

From a Mathematics language perspective, the Assessment Officer stresses that there are new terms being introduced to Year 12 students such as: *differentiation, integration, arithmetic* and *geometric sequence, series, terms* as well as symbols like *summation notation* $\sum_b^a f(x)$, $t_a + t_b = t_c$ for series, and so forth. Such terms normally incorporate symbols and rules (Bakalevu, 1999; Chard, 2003; Manu, 2005). Teaching and learning such terms is likely to take time for students to comprehend as they are not familiar with them (Ferrari, 2004). If such topics were included at the Year 11 level then it would be easier for students to comprehend as some terms are familiar. The Year 11 syllabus acts as a prerequisite for the Year 12 syllabus (Ministry of Education, 2011). The Assessment Officer adds that the Ministry of Education is currently revising the syllabi for all levels in elementary and high schools. The Year 11 and 12 syllabi will be also reviewed to address the gap and develop a more achievable set of learning outcomes. However, until this happens the problems will remain.

In the literature, Stabback (2016) discusses the issues identified by the participants and stressed that curriculum work needs to be dynamic and capable of adaption,

amendment and improvement over time. In terms of curriculum Stabback (2016) stresses that it is important that curricula be understood across key learning areas and not be confined to the narrow field of, for example, Mathematics only. This will enable students to make better sense of their learning. In addition to that, as curricula is found to be overloaded with learning outcomes it is likely to influence students to memorize concepts prior to formal assessment, which has shortcomings for students in their later school journey. With that, there is a need for revising Year 12 Mathematics curricula so that the problems of overload and gap existence will be addressed.

Conclusion

To conclude, there are seven significant themes identified that impact on teachers and students as together they approach algebraic language in Kiribati Year 12 Mathematics classrooms. The seven themes include: *teacher quality issue; student learning; problems with algebraic language; teaching and learning materials; large class-size; Mathematics assessment;* and *Mathematics syllabus issues*. Teacher quality is related to the need for more formal training and conducting school-based professional development to improve pedagogical and content knowledge of teachers. Secondly, student learning is related to problems of learning basic skills in Mathematics at lower levels and a related low level of commitment in more senior Mathematics classes. Thirdly, are the problems related to the complexity of algebraic language caused by the need for English language and the learning of key algebraic words incorporating symbols and rules. The fourth issue is related to the availability of Mathematics resources integral for the effective teaching and learning algebraic language. The fifth issue is based on large class-size which is perceived to impact on learning and the levels of attention teachers give to all students in the class when needed. The sixth issue is related with the assessment where items and symbols were written differently thus effecting students' comprehension. The final issue is based on the curriculum in terms of overloading as well as a mis-match between Year 11 and 12 syllabi.

The following chapter will draw conclusions based on the seven themes and make recommendations for more effective teaching of algebraic language based on the findings as well as further areas of research.

CHAPTER 5

Conclusion and Recommendations

Introduction

This study has found that challenges in learning and teaching algebraic language in Kiribati Year 12 Mathematics classrooms are not only linked to the complexity of algebraic language, but involve the practices of the teachers, the attitude of students to their learning, schooling generally, and a range of other associated issues. The study identifies seven dimensions to the challenges experienced by Year 12 students and their Mathematics teachers in their learning and teaching of algebraic language. These dimensions include: *quality teaching, student learning, language complexity, teaching and learning resources, class size, assessment* and *Mathematics syllabus issues*. Some of these dimensions impact both Mathematics teachers and students, whereas, others impact just teachers or students. This chapter concludes by outlining a brief summary of the seven dimensions. This is then followed by addressing the three main research questions underpinning this research. Finally there will be some discussion for further research.

Summary of Seven Dimensions

Teacher Quality

This dimension describes the teachers themselves regarding their pedagogic skills and content knowledge with regard to the teaching of Mathematics. As indicated by the teachers sometimes students do not comprehend what has been explained and are easily confused. This finding was also affirmed by the students about some of their Mathematics teachers. This is a problem that needs to be addressed at a professional level. Some teachers do not have formal education qualifications nor do they engage in on-going professional development while teaching. The perception of some experienced teachers who are currently undertaking their formal teacher education degree at the University of the South Pacific and are also involved in some professional development indicated an improvement in their pedagogical skills and content knowledge via their study. These teachers felt more confident to vary their

teaching style. They understand other teaching styles and how they can apply them in a classroom context. Undertaking formal teacher education programs or being involved in professional development assists immensely to lighten the load of teachers in the classroom.

Student Learning

Apart from teacher quality, there are also issues identified among the students which contribute to the problem of learning algebraic language. This mostly involves a lack of skills in basic Mathematics and students' low levels of commitment to participate in class. Lack of basic skills by students is noted directly from the students themselves and also from their Mathematics teachers. Some students revealed that Mathematics was a challenge when they were in the lower forms and they did not learn the necessary concepts which in turn has affected them severely in Year 12. Most of the concepts learned are built up and derived from concepts learned at lower secondary and primary levels. Mathematics teachers echoed students' problems in the classroom and indicated that Mathematics teaching in the lower forms should be strengthened. It is also noted in this research that some students are not able to cope with Mathematics teaching and learning due to lack of basic skills. The Kiribati education system at the upper secondary levels is very selective. However, due to the obligations of church secondary schools to cater for their own members, students can enter Year 12 despite their poor academic background.

In addition to that, some students at Year 12 level show little interest in participating in Mathematics class. Teachers explained that some students show low levels of commitment in the class by not doing their class-work or home-work and sometimes missing class altogether. A number of students in this research affirmed the perspective of teachers by admitting that they are sometimes dis-inclined to read the notes from the teacher. This is also contributing to the problem of learning algebraic language because students do not play their part. Regardless of student attitude, there is a need for proactive teachers to engage students more in their learning so that they can be more familiar with the algebraic language (Morgan, 2005) and understand what, how and when to apply it (Chard, 2003; Ferrari, 2004).

Algebraic Language

In relation to algebraic language itself, the two main issues are application type questions and learning algebraic key words. Using English language and the translation of English statements into Mathematical statements are the main problem identified with application questions. Mathematics teachers revealed that some students cannot literally comprehend the meaning of the question based on the unfamiliar English vocabulary used. Other students can understand the question but translating it into a Mathematical statement is their main problem. Learning algebraic key words also makes students confused because key words often incorporate rules and symbols which in themselves are hard to comprehend. In addition to that, some algebraic key words also require multiple concepts to calculate answers. This also makes students confused as they feel overwhelmed with learning different concepts.

Learning algebraic language, using English language in application questions, translating English statements into Mathematical statements and learning algebraic key words which incorporate multiple rules and symbols, are the main challenges affecting Year 12 students. The use of planned 'bilingualism' (Baker, 2011; Garcia, 2009; Moschkovich, 2012) in the learning process and using 'contextualization' (Bakalevu, 1999, 2009) for Mathematics questions offers a way forward for teachers and students in terms of this particular problem.

Teaching and Learning Resources

Apart from the complexity of algebraic language, the availability of basic Mathematics resources was perceived by both teachers and students as a challenge to the teaching and learning of algebraic language. It is also noted that participants seemed to lean toward Mathematics textbooks only as their main tool in teaching and learning due to the fact that other teaching and learning resources such as computers, graphic calculators and internet are simply not available in most Year 12 Mathematics classrooms.

The need for textbooks by teachers is based on the short timeframe of their classes. The textbook is perceived to assist teachers in providing more time to engage with

students in the class as teachers do not need to write down detailed class notes, examples and activities on the blackboard. In some schools, the availability of textbooks can assist teachers to overcome their time shortage. Students also perceived that textbooks can assist them to understand more about algebraic language as in some cases the notes given from the teacher in the class are not sufficient and sometimes confusing. Having the textbook or handout can help students clarify challenging concepts by following the many examples and activities provided. Apart from the positive perspectives about textbooks, they also resented as a significant problem to students where the application questions were derived from other cultural contexts outside of Kiribati. This makes learning even harder for students as they cannot comprehend the context of the questions (Bakalevu, 1999; Vaka'uta, 2012a).

Class Sizes

Teachers in this study indicated that large classes in their Mathematics classrooms also affect their teaching of algebraic language in a way that they can only minimally interact with a few students to assist. Most teachers firmly believe that engaging with individual students during lessons is crucial for students to clarify their queries related to algebraic language. In addition to that, large class sizes also tends to reinforce unwanted behaviours (Blatchford et al., 2011) which also has an impact upon teaching and learning algebraic language. Students, however, did not directly indicate they had a problem with large class sizes, but some of them explained that the behaviour of some students affected their learning. Chapman and Ludlow (2010) and (Maples, 2009) indicate that large class sizes are not necessarily a problem which ties this issue in Kiribati classrooms for further research.

Mathematics Assessment

In relation to Mathematics assessment, the issue identified is not associated with non-alignment of test or exam items against syllabus outcomes, but the construction of items in a different way compared to those of daily classroom activities. This issue stems from lack of English understanding by students and also from teachers not exposing students to different symbols or key-words based on the same concept. In addition, superficial learning of symbols and key-words in algebraic language

also affects students in a way that they are not familiar with other symbols or key-words used in both assessment and daily class activities. One kind of question that often appears in the exam or common assessment test which confuses students is one that requires multiple learning strategies to be applied. These confuse students because all the questions are linked to each other and require different concepts to be applied. This indicates a lack of English skills and the superficial learning by students that results can impact on student assessment. Chard (2003) argues that if students are familiar with and understand the terminology then they can execute any problem they encounter even though the questions are written differently.

Mathematics Syllabus Issues

There are two main elements identified concerning the Mathematics syllabus. The first one concerns overloading of the Year 12 syllabus with learning outcomes and the second the mis-match between Kiribati local Year 11 syllabus outcomes and EQAP regional Year 12 syllabus outcomes. A number of teachers mentioned that there are too many learning outcomes leading to a very fast approach to teaching which tends to leave slower learners in the class behind. The gap between Year 11 and Year 12 outcomes is also a problem as Year 11 outcomes do not prepare students for some new concepts introduced in Year 12. This affects the learning of concepts and their incorporated rules and symbols. With that, there is a need for revising both sets of outcomes so that teaching and learning algebraic language is more manageable and achievable.

Table 5 below briefly illustrates the seven dimensions in terms of classroom and school levels.

Table 5: Summary of Seven Dimensions

Levels	Issues	Cause of the problem
Classroom	Algebraic language	- Lack of English understanding - Lack skill to translate English statements into Mathematics statements - The use of algebraic key-words which incorporate rules, unknown variables and

		symbols
	Teacher Quality	- Lack of pedagogical skills - Lack of content knowledge
	Student learning	- Lack of learning basic skills - Low level of commitment in learning process
	Assessment	- Exposing students to different symbols and key-words similar in meanings.
School	Class size	- Enrolment policies of church schools
	Teaching and learning resources	- Unavailability of Mathematics textbooks - Lack use of internet, Mathematics software and graphic calculators in Kiribati high schools
	Syllabus	- Mis-match between Year 11 and Year 12 syllabi

Learning Algebraic language

In this research, the learning difficulties faced by Year 12 students in learning algebraic language are associated with the complexity of algebraic language, teacher quality issues, student themselves in terms of their commitment in their learning, the unavailability of learning resources and the use of unfamiliar assessment questions in exams or common assessment tests.

The complexity of algebraic language involves the use of algebraic key-words which incorporate rules, unknown variables and symbols. In addition to that, a lack of skills to understand English and translation of English statements to Mathematical statements also lead to difficulties for students.

The way teachers teach the subject also matters in learning algebraic language as it can bridge the gap of confusion. This is the most fundamental part in the learning process as teachers are the ones who can shape the learning of students. However, the findings show that some Mathematics teachers still need formal education training or professional development to bridge the gap of confusion due to their lack of pedagogical skills and content knowledge. The findings also show that students

themselves are part of the challenge due to their variable level of commitment to learn basic skills and also their participation in class. This is also contributing to the difficulty of learning algebraic language.

The unavailability of teaching and learning resources in terms of textbooks and other resources is also affecting students in a way that their learning is bound by what the teacher has prepared for them. To some extent students need to extend their learning beyond what has been prepared by the teacher, however they often cannot do that because they do not have the textbook or hand-out to work with.

In relation to Mathematics assessment, it is noted that writing questions differently or using unfamiliar key-words or symbols make students confused. This issue is related to superficial learning of some key-words or symbols or not understanding similar key-words or symbols that can be used which carry the same meaning. This occurs in either exams or common assessment tests where different key-words or symbols are but not learned by students in their daily activities. With that, these are the fundamental issues which makes learning of algebraic language difficult in Year 12 classroom in Kiribati.

Teaching Algebraic Language

In relation to challenges encountered by Mathematics teachers, findings show that teacher quality in terms of pedagogical skills and Mathematics content knowledge, students learning issues, class size, teaching and learning resources and syllabus issues, are the main challenges faced by Mathematics teachers in the effective teaching of algebraic language. In relation to teacher quality, findings show that limited pedagogical skill and Mathematics content knowledge is one of the challenges to teaching algebraic language. Some teachers confessed that they were not good at teaching. Those teachers need to be assisted to improve their pedagogical skills as well as Mathematics content knowledge through formal teacher education training or via school-based professional development opportunities so that student learning is improved as well.

Apart from that, challenges for teachers are linked to the students themselves. This is based upon their commitment to their learning in and out of the class. Some

students do not comprehend Mathematics basics while some show no interest to participate in the class. Miscomprehension of the basics and missing classes by some students present teachers with a challenge. At the school level, teaching algebraic language is challenging when the class size is too big. The findings show that large class sizes minimise valuable interactive learning between the students and the teacher. The teacher tends to help only a few students and others go unassisted and slip further behind. Large class size also leads to unwanted behaviours from some students that are likely to hinder all students from learning algebraic language.

Beside the class size, teaching and learning resources such as textbooks, the use of computers using Mathematics software and the internet are needed to be available at school to assist the teacher to teach algebraic language effectively. However, such materials are never used in schools. The use of textbook by teachers and students is practically the only resource available to enrich the teaching and learning of algebraic language. Textbooks provide more time for teachers to interact with students during the class as they do not spend time writing notes and activities on the blackboard. Teachers also perceive that the Year 12 syllabus is overloaded with learning outcomes which means teaching becomes accelerated in order to cover all syllabus expectations. Beside that, there is also a mis-match between Year 11 syllabus outcomes which are devised locally and Year 12 syllabus outcomes from EQAP. This makes teaching hard especially in the newer topics that have not had their roots in the Year 11 syllabus.

Recommendations

From this research emerge five fundamental recommendations to improve the learning of algebra in Kiribati Year 12 classrooms.

- There is a need for formal teacher education for Mathematics teachers as well as professional development to improve teachers' pedagogical skills and content knowledge in Mathematics (Bakalevu, 1999; Dayal, 2013). This would address concerns expressed directly by many teachers themselves concerning their own capacity to teach mathematics effectively at the senior secondary level.

- There is a need for teachers to use a formalised and strategic balanced bilingual approach in their teaching (Baker, 2011) so that students are familiar with and understand the complex English used in Mathematics as well as use both languages as a tool to understand Mathematics concepts (Barwell et al., 2002; Moschkovich, 2012; Trinik et al., 2014).
- There is also a need for contextualizing Mathematics so that it can be better understood by students in the Kiribati setting (Bakalevu, 1999, 2009; Vaka'uta, 2012b). This is based on the need to associate abstract Mathematics concept learned in school to real life situations as well as using the Kiribati cultural context in the learning.
- There is a need for teaching and learning resources in terms of textbooks as well as using technology (Goos & Bennison, 2007; Lingam & Lingam, 2013; Moschkovich, 2012) in-order to improve the teaching and learning of algebra. The responsibility for this lies with the school administration to provide these resources.
- There is a need for revising and improving the Mathematics syllabus for Year 11 and Year 12 so that the learning of students is smooth and consistent from one level to the other (Stabback, 2016). This process is normally conducted at the Ministry of Education level where specialists can make the changes in accordance with the education standards required both nationally and regionally.

Areas for further research

This research indicates the challenges in teaching and learning algebraic language in Kiribati Year 12 classrooms at both classroom and school levels. However, the research further indicates there is a need to widen the scope to include primary and junior secondary levels. These levels in particular are the only school levels which receive any workshop or professional development support from Kiribati Teachers College. Investigations into the type of mathematics teaching Professional Development may provide a different perspective. In addition to that, investigating the social context of students' families would shed light on why some students struggle with algebraic language in the final years of their secondary schooling.

References

Abe, T. O. (2014). The effect of teachers' qualifications on student performance in mathematics. *Sky Journal of Educational Research, 2*(1), 10-14.

Afamasaga-Fuata'i, K. (2002). *A Samoan Perspective on Pacific Mathematics Education.* Paper presented at the Mathematics Education Research Group of Australasia, Auckland, Sydney.

Bakalevu, S. (1999). The language factor in mathematics education. *Journal of Educational Studies, 21*(2), 59-68.

Bakalevu, S. (2009). Engendering culturally responsive teaching. In K. Sanga & K. H. Thaman (Eds.), *Re-thinking Education Curricula in the Pacific: Challenges and Prospects* (pp. 58-70). Wellington: He Parekereke Institute for Research and Development in Maori and Pacific Education.

Baker, A., & Charvat, B. J. (2008). In-depth Interview *Research Methods in Child Welfare*. New York: Columbia University Press.

Baker, C. (2011). *Foundations of Bilingual Education and Bilingualism* (5 ed.). Bristol: Short Run Press Ltd.

Barnett, W. S., Yarosz, D. J., Thomas, J., Jung, K., & Blanco, D. (2007). Two-way and monolingual English immersion in preschool education: An experimental comparison. *Early Childhood Research Quarterly, 22*(3), 277-293.

Barton, B. (1995). The Politics of Mathematics Education. In J. Neyland (Ed.), *Mathematics Education: A Handbook for Teachers* (pp. 165-174). New Zealand: Wellington College of Education.

Barton, D. (2011). *Theta Mathematics: NCEA Level 2*: Pearson Education New Zealand Limited.

Barwell, R. (2002). Understanding EAL issues in mathematics. In C. Leung (Ed.), *Language and Second/Additional Language Issues for School Education: A Reader for Teachers*. Watford: NALDIC Publications Group.

Barwell, R., Leung, C., Morgan, C., & Street, B. (2002). The language dimension of mathematics teaching. *Mathematics Teaching-Derby-*, 12-15.

Beuka, J. (2007) A united front for professional development and training in numeracy. *The Basics of Learning: Literacy and Numeracy in the Pacific* (pp. 131-140). University of the South Pacific: Institute of Education.

Bhattacherjee, A. (2012). *Social Science Research: Principles, Methods, and Practices* Retrieved from http://scholarcommons.usf.edu/oa_textbooks/3

Bicer, A., Capraro, R., & Capraro, M. (2013). Integrating Writing into Mathematics Classroom to Increase Students' Problem Solving Skills. *International Online Journal of Educational Sciences*, *5*(2), 361-369.

Biggs, J. (1996). Enhancing teaching through constructive alignment. *Higher education, 32*(3), 347-364.

Bishop, A. J. (1990). Western Mathematics: the secret weapon of cultural imperialism. *Race and Class, 32*(2), 51-65.

Blatchford, P., Bassett, P., & Brown, P. (2011). Examining the effect of class size on classroom engagement and teacher-pupil interaction: Differences in relation to pupil prior attainment and primary vs. secondary schools. *Learning and Instruction, 21*, 715-730.

Boulet, G. (2007). How Does Language Impact the Learning of Mathematics? Let Me Count the Ways. *Journal of Teaching and Learning, 5*(1), 1-12.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology, 3*(2), 77-101.

Burnett, G. (2002). Technologies and discourses of colonialism in education in the Republic of Kiribati. *Journal of Educational Studies, 24*(2), 1-14.

Burnett, G. (2013). Approaches to English literacy teaching in the Central Pacific Republic of Kiribati: Quality teaching, educational aid and curriculum reform. *Asia Pacific Journal of Education, 33*(3), 350-363.

Carter, L. (2009). Globalisation and learner-centered pedagogies. *Journal for Activist Science & Technology Education, 1*(1), 58-61.

Chapman, L., & Ludlow, L. (2010). Can Downsizing College Class Sizes Augement Student Outcomes? An Investigation of the Effects of Class Size on Student Learning. *The Journal of General Education, 59*(2), 105-123.

Chard, D. (2003). *Vocabulary Strategies for the Mathematics Classroom*. Boston, MA: Houghton Mifflin.

Cope, W., & Kalantzis, M. (2009). "Multiliteracies": New Literacies, New Learning, Pedagogies. *An International Journal, 4*(3), 164-195.

Creswell, J. W. (2012). *Educational Research, Planning, Conducting, and Evaluating Quantitative and Qualitative Research* (4 ed.). Boston: Pearson Education.

Crowley, L., Thomas, M., & Tall, D. (1994). *Algebra, symbols, and translation of meaning.* Paper presented at the Proceedings of the 18th Conference of the International Group for the Psychology of Mathematics Education.

Dayal, H. C. (2013). Teachers' perceptions of teaching mathematics at the senior secondary level in Fiji. *Australian Senior Mathematics Journal, 27*(2), 1-12.

Devlin, K. J. (2012). *Introduction to mathematical thinking*: Keith Devlin Palo Alto.

Docherty, C., Barakat, T., Kniveton, E., Mikati, L., & Khalifa, H. (2017). Research Notes: Impact of Cambridge English exams and English language learning programmes in a variety of contexts. . In H. Khalifa & F. Barker (Eds.), *A quarterly publication reporting on teaching, learning and assessment* (pp. 75-88). United Kingdom: University of Cambridge.

EQAP. (2008). Pacific Senior Secondary Certificate Mathematics Prescription Form 6 *Assessment* (pp. 1-37). Suva, Fiji: SPBEA.

Fasi, U. M.-L. (2009). Towards an equality of condition. In K. Sanga & K. H. Thaman (Eds.), *Re-thinking Education Curricula in the Pacific: Challenges and Prospects* (pp. 87-101). Wellington: He Parekereke Institute for Research and Development in Maori and Pacific Education.

Ferrari, P. L. (2004). *Mathematical language and Advanced Mathematics Learning.* Paper presented at the 28th Conference of the International.

Garcia, O. (2009). *Bilingual Education in the 21st Century. A Global Perspective*. Singapore: Utopia Press Pte Ltd.

Goos, M., & Bennison, A. (2007). *Technology-Enriched Teaching of Secondary Mathematics: Factors Influencing Innovative Practice.* Paper presented at the 30th annual conference of the Mathematics Education Research Group of Australsia, Australia.

Government of Kiribati. (2015). *Kiribati Development Plan 2016-19*. Bairiki, Tarawa: Ministry of Finance and Economic Development.

Groenewald, T. (2004). A phenomenological research design illustrated. *International Journal of Qualitative Methods, 3*(1), 1-26.

Heine, H. C., & Emesiochl, M. A. (2007). Preparing and licensing high quality teachers in Pacific Region jurisdiction *Issues & Answers Report, REL 2007* (pp. 1-6). Washington, DC: Institute of Education Sciences.

Javadi, M., & Zarea, K. (2016). Understanding Thematic Analysis and its Pitfall. *Journal of Client Care, 1*(1), 33-39.

Johnston-Wilder, P. (2005). Assessment and Public Examinations. In S. Johnston-Wilder, P. Johnston-Wilder, D. Pimm & J. Westwell (Eds.), *Learning to Teach Mathematics in the Secondary School* (2 ed., pp. 114-141). London and New York: Routledge.

Kaei, T. T. (2007) Local/Indigenous numeracy and its place in Pacific Island classrooms. *The Basics of Learning: Literacy and Numeracy in the Pacific* (pp. 123-130). University of the South Pacific: Institute of Education.

Kane, P. J. (2010). *NCEA Level 2 Mathematics. Questions & Answers* Retrieved from www.mathscentre.co.nz/html/blobLog.php?id=11447

Kiribati Ministry of Education. (2014). *School Improvement Plan Standards*. Bikenibeu, Tarawa: Printry Unit.

Korauaba, T. (2012). *Media and the politics of climate change in Kiribati: A case study on jornalism in a "disapperaring nation".* (Master in Communication Studies), Auckland University of Technology, Auckland.

Lather, P. (2006). Paradigm proliferation as a good thing to think with: teaching research in education as a wild profusion. *International Journal of Qualitative Studies in Education, 19*(1), 35-57.

Lee, L., & Low, M. (2007) Integrating numeracy and literacy: a case study. *The Basics of Learning Literacy and Numeracy in the Pacific* (pp. 141-153). University of the South Pacific: Institution of Education.

Leibowitz, D. (2016). Supporting Mathematical Literacy Development: A Case Study of the Syntax of Introductory Algebra. *Interdisciplinary Undergraduate Research Journal, 2*(1), 7-13.

Lester, S. (1999). An introduction to phenomenological research: Taunton UK: Stan Lester Developments.

Lingam, G. I., & Lingam, N. (2013). Making learning and teaching a richer experience: A challenge for rural Fijian primary schools. *Education Research and Reviews, 8*(21), 2160-2168.

Malisani, E., & Spagnolo, F. (2009). From arithmetical thought to algebraic thought: The role of the "variable". *Educational studies in mathematics, 71*(1), 19-41.

Manu, S. S. (2005). *Mathematical Understanding and Tongan bilingual students' language switching- Is there a relationship?* (Doctor of Philosophy), The University of British Columbia.

Maples, J. B. (2009). *An analysis of the effects of class size on student achievement in selected middle schools in the Sandhills region of North Carolina.* (Doctor of Education), Fayetteville State University, Fayetteville, North Carolina.

Mayo, E. (1994). On Power and Equity: Let's Not Blame the Victim. In J. Neyland (Ed.), *Mathematics Education: A Handbook for Teachers* (Vol. 1, pp. 291-306). New Zealand: Wellington College of Education.

Mbugua, Z. K., Kibet, K., Muthaa, G. M., & Nkonke, G. R. (2012). Factors Contributing To Students' Poor Performance in Mathematics at Kenya Certificate of Secondary Education in Kenya: A Case of Baringo County, Kenya. *American International Journal of Contemporary Research, 2*(6), 87-91.

McFall-McCaffery, J. T., & McCaffery, J. (2012). *Submission on the Public Inquiry into Pacific Languages in ECE*. Paper presented at the Education and Science Select Committee, Wellington.

Mel, M. A. (2009). Shifting Cultures: Mbu - A proposal for a Pluri Cultural Perspective to Culture in Education in Papua New Guinea. In K. H. Thaman (Ed.), *Educational Ideas from Oceania* (2 ed., pp. 31-40). University of the South Pacific: Institute of Education.

Mertler, C. A. (2016). *Introduction to Educational Research*. Los Angeles: SAGE Publication, Inc.

MEYS. (2014). *English for Kiribati*. Tarawa: Curriculum Development Resource Centre.

Ministry of Education. (2008). *Kiribati National Education Summit Outcomes*. Bikenibeu, Tarawa: Curriculum Unit.

Ministry of Education. (2011). *Kiribati National Curriculum and Assessment Framework (NCAF)*. Bikenibeu, Tarawa: Curriculum Printry Unit.

Ministry of Education. (2013). *KSSC Exam results report 2013*. Exams Unit. Bikenibeu, Tarawa.

Ministry of Education. (2014a). *Education for All 2015 National Review Report*. Bikenibeu, Tarawa.: Curriculum Unit.

Ministry of Education. (2014b). Kiribati Education Improvement Program: Evaluation Report (pp. 1-75). Bikenibeu, Tarawa: Education Resource Facility.

Ministry of Education. (2016). STAKI 2015 National report. Report of the Standardize Test of Achievement in Kiribati conducted in 2015 with Years 4, 6 and 8 students (pp. 1-27). Bikenibeu, Tarawa: Kiribati Ministry of Education.

Ministry of Education. (2017). *KSSC Results for 2013 to 2015*. Exams and Assessments Unit.Tarawa Kiribati.

Morgan, C. (2005). Communicating Mathematically. In S. Johnston-Wilder, P. Johnston-Wilder, D. Pimm & J. Westwell (Eds.), *Learning to Teach Mathematics in the Secondary School* (2 ed., pp. 142-157). London and New York: Routledge.

Moschkovich, J. (2012). Mathematics, the Common Core, and language: Recommendations for mathematics instruction for ELs aligned with the Common Core. *Commissioned Papers on Language and Literacy Issues in the Common Core State Standards and Next Generation Science Standards, 94*, 17-31.

Nabobo-Baba, U. (2005). *Vugalei : voices and silences of what and how we know : indigenous Fijian epistemology and implications for education.* (PhD in Education Thesis), University of Auckland, New Zealand.

NCAF. (2011). *Kiribati National Curriculum and Assessment Framework*. Bikenibeu, Tarawa: Curriculum Printry Unit.

Neville-Barton, P., & Barton, B. (2005). The relationship between English language and mathematics learning for non-native speakers. *Teaching and Learning Research Initiative final report. Retrieved August*.

OECD. (2016). PISA 2015 Results in Focus (Vol. 3, pp. 1-16).

Ontario Ministry of Education. (2004). Leading Math Success: Mathematical Literacy Grades 7-12 (pp. 1-108). Toronto.

Pimm, D., & Johnston-Wilder, S. (2005). Different Teaching Approaches. In S. Johnston-Wilder, P. Johnston-Wilder, D. Pimm & J. Westwell (Eds.), *Learning to Teach Mathematics in the Secondary School* (2 ed., pp. 65-92). London and New York: Routledge.

Puamau, P. (2005). *Rethinking Educational Reform: A Pacific Perspective*. Paper presented at the Redesigning Pedagogy: Research, Policy & Practice, Singapore.

Rice, J. K. (2010). The Impact of Teacher Experience: Examining the Evidence and Policy Implications. Brief No. 11. *National center for analysis of longitudinal data in education research*.

Rodd, M. (2005). Inclusion in Practice: Special Needs Pupils in Mainstream Mathematics. In S. Johnston-Wilder, P. Johnston-Wilder, D. Pimm & J. Westwell (Eds.), *Learning to Teach Mathematics in the Secondary School* (2 ed., pp. 187-205). London and New York: Routledge.

Schweisfurth, M. (2011). Leaner-centred education in developing country contexts: From solution to problem? *International Journal of Educational Development, 31*, 425-432.

Siddle, J. (2014). Kiribati: Tiny island's struggle with overpopulation [Press release]. Retrieved from http://www.bbc.com/news/science-environment-26017336

Slavin, R. E. (2007). *Educational Research in an age of accountability*. Boston: Pearson Education, Inc.

Stabback, P. (2016) What Makes a Quality Curriculum? , *Current and Critical Issues in Curriculum and Learning* (pp. 1-41): UNESCO and International Bureau of Education.

Stacey, K. (2010). Mathematical and scientific literacy around the world. *Journal of Science and Mathematics Education in Southeast Asia, 33*(1), 1-16.

Street, B. (1993). Introduction: The New Literacy Studies. In B. Street (Ed.), *Cross-Cultural Approaches to Literacy* (pp. 23-29). New York: Cambridge University Press.

Taufe'ulungaki, A. M. (2009a). Tongan Values in Education: Some issues and questions. In K. Sanga & K. H. Thaman (Eds.), *Re-thinking Education Curricula in the Pacific: Challenges and Prospects* (pp. 125-136). Wellington: He Parekereke Institute for Research and Development in Maori and Pacific Education.

Taufe'ulungaki, A. M. (2009b). Vernacular Languages and Classroom interactions in the Pacific. In K. H. Thaman (Ed.), *Educational Ideas from Oceania* (2 ed., pp. 9-30). University of the South Pacific: Institute of Education.

Teaero, T. (2007) Eutia moa mai nanoa: navigating currents of literacy and numeracy in the Pacific. *The Basics of Learning Leiteracy and Numeracy in*

the Pacific (pp. 154-177). University of the South Pacific: Institution of Education.

Teaero, T. (2009a). Curriculum policies and framework in the context of Pacific values: A view from Kiribati. In K. Sanga & K. H. Thaman (Eds.), *Re-thinking Education Curricula in the Pacific: Challenges and Prospects* (pp. 159-171). Victoria University, Wellington: He Parekereke Institute for Research and Development in Maori and Pacific Education.

Teaero, T. (2009b). Indigenous Education in Kiribati. In K. H. Thaman (Ed.), *Educational Ideas from Oceania* (2 ed., pp. 100-109). University of the South Pacific: Institute of Education.

Thaman, K. H. (2009a). Culture, Teaching and Learning in Oceania. In K. H. Thaman (Ed.), *Educational Ideas from Oceania* (2 ed., pp. 1-8). University of the South Pacific: Institute of Education.

Thaman, K. H. (2009b). Introduction: The need to re-think Pacific curriculum. In K. Sanga & K. H. Thaman (Eds.), *Re-thinking Education Curricula in the Pacific: Challenges and Prospects* (pp. 13-27). Victoria University, Wellington: He Parekereke Institue for Research and Development in Maori and Pacific Education.

Tilley, S. A., & Powick, K. D. (2002). Distanced Data: Transcribing Other People's Research Tapes. *Canadian Journal of Education, 27*(2/3), 291-310.

Trinik, T., Meaney, T., & Fairhall, U. (2014). Teachers learning the registers of mathematics and mathematics education in another language: an exploratory study. *ZDM Mathematics Education, 46*, 953-965. doi:10. 1007/s11858-014-0618-7

Tuafuti, P. (2010). Additive bilingual education: Unlocking the culture of silence. *Mai Review*, 1-14.

Vaka'uta, C. F. K. (2012a). Re-thinking Pacific Teacher Standards: Reflections on a value-theory approach to conceptualizing the 'ideal' Pacific teacher (pp. 1-35). University of the South Pacific: School of Education.

Vaka'uta, C. F. K. (2012b). Teacher Education in the Pacific Islands: A Premilinary Literature Review: SoE-Bristol-Nottingham Research Project.

Vygotsky, L. (1978). Interaction Between Learning and Development. In Gauvain & Cole (Eds.), *Readings on the Development of Children* (pp. 34-40). New York: Scientific American Books.

Westwell, J. (2005). Mathematics in the National Curriculum. In S. Johnston-Wilder, P. Johnston-Wilder, D. Pimm & J. Westwell (Eds.), *Learning to*

Teach Mathematics in the Secondary School (2 ed., pp. 22-43). London and New York: Routledge.

Wiersma, W., & Jurs, S. G. (2009). *Research Methods in Education: An Introduction* (9 ed.). New York, United States of America: Pearson Education, Inc.

Wilcox, B., & Monroe, E. E. (2011). Integrating Writing and Mathematics. *The Reading Teacher, 64*(7), 521-529.

Willis, J. W. (2007). World Views, Paradigms, and the Practice of Social Science Research *Foundations of Qualitative Research: Interpretive and Critical Approaches* (pp. 1-26). Thousand Oaks: SAGE Publications, INC.

Wilson, W. S. (2009). Elementary school mathematics priorities. *Articles on Best Practice, 40*, 1-10.

Appendix A: Teacher Interview schedule

Teaching Methods

1. What teaching methods do you often use to teach algebra? Please elaborate on the method used (grouping, independent learning)
2. Which teaching methods do you suggest might help students to learn Mathematics?
3. What are the challenges that affect the quality of teaching in Mathematics?

Using language

4. What language do you use in teaching Mathematics? Please discuss why you prefer to use the language. If you mix your languages how do you decide which one to use and when?
5. Do you believe that the level of English proficiency is related to learning algebra? Please explain the relationship or explain why there is no relationship.
6. How do you help students understand the language used in algebra?
7. Did your previous tertiary study (Training college or University) equip you to teach English of Mathematics or registers of Mathematics? In-service workshops?
8. How do you clarify the Mathematical vocabulary when students want your assistance to explain the terms?
9. Please list down some algebraic language examples that normally confuse students when used in the activities. Elaborate on the problems they face. Eg. *simplify, expansion, factorise, evaluate, as twice as, triple, times* etc.
10. What are the symbols that commonly confuse students when used in the activities? Please explain the problem with the symbol.
11. How do students interpret the graphs when used in the activities? Is there a problem? Please explain.
12. What are your suggestions that will be considered in Mathematics to help students to learn registers of Mathematics effectively? Please explain how the suggestions can be used.

Cultural silence

13. Do you encourage your students to ask questions?
14. How do you deal with silent students in your class? What are your techniques to get them involved in the question and answer discussion?
15. From your own perspective, what are some of the factors that keep students silent in the classroom?

Appendix B: Student Interview Questions

1. What is your favourite subject? Please elaborate more on why you favour the subject.
   Tera mamaten nanon n am bwai n reirei ae ko reireiaki iai? Taiaoka angaa bukina bwa ibukin tera bwa ko tatangira te bwai n reirei anne.

2. Do you like word problems in Mathematics? State the reason why you do like or not like them?
   Ko tatangira karaoan te Numera n te karaki ke koaki? Taiaoka angaa bukina bwa ibukin tera ngkai ko tatangiria ao ibukin tera ngkai ko aki.

3. How does your teacher teach Mathematics? Please elaborate on how he or she clarifies the Mathematical terms used, how they deliver the lesson by using language of communication and instructions? Do they assist students who have questions? Resource use? Concluding the lesson?
   E kanga aron am tia reirei n te Numera n reiakini ngkami inanon tain te reirei? Taiaoka kabwarabwara bwa e teimatoa n kabwarabwarai te naan taeka ni Imatang are a kabonganaaki ke eaki, tera te taetae ae e kabonganaa ibukin kain te reirei, e kanga arona n buokiia ataei ake iai aia titiraki, tera bwaai ae e anga reirei mai iai, ao e kanga arona ni kaina ami reirei.

4. Do you believe that your English proficiency can affect your learning capacity in learning Mathematics? Please elaborate on that.
   Ko kakoaua ae rabakaum n te taetae ni Imatang (ko kona ongo ke koroboki) e irekereke ke e kona n roota am kekeiaki n te Numera
   ?
5. List some of the common English terms used in Algebra that make you confused in class?
   Anga tabeua te taetae ni Imatang aika a rang kabonganaaki n te Numera ae ko teimatoa n tuai atai nanoia, ke ngkana a kabonganaai ao koaki naba oota iai.

6. How do you deal with your problem of confusing words? Do you seek assistance from your teacher or someone else (friends/parent/other Mathematics teachers) or do the tasks on your own? How do you feel about seeking assistance?
   Kabwarabwara bwa e kanga arom n kamatebwaia taeka ake koaki oota iai? Ko kakaea buokam mai iroun am tia reirei ke iai riki irarikina ke ko bon karaoia nakon ootam.

7. Do you have problems with interpreting symbols and graphs when given in class? If yes please elaborate your problem in detail.
   Iai am kanganga n reiakinan te symbol ke te graph inanon am tai n reirei n te Mathematics. Ngkana arona bwa iai ao taiaoka kabwarabwaraa bwa tera raoi am kanganga iai.

8. If you were asked to make a speech to your lower form colleagues in learning Mathematics, what would be your suggestion to learn best in Mathematics?
   Ngkana arona bwa ko katabeaki man te reirei bwa kona taetae nakoia raomi n te reirei ake a uarereke ibukin buokaia n kamatebwaian te Numera n te koraki onoua, tera te anga ke te kawai ae kona tuangiia bwa ana karaoia bwa aonga n buokaki ibukin reiakinan te Numera.

Appendix C: Interview Questions for Assessment Officer

1. What are the main problems faced by students in Mathematics formal assessments?

2. In your opinion, what are the main causes of such problems?

3. What are the main problems faced by Mathematics teachers when teaching Mathematics language in the classroom?

4. In your opinion, what are the causes of those problems?

5. Are there any workshops or professional development run by the Ministry of Education for Mathematics? Why and how?

6. Are there any current plan made at the Ministry of Education about the future of Mathematics teaching in Kiribati? Explain.

7. As an Assessment Officer what are your suggestions to address the problem in learning and teaching Mathematics language?

8. Is there any other comment you want to share about the challenges in learning and teaching Mathematics language?

Appendix D: Observation Form

School: _____
Date: _____
Time: _____

Introduction
How does the teacher begin the lesson?

Lesson Development and Activity

i. Communication

What kind of language use for communication and instructions?

How does the teacher explain a mathematical concept(s) or vocabulary?

Does the teacher allow students to ask questions? What type of questions do students ask?

ii. Classroom arrangement

Do the students appear motivated to learn?

Do the low achievers and silent students in Mathematics engage well in the lesson?

How students do their class-tasks? (individual, grouping)

How do students sit in their classroom?

What are the teaching methods they currently use and how do these methods help students to understand Mathematical vocabulary?

Conclusion
How does the teacher conclude the lesson?

Other comments