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Dilemma in Understanding Mathematics Concepts: A link between Language Proficiency and an Understanding of Mathematics Concepts in Secondary Schools in PNG

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Con’t

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Introduction

- The foundations for mathematical understanding are embedded in our reasoning and problem-solving skills. These are fundamental to our survival and we express our thoughts in language as well as in the application of these thoughts in daily tasks or activities and through our ability to find solutions to problems.

Con't

- Despite this inherent capacity to reason and problem-solve, learning mathematics in schools has been a huge challenge for many students in Papua New Guinea as well the world. The inherent ability to understand mathematics concepts has been a challenge for many students in schools in PNG. By the time students get to the secondary grades the number of students interested in taking mathematics declines.

Con't

- Evidence (Pimms, 1987) suggests that language contributes immensely to children's performance in mathematics. There is somewhat a significant correlation between children's performance in language and mathematics, that is, children who perform well in mathematics also are more likely to perform well in language. However, the fact is that mathematics continues to be one of the challenging subjects to learn in schools and if its key concepts are not clearly understood by students, the problem continues throughout the progressive grades in primary and secondary schools.

Con’t

- This paper examines the dilemma between language proficiency in the language of instruction for mathematics and the understanding of mathematical concepts. It is believed that a significant link exists between the teachers’ and students’ language proficiency in the language of instruction and the understanding of mathematical concepts.

How mathematics concepts are taught in secondary schools in PNG

- A **mathematics concept** relates to the 'why' or 'big idea' of mathematics. It is an explanation of how big ideas such as addition and multiplication work the way they do and do what they do. Understanding a mathematics concept means that you know and are familiar with what happens behind an answer; therefore you can explain why you reached a certain answer and you do not need to memorise answers or formulas to work out answers.

Con’t

- This is because you understand why things work. You understand answers and formulas better and can tell when something isn't quite right. To understand a mathematic concept means that you have reached an upper level of understanding in mathematics that allows you to think and process abstractly. This is the difference between understanding a mathematics concept and a mathematics fact.

Con’t

- The problem we have in teaching mathematics in schools, including secondary schools, is that teachers teach mathematics facts, formula, equation and formula. Many mathematics teachers are concerned about teaching mathematical operations without teaching the language of mathematics which would enable them to understand mathematical concepts. Teaching students to understand mathematics language is far reaching than teaching mathematics facts. This indicates that many teachers do not thoroughly teach mathematics concepts.

Con’t

- Therefore, our school children cannot be blamed as they are simply taught what is called math facts (equation, formula, and problem) which can only solve one specific problem. Students follow and believe what their teachers teach. Therefore, students’ gaining of mathematical knowledge, their capability to do exercises, to work out problems, students’ faith and attitudes in relation to mathematics are all moulded by the teaching they encounter in school (Forgasz and Leder, 2008).

Con't

- Can the poor performance by the grade 12 students during the examinations in the recent years be a result of how mathematics concepts are taught by teachers? Most mathematics teachers believe that mathematics is a subject that deals mostly with numbers, mathematical symbols, rules and formulas. They therefore perceive mathematics as simply applying those math facts in solving mathematics problems disregarding the importance of the mathematics concepts in teaching and learning of mathematics.

Con’t

- The importance of a mathematical concept is that its ideas are general behind an equation, problem or formula in math and can be applied in any equation, problem or formula despite the level/grade.

Con’t

- In contrast to a math fact which must be committed to memory is eventually easily lost during the examinations but a math concept explains why math works in a certain way. We believe that as a result many fail to develop a deep understanding of mathematics, hence, have huge number of gaps in mathematical knowledge.

A Link Between Language Proficiency and Understanding of Mathematics Concepts

- How do you view the role of language in mathematics? It is interesting that how you respond to this question could influence your opinion of English as an additional language in mathematics lessons. If you see mathematics as a language, then you might not see the importance of learning English (Barwell, ud).

Con’t

- Issues of language in mathematics learning and teaching are important for both practical and theoretical reasons but ensuring proficiency in the language of instrument is also very critical. Addressing issues of language is crucial for improving mathematics learning and teaching for students who are bilingual, multilingual, or learning English.

Con't

- Many teachers think that mathematics is not associated with language and culture. However language plays a vital role in learning mathematics and is a tool through which teachers teach mathematical concepts and undertake mathematics processes. When solving problems in mathematics, specialised mathematical terms such as *addition, subtraction, division, sum* and *multiplication* are used.

Con’t

- Learning language is greatly beneficial to students as it deepens their understanding of the concepts and the subject matter when they use language to communicate and reflect on their ideas and thinking. In discussing their mathematical thinking, it helps students to improve their logical reasoning ability (Aineamani, 2009).

Con’t

- There is however, a need for students to be proficient in the language of instruction to gain maximum benefit from learning mathematics. Likewise, it is vital for teachers to be proficient in the language of instruction to better facilitate or teach mathematics concepts in the classroom.

Con't

- A link between language proficiency and understanding of mathematics concepts is well documented (Aineamani, 2009; Barwell, 2002a &b; Barwell, 2001; Mercer & Sams, 1999; Pimms, 1987). According to Pimms (1991) learners tend to bring, informal mathematics language to their classrooms and use it to communicate their mathematics concepts and ideas.

Con’t

- The same learners are expected to move from informal mathematics language to the formal mathematics language which exists in the language of instruction. Hence, it is vital for learners to proceed from the informal to the formal mathematics language, as it is expected of the school system. For example, if learners are to learn the concepts such as functions, they must first of all, understand the formal language of functions (Aineamani, 2009).

Con’t

- Therefore, when learning mathematics concepts in English, learners need to learn the key concepts of mathematics because all learning is language dependent “from the arousal of curiosity to the teacher’s explanation of concepts, to the formation of an understanding of that concept, to the verbalisation or written expression of that understanding” (Aineamani,2009).

Con’t

- So, from the basic curiosity stage to a demonstration of understanding, a learner needs to clarify his understanding or interpretation, test hypothesis and verify their thinking and understanding. All these are made possible through language and if a learner is undertaking all these cognitive activities in the second or third language in which they (students) or the teacher lack proficiency, limitations as such can result in limitations in learning (Aineamani, 2009).

Con’t

- As students progress through the primary and secondary grades, mathematics becomes more challenging and abstract. However, explained by Aineamani (ibid), where instruction is provided in English or the language of instruction, and the more support is provided to learning English or the language of instruction, the easier it is for them to understand and love the world of mathematics.

The Dilemma of Teaching Mathematics Concepts in PNG

- In PNG, English is the medium or the language of instruction; however, there has been a huge challenge in acquiring proficiency in this language of instruction by many students. With the reformation the school system in the 1990s, elementary schools were established. The National Department of Education and is decision makers called for children at this level to be taught in vernacular and bridged to English in Grade 3.

Con't

- The bridging to English that was supposed to have been done was a difficult concept to implement. Whilst appreciating this as a move with good intentions, that is, to protect our local languages, little did they realise that this was going to give Tok Pisin the ideal opportunity to spread. This resulted in many teachers, even in rural areas and more so in urban centres of PNG, using Tok Pisin to teach even in primary and secondary schools.

Con't

- The problems of this era and the type of education received has been shown by the recent Pacific Islands Literacy and Numeracy Assessment (PILNA) report (2013) which has shown very high rate of illiteracy (82%) and innumeracy (64%) amongst our Grade 5 students throughout PNG. These results support that when school students should be moving towards developing their English fluency, they are not. We have being seeing the many products of this era have lack fluency in English in our secondary classrooms, universities and other tertiary institutions.

Con’t

- The lack of proficiency in English in many schools has become a cyclical problem where many teachers who lack proficiency in English language themselves are teaching our children. In turn, many of their students are also not proficient in English, too. We identify that this, in itself, becomes a dilemma when we have many new generation of mathematics teachers who lack proficiency in the language of instruction teaching mathematics and other subjects.

Con't

- If teachers lack proficiency in English how are they supposed to develop our students' informal mathematics language and elevate them to the formal mathematics language? Therefore the challenge for teaching mathematics in English to Papua New Guinean students today is that with many teachers lacking the proficiency in English, they have limitations in the language to explain mathematics concepts.

Con’t

- In the other hand, with lack of proficiency in English language, it is problematic for students to understand instruction and express their understanding of mathematics concepts orally and in writing. Consequently, there are often misconceptions about some technical concepts in mathematics such as *left, function, even, odd*, etc.

- Where mathematical problems are given, students need to have good grasp of English language to be able to interpret, understand the context of the problem and problem-solve. The results of poor communication as a result of lack of proficiency in the language of instruction can result in misconceptions that are sometimes hard to undo.

Con’t

- As Aineamani (2009) explains, learning language in mathematics is greatly beneficial to students as it deepens their understanding of the mathematics concepts and the subject matter when they use language to communicate and reflect on their ideas and thinking. When they express their mathematical thinking, it helps them to improve their logical reasoning ability. This needs to start in early childhood and continue onto the progressive levels of education.

Con't

- Many of the difficulties many secondary students in PNG have today in understanding mathematics concepts and developing love and appreciation for mathematics are linked to their teachers and subsequently, their own lack of proficiency in English.

Enhancing Understanding of Mathematics Concepts in Secondary Schools in PNG

- How well students understand mathematics concepts in PNG really depends on how teachers view the role of language in mathematics as this influences their opinion of English as an additional language in mathematics lessons. If they see mathematics as a language, then they might not see the importance of learning English (Barwell, ud). Additionally, Ongstad (ud) explains, "*Teaching* mathematics needs to be seen as communication. *Developing the discipline/school subject* of mathematics ('disciplining') needs to be seen as communication, and *learning* mathematics needs to be seen as communication".

Con't

- What these two experts are saying is that in order for students, no matter what level, to understand mathematics concepts and develop appreciation and love for mathematics as a subject, teachers need to realign their perception of language in mathematics. If teachers see their role in teaching mathematics as communication and developing mathematic concepts as communication and learning mathematics as communication, they will ensure to teach language (English) in mathematics. In order to be successful in teaching language in mathematics, they need to be proficient in it.

Recommendations

- We propose only one recommendation for enhancing understanding of mathematics concepts and that is that anyone wanting to become a mathematics teacher must have a minimum B grade or better in English or Language and Literature and be proficient in English language. This means that selectors of Teachers Colleges and Universities that offer Teacher Education programs need to consider this seriously.

Summary

- There is a significant correlation between children's performance in language and mathematics. Children who perform well in mathematics also are more likely to perform well in language.
- In PNG mathematics continues to be one of the challenging subjects to learn in schools and key concepts are not clearly understood by students.

Con't

- Proficiency in the language of instruction and in PNG, it is English, is vital for teachers of mathematics.
- Proficiency in the language of instruction is greatly beneficial to students as it deepens their understanding of the concepts and the subject matter when they use language to communicate and reflect on their ideas and thinking and it helps students to improve their logical reasoning ability.
- Mathematics teachers need to be proficient in the language of instruction.

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- Thank You all for your patience

…… The End! …….

Con’t

- These are only revealed when they are confronted with more difficult topics in upper secondary. But students who understand mathematical concepts advance to a higher level of learning involving abstract thinking because when understanding a math concept reaches an upper tier in math essentially that allows thinking and processing abstractly.