INVESTIGATING THE USE OF LEARNERS’ HOME LANGUAGES TO SUPPORT MATHEMATICS LEARNING

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The paper presents an investigation into how learners’ home language can be used as a support for learning mathematics. This qualitative case study was conducted in primary school where learners were taking mathematics in English, which is not their home language. The school worked in collaboration with the Home Language Project to facilitate the learning of mathematics. The study revealed that when learners use their home languages they interacted better and freely with their peers and their teachers. The home language served as a reference point for words that were ambiguous and unfamiliar to learners. Mathematical practices such as conceptual understanding, procedural fluency, adaptive reasoning and strategic competence were furthermore facilitated by the use of learners’ home language.

INTRODUCTION

This was a qualitative case study, conducted in a grade three class in Johannesburg. The main purpose of this study was to investigate how the learners’ home language(s) can be used to support the teaching and learning of mathematics in a class of multilingual learners. The study was guided by the following questions:

a) How do learners use their home languages when they interact with mathematical tasks?

b) What mathematical practices are carried out by the use of the learner’s home language?

The paper will furthermore highlight how the research was conducted and this will be followed by a brief review of the literature and the debates on how language relates to mathematics. The analysis and findings of the data collected will be described later in the paper.

THE RESEARCH

The school where the study was conducted was working in collaboration with the Home Language Project (HLP), which started in 2001 as an initiative by parents and governing bodies from six Johannesburg schools. The aim of the HLP was to assist learners whose
home language is not English, to use their home language as a resource for learning, and to achieve bilingualism. The project provides home language support in a group of schools using English as the LoLT. The overarching goal of the HLP was to promote the ongoing learning of African home languages alongside the formal language of learning and teaching in schools where the LoLT is English or Afrikaans.

The lessons in this study were conducted by three teachers i.e. two teachers from the HLP and a mathematics teacher. The two HLP teachers assisted learners with the reading of home language tasks because learners were not yet proficient in reading their home languages. The mathematics teacher conducted the lessons in English.

THE DEBATES

It is widely accepted that language is important for learning and thinking. Researchers such as Pimm (1987), Pirie (1998), Torbe and Shuard (1982) have long recognized the relationship between mathematics and language. They argued that mathematics is like a language and learning it is much more abstract. They furthermore highlighted learning ways of speaking, reading and writing that are appropriate in mathematics.

What is still under constant debate and investigation in both the public domain and in research is which language is most appropriate for learning subjects such as mathematics, especially in a multilingual context such as South Africa.

Adler (1998, 2001) and Setati & Adler (2001) argued that multilingualism per se does not impede the learning of mathematics. They maintain that home language can be used as a useful resource for learning mathematics. Setati & Adler (2001) recommended code switching as a valuable resource for learning mathematics. Setati (2003) maintained that code switching is also one of the ways in which a teacher can encourage conceptual discourse, by allowing learners to speak informally about their mathematics: explaining, exploring and arguing about their interpretations and ideas. This talk is an important technique for learners to develop ideas in a comfortable environment.

Dawei (1983, cited in Yushau, 2004) also investigated the effect of teaching mathematics (in English) to students that have English as their second language. He focused on Punjabi, Impure, Italian and Jamaican learners who grew up in England. The results showed that first language competence was an important factor in the children’s ability to do mathematical reasoning in English as a second language.

Chan (1982, cited in Yushau, 2004), in his investigation on the difference in discourse patterns between bilingual and monolingual Mexican-American mathematics students he observed that where English was the only language used for teaching and learning, students were unable to engage in both procedural and conceptual discourse. Setati (2003) found the same in South African classrooms, while Rakgokong (1994) whose study also involved primary school children in multilingual classrooms in South Africa maintains that using English only as a LoLT has negative effects on learners’ meaning making and problem solving ability.
Moschkovich (1996, 1999, and 2002) whose work focuses on Latino bilingual mathematics learners argues that learners bring into the classroom different ways of making meaning in the mathematics classroom. In her analysis of the discourse that took place in the classroom, she noted the importance of supporting learners by “revoicing or modeling” their utterances. She argues that “revoicing” learners’ incorrect English utterances and modeling learner contributions enabled the teacher to get a deeper understanding of the mathematical discourses that students bring into the classroom. Moschkovich maintains that if we focus on students’ failure to use technical terms, we might miss how students construct meaning for mathematical terms or uses multiple resources such as gestures, objects or everyday experiences to communicate mathematically. She emphasizes the importance of valuing learners’ first language and mathematical discourses.

Gorgorio and Planas (2001) explored the role of language as a social tool that is crucial for the construction of mathematical knowledge in a multilingual classroom. They considered language as a wide notion where social, cultural, linguistic, emotional and cognitive tools are intertwined. They argue that teaching and learning should be a continuity between home and school or else new meaning or new words learnt in the school can turn into a wide variety of cultural conflicts and disruptions of the learning process.

On the other hand, there are other researchers such as Lim (1998 cited in Yushau, 2004) who do not view the use of home language as a resource for learning mathematics. They argue for the continued use of English as the LoLT in multilingual contexts and maintain that efforts should be made to improve English language proficiency of the learners. Lim studied the relationship between language and mathematics among Korean–American students and found that bilingual students’ success in problem solving is inextricably interwoven with their level of proficiency in English and other factors that relate to English proficiency. He recommended greater exposure to the language of the classroom (English) and the language of mathematics. Lim’s findings and recommendations resonate with those by Howie (2001), who argues that the solution to improving South African second language learners’ performance in mathematics is to develop their English language proficiency. Like Lim, Howie (2001) maintains that proficiency in the English language is related to performance in mathematics.

THEORETICAL FRAMEWORK.

I have used Kilpatrick, Swafford and Findell’s (2001) five strands for mathematical proficiency to analyze my data. Kilpatrick et al. (2001) argue that these five interwoven and interdependent are essential for developing proficiency in mathematics. They furthermore indicate that these five strands would enable learners to cope with the mathematical challenges of daily life.

The five strands are as follows:
• **Conceptual Understanding**: Conceptual understanding refers to an integrated and functional grasp of mathematical ideas. Learners with a conceptual understanding know more than isolated facts and methods (Kilpatrick et al 2001).

• **Procedural fluency**: Procedural fluency refers to knowledge of procedure, knowledge of when and how to use them appropriately and the skill of performing them flexibly, accurately and efficiently (Kilpatrick et al 2001).

• **Strategic competence**: Strategic competence refers to the ability to formulate mathematical problems, represent them and solve them. This strand is also known as problem solving and problem formulation in the literature of mathematics education and cognitive science (Kilpatrick et al 2001).

• **Adaptive reasoning**: Adaptive reasoning refers to the capacity to think logically about relations among concepts and situations. Learners use adaptive reasoning to navigate through many facts, procedures, concepts and solutions methods to see that they all fit together in some way, that they make sense (Kilpatrick et al 2001). Adaptive reasoning does not only include informal explanation and justification but also intuitive and inductive reasoning based on pattern, analogy and metaphor.

• **Productive Disposition**: Productive disposition refers to the tendency to see mathematics, to perceive it as both useful and worthwhile, to believe that steady effort in learning mathematics pays off, and to see oneself as an effective learner and doer of mathematics (Kilpatrick et al 2001). In short, a good attitude towards mathematics is imperative for acquiring the five mathematical strands.

**HOW LEARNERS USED THEIR HOME LANGUAGE AS A SUPPORT FOR LEARNING MATHEMATICS**

In order to illustrate how learners used their home language as a support for learning, I will use the following vignette to highlight how learners used their home languages to demonstrate the four strands. In the vignette the learners are discussing the attached task. The task was titled “the rainy days”. The task was prepared in a variety of languages: English, IsiZulu, Sesotho, Setswana, Sepedi, Xhosa, Xitsonga and Tshivenda. The learners were given the task in two languages: English and their home language. I give the version that was given to the Sepedi group. This version has the pictograph presented in Sepedi and is followed by questions in Sepedi and then in English. The translations of the months of the year were written as indicated in the task below.
THE ENGLISH TRANSLATION

Questions

Look at the calendar. Answer the questions.

1. Which month has the most rain? ..........................................................
2. Which month has the least rain? ..........................................................
3. Which months have the same amount of rain? .................................
4. How many more days does it rain in February March?..................
5. How many days does it rain in September and October altogether?...
6. Which month has 20 days of rain? ..................................................
English only questions:
7. How many more days does it rain in May than September? ........................................
8. Which three months together have the fewest rain? ................................................
9. Are there more or fewer days in May than in October? ...........................................
10. Are there more or fewer rainy days in January than in December? What is the difference between them?

11. Which 3 consecutive months have the least rain? ................................................
12. Which 2 consecutive months have the least? ............................................................

THE MONTHS OF THE YEAR IN ENGLISH
1. JANUARY 2. FEBRUARY 3. MARCH 4. APRIL
5. MAY 6. JUNE 7. JULY 8. AUGUST
9. SEPTEMBER 10. OCTOBER 11. NOVEMBER 12. DECEMBER

The vignette
In this vignette, the three learners were working on question two of the task described earlier, which involved the use of the concept “least”. The three learners are Sifiso, Nhlanhla and Sipho.

[ ] represent action taken in the lesson
( ) represents a translation to English
HLPT: Home language project teacher
MT: Mathematics teacher
L: Any learner in the class, (name not allocated)
R: For researcher

[the three learners are reading the question loudly in Zulu, then in English and then in Zulu again]

The group: Yiphile Inyanaga enemvula encane? [they turned to the English version] (Which month has the least rain?) [They turned to home language version and read.]

Sipho: June, July……. agunethi ngo June no July ku ya bhanda (its June and July it does not rain in Winter). … [The other group members shook their heads]

Nhlanhla: masi zi counteni futhi. (lets count again ) [They refer to the pictograph to see what has been represented in each, month.]

Nhlanhla: Hu August, there is nothing in August

203
Sifiso: but bathe imvula encane, a kuna mvula ngo August, hu July. (but they said the month with the least rain, there is no rain in August)

Nhlanhla: encane (the least) a kuna niks ……ho “naught” (its zero).

Sifiso: Sifiso pointing to compare at the August and the July pictograph. He eee hu July one mvula encane ……(No…… but it is July that has the least rain) [They all agreed on that July is the month with the least rain, Sifiso was insisting on July after the argument with Nhlanhla. Now the whole group writes July on their worksheet].

The three learners in the vignette, began by reading and deciphering the meaning of the words used in their home languages and then moved to the English version. The home language version acted as a source of reference in instances where they did not understand the meaning of words in English. They further used their home language version to ensure that they understood what was required in the question.

Sipho’s response to the question was “agunethi ngo June no July ku ya bhanda”(its’ June and July, it does not rain in Winter). Sipho did not refer to the graph to figure out the answer, he used his everyday experience. His answer may not be correct but he understood what was required in the question. The meaning of the word “least” which meant “encane” in Zulu was understood. Sipho could relate the concepts least with “nothing”. However, his interpretation of the concept “least” was interpreted differently by Sifiso. The different interpretation of the concept “least” heated up the discussion between Sifiso and Nhlanhla. Nhlanhla argued that the month with the least rain is August. “Hu August, there is nothing in August “(its August there is nothing in Augusts) but Sifiso insisted that “but bathe imvula encane, a kuna mvula ngo August, hu July . (But, they said the month with the least rain ). Sifiso was implying that there should be a certain amount of rain for the month to be declared the month with least rain. He maintains that the question was stated as: “Hi yiphi inyanga enemvula encane (the month with least rain) and not “hi yiphi inyanga engenamvula” (the month that does not have any rain). He interpreted the concept “least” as something that can be quantified. It can be argued that the meaning he attached to the concepts “least” is influenced by his linguistic background. In ordinary language (both English and Zulu languages) “encane” or “least” cannot be related to nothing. We talk about “encane” when there is presence of something. Mathematically, least means the lowest quantity and zero or nothing. Zero is the smallest value in this case; as a result, the absence of rain should be the least amount. Numerically zero is less than one (Kaplan, 1999).

The discussion between the two learners demonstrated how learners used their home languages to argue, justify their answers, talk about the ideas and interpret mathematical concept. Sifiso who interpreted the question as “Hi yiphi inyanga enemvula encane (the month with least rain) and not “hi yiphi inyanga engenamvula” (the month that does have any rain) justified his answer. He displayed an excellent and logical adaptive reasoning for a grade three learner. He might not have understood that zero is also a number for quantifying things but he understood that the concept least meant “encane” which meant the lowest value. The interaction between the two learners displayed a high
level of adaptive reasoning, conceptual understanding and procedural fluency. They used their home languages to put forth what they believed to be valid explanations.

CONCLUSION

The use of home language for reading, translating English words, talking, sharing ideas, disputing ideas, challenging each other’s ideas facilitated the four strands of mathematical proficiency. Learners displayed skills of procedural fluency when they were solving tasks. Procedural fluency also played an important role in developing learners’ strategic competence. Students develop procedural fluency as they use strategic competence to choose among effective procedures. They also learn that solving challenging mathematics problems depends on the ability to carry out procedures readily and, conversely those problems solving experience helps then to acquire new concepts and skills (Kilpatrick et al 2001). Learners in this study have displayed a sound skill in procedural fluency, which is crucial for developing strategic competence.

They could connect their understanding of the concepts least with zero. This is a significant indicator of conceptual understanding; i.e. being able to represent mathematical situations in different ways and knowing how different representations can be useful for different purposes. The degree of student’s conceptual understanding is related to the richness and extent of the connections they have made. Connections are useful when they link related concepts and methods in appropriate ways (Kilpatrick et al 2001).

The other important strand that learners have displayed in their discussion is adaptive reasoning. They could justify their work and explain ideas in order to make their reasoning clear. They could use evidence to critically reason, generate explanations with their data, and defend them orally or in writing. This interaction enabled them to reach a higher level of understanding, which developed their capacity to solve mathematical problems collectively. All mathematical ideas, interpretations, reasoning and thoughts were filtered through communication in the classroom. As they communicated their ideas, they learned to clarify, explain, refine and consolidate thinking (Sfard, Nesher, Streetland, Cobb & Mason, 1998).

In short, the mathematical conversations they had were good for mathematical thinking, reasoning, conceptualizing and solving problems (Sfard et al, 1998).

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