

Language Practices in Bilingual Mathematical Classrooms: The Role of Linguistic Diversity

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Abstract: The aim of this study was to explore how Sri Lankan bilingual students in public sector middle schools use their two languages – Sinhalese and English – to support learning of Mathematics in small groups with their counterparts who use Sinhalese only. The sample consisted of randomly selected 45 bilinguals and 45 monolinguals from three public schools in Colombo in Sri Lanka. The average age of the sample was 12 to 14 years. Over a two-month period, 8 forty-minute lessons from bilingual mathematics classrooms were video-recorded and later transcribed for analysis. In the presentation of findings, three practices in the language usage which emerged are discussed, i.e. (1) using academic vocabulary, (2) invention of new terms, (3) word-for-word translation. In the study, one example was chosen to represent each practice with some of its situated effects. In the discussion, the first two examples contribute to the idea that the students' experience of language difficulties, whether real or presumed, contributes to creating opportunities that can be beneficial to learning mathematics. The third example, which focuses on learning mathematics in the medium of English points to some contrasting findings. Unlike many other studies found in this field, locally or internationally, which report difficulties and obstacles that arise in learning and teaching due to bilingualism in middle school classrooms, a change of focus via the conceptualization of language in the form of thinking and doing is emphasized in this study especially for learning and teaching mathematics in the context of bilingual classrooms in Sri Lankan public schools.

Keywords: Bilingual classroom, Mathematics, Language learning, Language as resource, English medium education

Introduction

The main aim of this study was to explore how Sri Lankan bilingual students use Sinhalese and English languages to support the learning of mathematics in small activity groups, while interacting with their monolingual Sinhalese students in the same group work.

In many parts of the world, mathematics teaching and learning are carried on in languages other than the students' native or dominant languages. However, studies in the field of mathematics teaching have acknowledged greatly the impact of the language of instruction in the development of teaching and learning practices (Adler, 2001; Barwell, 2012; Jorgensen, 2010). Many studies in the field of bilingualism show advantages of bilingual education (Clarkson, 2007; Chval & Khisty, 2009). This study attempts to offer a positivistic view of bilingualism from the point of view of its relationship with the creation of opportunities that are beneficial to mathematics learning in Sri Lankan middle school context. Considering the studies in the field of bilingual education that have explored advantages of bilingualism (Ni Riordain & O' Donoghue, 2009; Parvanehnezhad & Clarkson, 2008) utilizing small group activities, this study also used small group work assigned to the middle school students in the bilingual mathematics classrooms in the chosen three schools.

Pimm (1987) stated in his research findings that the language is one of the most important areas for research in the field of mathematics education. Expanding his views about bilingual education, Morgan (2007) argued that studying academic language in mathematics supports multilingualism and in many occasions multilingualism supports studying mathematics. Moschkovich (2002) investigated the experience gained by the Latin students in US School system in learning mathematics in the medium of English in bilingual classrooms. She has observed code switching often made by the students mixing both Latin and English to communicate with their teacher of mathematics in the classroom. Moschkovich gave evidence to support that code switching also plays a vital role in learning mathematics in bilingual classrooms when the students find the medium of instruction becomes a barrier to keep focus on the subject content. From the social perspective, the possibilities for mathematics learning opportunities may be influenced by the individual behaviour while they interact in the bilingual classroom. Yackel et al. (1991) states that when the students work together in bilingual classrooms and try to communicate with the peers in his or her second language, many learning opportunities arise naturally for both monolinguals and bilinguals to verbalize their different thinking, explain or justify the solutions they offer, and ask for some clarifications when needed (p. 401).

Therefore, it is reasonably important to examine the use of the bilinguals' languages and their impact on learning opportunities in the bilingual mathematics classrooms.

Methodology

The main research question addressed in the present study was: How do Sri Lankan bilingual students use their two languages, Sinhalese and English, in small group activities in mathematics? and how is it

associated with the creation of new learning opportunities for the students?

Over a two month period 8 lessons from mathematics bilingual classrooms in the selected three schools were video recorded. They were later transcribed and analysed in line with the research questions. Three excerpts, each from one school, were elaborated for the study purpose. The three schools were purposefully selected considering the easy access to the researcher. The sample of students, 30 from each school (15 bilinguals and 15 monolinguals), were randomly chosen out of the numbers in bilingual and monolingual mathematics classrooms and further grouped in to three mixed classrooms in the three schools for the study purpose based on the consent of the students, their parents, teachers, School heads and the Ministry of Education prior to the administration of the pre planned lessons. Each lesson consumed 40 minutes, i.e. one school period in the respective school. Lessons were planned ahead targeting six small groups of five students in one classroom. The entire classroom was video recorded at the beginning of the study focusing a camera on the group with the selected bilingual students whose recording was later transcribed for analysis. The topics of the lessons varied according to the school term requirements and the preferences of the teachers in charge. All the mathematics teachers motivated the students in groups to participate actively in the study, solve the given tasks in their groups and finally to report their work to the class.



Figure 2. A photograph showing a group work in the School 1.

Source: Researcher's collection of photos

Figure 2. A photograph showing a group work in the School 2.

Source: Researcher's collection of photos



Figure 3. A photograph showing a monolingual and a bilingual present their group work to the class.

Source: Researcher's collection of photos

Results

For each of the three examples of practice of the students in the study, two stages are analysed, giving identification to the language practice while describing mathematics learning opportunities. The first two examples show how the knowledge of English (the second language of the learner) is contributing to comprehend the question in the group activity. The creation of new learning opportunity of mathematics is facilitated when monolinguals, facing either real or presumed second language difficulties, keep their focus on mathematics in their group discussion. The difficulty in understanding the second language - English- is observed to be facilitating mathematical reasoning that was started in the native language - Sinhalese- in the first two examples.

The Excerpt 1 in the study shows how one monolingual student (Sudesh) discusses a mathematical problem about odd and even numbers with his bilingual peers (Randeep and Vinuk). The interaction helps the monolingual student to understand the meanings of the terms 'odd' and 'even' at the of the interaction which is considered as learning academic vocabulary (odd and even) taking the second language as resource.

The Excerpt 1

Sudesh: Thd fudllao filg fu;k ,sōfj@ (What did you write here for this $4x+3x$?)

Randeep: ux ,sōfō T;af;a ixLHdjla (I wrote an odd number)

Sudesh: ux weyqfj Thd fudllao ,sōfj@ (No, I asked what did you write?)

Randeep: fi n,kak" ux ,sōfj fukak fi T;af;a ixLHdj (See, I wrote this odd number).

Sudesh: 'Tâ' lshkafk wuq;=hs lshk tlfk@ ('Odd'.... Doesn't it mean 'amuthui'?...)

Vinuk: kE" uu;a ,sōfj T;af;a ixLHdjla' T;af;a lshkafka brÜfÜ fkuhs lshk tl' brÜfÜ lshkafka 2"4"6 jf.a tajd' ta;a fu;k ;sfhkafka 7' b;sx tal T;af;a ixLHdjla' Thd fudllao ,sōfō@ ug fmkakkak' (No, I have also written an odd number. Odd means not even. Even are 2, 4, 6 like that. But here it is 7. So it is an odd number. What have you written? Show me.)

Sudesh: ug f;afkrjd" Tâ lshkafka T;af;a (I understand...odd means *oththe*).

The Excerpt 2 of the study shows how two monolingual students (Roshan and Maneesh) discuss an algebraic expression with a bilingual peer (Dilum) in their group work facilitating the monolingual student to comprehend a new term, 'Consecutive'.

The Excerpt 2

Dilum: $3y+(3y+y)+(3y+2y)$... tl .dj tk b,lali 2la tl;= lrkakhs lshkafk" n,kak tal f,aishs' $(3y+(3y+y)+(3y+2y))$Adding two or three consecutive numbers...see it is easy!

Roshan: tal fldfyduo tfyu fjkafk@ (How can that happen?)

Dilum: yß f,aishs" tal kslx Thd tl b,lalulg 1la tl;= lrkjd jf.a"yßhg 1+1, 2+1 ke;aki 2.5+3.5.. f;areKdo@ tajd wkqhd; ixLHd" fi n,kak (Simple, it's just like you add 1 to another number....just like 1+1, 2+1 or 2.5+3.5..got it? They are consecutive numbers look.)

Roshan: Thd lshkafk Thd B.dj b,lalu .kak kslüu l,ska b,lalug 1la tl;= lrkjd lsh,o@ tajd tl

.dj b,lali jqKdu (you mean you just add 1 to the former number to get the next number? And they should follow each other?)

Dilum: kE ksliu 1 la tl;= lr,d nE" tajd tl .dj tk b,laliu fjkak 'k;a kE" iuyr fj,djg Thd tl;= lrkafk x yß y" yenehs tajd wkqhd; fjkak 'k' (No, not just adding 1, not the numbers that follow each other always, sometimes you add x or y but they should be consecutive numbers).

Maneesh: Thd ta b,lali wkqhd;hs lshkafka yeu ;siafiau tajdfha fjki 1 fjk ksido@' (You mean they are 'consecutive' because the difference between the two numbers is always 1? .)

Dilum: wkak yßæ tajd wkqhd;hs""n,kak 4.5y 1y 5.5y tajdfha fjki 1 hs" f;areKdo frdaaIdka@ (That's right! They are consecutive numbers...see this 4.5y and 5.5y... The difference is 1. You got it Roshan?).

Roshan: Tõ""tajd lkailáõ b,lali fjkak 'k (Yes...they should be consecutive.)

The Excerpt 3

The Excerpt 3 in the study shows one monolingual student (Samantha) interacts with a bilingual peer (Hiran). They discuss about the perimeter and radius of objects. Their interaction was supported by word-for-word translations, from Sinhalese to English.

Samantha: Thd okakjo mßñ;shg lshk jpfk@ (Do you know what we call for 'parimithiya'?)

Hiran: Tõ" fmßóg¾ (Yes. It is perimeter.)

Samantha: fmkakkak fiñ fmßóg¾ tl (Show me the perimeter in this.)

Hiran: fu;k b|,d fuf;kag tkliu jfÜg ;sfhk ýr (the distance from here to here.)

Samantha: ta lshkafk rEmfha jfÜ rjqfi ýrfk@ (That means the outer boundary of a body or figure.?)

iuyr fj,djg jfÜg ;sfhk odr Tlafldf.au tl;=j;a .kakjfk@ (Sometimes we take the sum of all the sides ?)

Hiran: Thd yß we;s (may be you are right)

Samantha: t;fldg rdähia lshkafk@ (What is the meaning of the word 'radius'?)

Hiran: rd-ähia fkuhs tal f¾-ähia""fukak fi È.""n,kak' (Its not 'raa-dius', it is 're-dius', this length.....)

Samantha: tfyki f¾ähia ;uhs wrh (then the 're-dius' should be the 'araya'.)

Hiran: yß" Thd okakjdo fmßóg¾ tl fidhk iQ;%h@ (Right, do you know the formula for the perimeter?)

Samantha: Tõ" fmßóg¾ tl fidhkafk 2 ∑π r j,ska (Yes, we use 2 ∑π r to find out the perimeter.)

Discussion and Conclusion

The Excerpt 1 which showed how one monolingual student (Sudesh) discussed a mathematical problem of odd and even numbers with his bilingual peers (Randeep and Vinuk) is an instance that proves the interaction helps the monolingual students to improve academic vocabulary. As Huguet (2007) revealed, some monolingual speakers choose academic vocabulary in the way that makes their native language look more distant to the second language linguistically. In the Excerpt 1, Sudesh does not first identify the mathematical term 'odd' as an academic vocabulary. Instead, he asks if it meant 'strange' ('amuthui' in Sinhalese). However, at the end, the monolingual, Sudesh, came to understand the meanings of the terms 'odd' and 'even' at the end of the interaction which is considered as learning academic vocabulary taking the second language as resource. The concern they have with specific vocabulary supports developing the arithmetic meaning for mathematical problems they come across.

The Excerpt 2 that shows how two monolingual students (Roshan and Maneesh) discussed an algebraic expression with a bilingual peer (Dilum) in their group work is an instance that supports the finding that bilingual

classrooms facilitate the monolingual students to invent new terms. In the example, two monolinguals comprehend the meaning of the term 'consecutive' and add it as a new term in to their vocabulary.

The Excerpt 3 is an example that shows how monolinguals' interaction with the bilinguals in group work is supported by word-for-word translations. in the example, the student (Samantha) interacts with a bilingual peer (Hiran) and discusses about the perimeter and radius of objects. Samantha, the monolingual, translates the terms, perimeter and radius, in to Sinhalese to conceptualize those mathematical concepts.

When the terms are translated from one language to another in the process of communication in mathematical lessons, second language does not support as resource for learning new vocabulary because the focus on the second language is kept away from its focus on mathematics. However, the language practice of the monolinguals of word-to-word translation could be observed in many instances throughout this study. The practice was equally common in almost all three schools.

In the present study, the focus was on linking language learning opportunities with the language practices in the bilingual classrooms rather than the opportunities of language learning. It also focused on academic and technical vocabulary in mathematics. The first two examples given in the results support the view that some language barriers contribute to generating learning opportunities in bilingual mathematics classrooms as long as the focus of the discussion is not directly related to language. The third example presented here is an instance where the students find it difficult to keep their focus on mathematics as it is interrupted by word-to-word translation. As Cobb et al., (2003) have suggested, some systematic research on learning opportunities of mathematics should be carried on in the bilingual classroom settings to find out how

linguistically diverse students are supported with better learning opportunities.

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