

# LIMITED ENGLISH PROFICIENCY STUDENTS AND MISCONCEPTIONS IN MATHEMATICS: A CASE STUDY

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**ABSTRACT** - When mathematics is taught in English, students not only have to learn English but they must also learn English words used in mathematical context. This can lead to misconception again due to the lack of understanding of English. So, mathematics can be particularly challenging for Limited English Proficiency (LEP) students. However, despite these challenges, the Malaysian government's policy to teach mathematics and science in English started five years ago in 2002 with the intent to provide the citizens of the country with the scientific and technological competence to face the globalize world. Thus, with regard to the above issue, this study aimed to identify the approaches and strategies teachers integrate in their lessons to overcome the challenges faced by LEP students. This qualitative case study was conducted in a rural primary school in Pahang which has an enrolment of 1800 students. The school's excellent achievement in the UPSR mathematics grade has been ranked among the top five schools in the state of Pahang. Specifically, what was observed were interesting classroom management strategies blended together with the variety of instructional modes and assessment methods which allow for conceptual change in students cognitive ability. Other findings through classroom observations, interviews with teachers and students and document analyses proved that teacher's strength, enthusiasm, and proficiency in English and creativity in their teaching strategies enable them to teach LEP students, the subject most feared that is mathematics, in the English Language. In addition to that, teachers teaching techniques encourage students to build confidence in learning mathematics and become less anxious to this fearful subject.

## BACKGROUND OF THE STUDY

Mathematics has its own specialized language, grammatical patterns and rules and it involves formulas, relationship, application and explanation (Short & Spanos 1989). Due to this complexity, students create a certain kind of attitude and thinking about mathematics.

As mentioned by MacGregor and Moore's (1991) that language plays an important role in organizing knowledge, thinking logically, giving explanations, and presenting

results. But how do you account for teaching mathematics in the students' weaker language? These students are the group of limited English proficiency (LEP) students who are learners of the English Language. They learn English as a second language but now have to be in a mathematics class is taught in English.

Teachers should not expect miracles to happen when teaching mathematics to LEP students in a language other than their mother tongue. Since mathematics has a language of its own, the nature of mathematics is itself a burden to students regardless of the language of instruction. Teachers have to teach students to develop academic mathematics skill as well as learning English. As a matter of fact teachers should understand that learning a second language is as difficult for a child in their class as it is for the teachers as adults. It may be more difficult for a child, since they do not have the access to the memory techniques and other strategies that more experienced learners can use in acquiring vocabulary and learning the grammatical rules of the language.

Together with learning English as a second language, these LEP students must also learn the unique meanings that some English words have in mathematical context. LEP students need to pick up and learn many content-specific vocabulary words (eg- quotient, equivalent, divisor, numerator, denominator). Besides that they have to know the meaning of many complex phrases (eg. least common factor, greatest common factor). Many complex phrases are not found in bilingual dictionaries. What most LEP students will do is that they will break apart the phrase (eg, least common multiple) and look up each individual word in a bilingual dictionary to try to understand the meaning of the phrase. However this strategy does not ensure accurate translation. They need to understand that many common English words have unique meanings in mathematics (i.e., bring down, face, plane, cone, net, positive, negative). LEP students have to understand that prepositions (i.e., by, with, to, into, from, etc.) are used in a variety of ways in word problems to highlight operations. They need to know the meaning of prefixes and suffixes (i.e., hept-, tri-, bi-, poly-, -gon, -lateral). There are other examples such as sentence constructions and statements that they have to understand and acquire before starting to think of solving the problem.

Some common examples are as follows:

Operation	Common English Words
Addition	add, plus, and, combine, sum, total of, more than, increased by, greater than.
Subtraction	subtract, minus, less, less than, fewer than, decreased by, difference, lower, take away, from, shorter.
Multiplication	multiply, times, product, as a factor, twice, double, triple, groups of.
Division	divide, divided by, quotient, separated into equal groups, shared equally, over, into, how many groups.
Equal	is, are, result, make.

Teachers' ability to provide an environment where the integration of the English language and academic skills development can be enhanced is necessary (Tikunoff, 1983). However, one major problem that leads to serious learning in mathematics is the occurrence of misconceptions which results if students do not have proper or adequate teaching, informal thinking process or poor remembrance. Misconception is defined as a mistaken idea or view resulting from a misunderstanding of something. Misconceptions are strongly held beliefs that students constructed based on limited understanding of a certain phenomena. An example of a misconception is- a teacher might just describes the operation of multiplying by 10 as adding a 0. These misunderstanding will cause students unlimited trouble in grasping with mathematics from the most elementary concepts until they do calculus.

Students' misconceptions cause teachers a lot of stress and frustration on why students cannot follow their teaching (Resnick 1983). Misconception needs to be repaired and remedied and it can only be done by changing the conceptual framework of students (Resnick 1983). It is not enough to just merely inform or advise the student on the misconception that they have. Neither does repeating a lesson or making it clearer help students who have already formed strong reasons for their misconceptions (Champagne, Klopfer & Gunstone 1982; McDermott 1984; Resnick 1983). Teachers have to explore and understand why these misconceptions arise and then plan a strategy on how to remedy the problem. Teachers must help students to reconstruct correct conceptions (Lohead & Mestre 1988). Misconception results from students belief systems and also their thinking process and the only effective way to correct misconception is to change these misconceptions from the inside, which is from the students' systems.

### STATEMENT OF THE PROBLEM

In 2003, the Malaysian government had implemented a national policy for the teaching of Mathematics and Science in English. This is in line with the increased importance of mathematics and science in the development of knowledge-based economies. Mathematics and Science teachers are required to use the English Language for their instructional delivery. The MOE is very much dependent on the capability and the expertise of teachers to bring change to any policy brought about especially with regards to reform in education. Teachers are direct agents of change for the mission and goals set by the Ministry of Education (MOE). Have the spirit and enthusiasm of our mathematics teachers declined ever since they started this mission? Are they capable to overcome students problems in learning mathematics?

Mathematics is not an easy subject to teach. Mathematics teachers have a growing concern about students' misconceptions in mathematics (Mestre 1987). Teachers understand that when students have misconceptions, students can become slow learners in mathematics and may even develop fear or anxiety toward mathematics. These problems if not solved early will interfere with students' future learning of mathematics. Teachers can easily make an easy explanation or excuse by saying that these students

are not capable of understanding and should not take mathematics or class them as low intelligence students. But what teachers are most concerned with is, every child is not left behind and have the right to learn in class.

Knowing the fact that students have misconception in mathematics (students do not come to class as "blank slates" – Resnick 1983) and coupled with a few more issues from the new policy, teachers are more stressed than ever. Certain issues such as, teachers inadequate proficiency in English and it has been observed that some mathematics teachers failed to plan effective measures to help students in overcome difficulties in learning mathematics in English (Noraini et al., 2006).

Therefore this study is conducted basically to look into the practices of the mathematics teachers on students' misconceptions and also teaching mathematics in English. This study aimed to investigate teachers' best practices in handling and overcoming misconceptions in the teaching of mathematics. In addition, this study also aimed to further explore the delivery methods teachers incorporate in their class in order to deliver mathematics instruction in English.

### OBJECTIVE OF THE STUDY

The main objective of the study is to uncover the best practices of successful teachers in this school in their delivery method to minimize misconception among students in mathematics as well as to maintain the culture of teaching the subject in English.

### Research Questions

The main research questions investigated in this study were:

1. How do teachers manage to teach mathematics in English while at the same time trying to overcome students difficulty in learning mathematics?
2. What are the common misconceptions that teachers observed among their LEP students?

### Scope of the Study

The scope of the study was limited to a primary school situated in the outskirts of Kuantan, Pahang. Primarily, this school was selected because it has been ranked among the top five of all the primary schools in Pahang according to the UPSR 2007 examination results.

### Research Methodology

The methodology used mainly consisted that of a qualitative case study. Data was collected mainly using interviews, class observation and document analysis. Context and background information of the school was collected through observation and document

analysis. A case study design was conducted since it seems that it is the most appropriate method to look into the nature of how the teaching and learning of mathematics takes place in class.

The school selected for the study was one of the top five schools in the state despite being located in the outskirts of Kuantan. The classes observed were from the Year Three and Year Five classes. The researchers also managed to gather data from the homework exercises done by students in their exercise books. These exercises were identified and collected according to the research questions.

### Data Collection and Management

Various procedures were followed before data were collected from the sample school. The principal provided the proper resources for the data collection. On the first day of the research, the principal gathered some of the mathematics teachers for a short meeting. The mathematics teachers were explained of the purpose of the research and the welcome the objective of the research. They showed their support and were willing to be interviewed and also to be observed in class while they are teaching (Bogdon & Biklen 1998). The principal, the assistant principal, the mathematics expert teacher (Guru Pakar Matematik) and the rest of the mathematics teachers were involved in the semi-structured interviews. Interview questions were focused on the issues and challenges of teaching mathematics based on the new policy; the common misconceptions teachers observed among their students and also their teaching strategies to guide and help students in learning mathematics in the English Language. The mathematics expert teacher collected students' exercise books from various classes in different years for further analysis of the misconceptions that can be traced from the mathematics questions answered by students. Focus group interviews explained the activities carried out by the mathematics panel in improving their teaching methods to ensure that students continue to learn even if they have to learn in English.

### Presentation of Results

Results were discussed and presented in two sections. The first section presents findings of the study whereas the second section will cover discussion, conclusions and implications of the study.

### Findings of the Study

The overall findings reflect the research question which focuses on the issues related to the misconception due to language and the subject matter. Findings will also reflect on the variation in teaching approaches to meet students' requirements in understanding the concepts.

There were altogether 17 mathematics teachers and all of them have more than five years teaching experience. The school has a male mathematics expert teacher who has more than 12 years teaching experience.

### a) Classroom Observation data

In all the classes observed the teachers were organized and efficient in their delivery of the subject content. Teachers communicate clearly and slowly to ensure students followed her instructions. In some of the classes observed, teachers explained the concepts in Malay before introducing the English term. In one of the classes observed almost 95 percent of the lesson was conducted in the Malay Language. This class is one of the end classes in Year Three.

Overall, classroom management in all the classes observed was good. This is so because students are actively involved over half the time of the lesson observed. Students followed through the instruction conscientiously, paying attention and looking at the teachers explaining in front of the class. Students participated actively especially during the 5 minutes questioning session at the beginning of the class. Students were motivated and appear to be more interested when their teachers bring in some teaching aids for them. They appear to enjoy listening and look earnestly at their teacher's explanation using the teaching aids.

In almost all the classes observed, the teachers speak slowly and they came into class with their manipulative to increase students' attention toward the subject. Teachers continuously explain in detail although students responded in groups when answering questions. The mathematics teachers accepted students' remark or students' responses in Malay. They do not penalize students who communicate with them other than the English Language.

However in summary, what have been observed is that at the end of the class, almost all the teachers' ask simple questions for example class do you understand this example?; do you think you can do some questions at home?;. They tend to limit themselves to 'Yes' or 'No' questions or low level questions which is sentence completion type and almost invited chorused answers. Throughout the classes observed there were hardly questions to probe students' ability to analyze the content discussed in the lesson.

The results of the study indicate that the classroom interaction in the classes observed were total class instruction. Teachers' instruction made up about 70 percent of the time and approximately about 30 percent of the time students worked independently. Almost 90 percent of the time students were observed doing seatwork.

The following is an observation of one of the classes.

Teacher enters class and distributes questions for the day.

Students were given five minutes to do the questions.

After five minutes teacher gives the answer and students mark their own paper.

Teacher then ask for the number of students who got all correct answers. Students raised their hands to show the correct answers they have got.

Then students put away the paper and formal class teaching begins.

Teacher begins by saying 'hari ni cikgu akan mengajar pecahan? Ingat kita dah pernah belajar pecahan pada tahun lepas?'

And teacher explained the whole topic of 'improper fraction' using the Malay. To start introducing the topic, she called two students (one being smaller than the other) to the front and showed the possibility of a smaller classmate carrying a bigger classmate and compared it if it is vice versa. And in Malay she explained that a smaller child cannot carry a bigger child, thus it is not proper. Then only she introduced the term 'improper fraction' to tell the class of some numbers which is bigger than the number at the bottom of a fraction and she uses the Malay term 'pecahan tak wajar'. She then used the teaching aid that she brought in and showed the class further examples of improper fractions.

### b) Data from Interview session

From the interview sessions, the mathematics teachers worked collaboratively in a team to teach the examination classes. The mathematics panel prepared questions that can be used during the first 5 minutes of class time. These questions were kept and sequenced according to the dates proposed by the panel. Teachers used these questions as a drill before teaching starts. Teachers admitted that they have very serious problems when teaching in English. They explained that almost 98% of the students are from families who do not use the English Language at home. The other difficulty that they complained is that of their own deficiency in delivering the subject in English. Although they have attended the ETeMS course conducted by the MOE, yet they still feel that they have not acquired the skill to successfully deliver confidently in English. Teachers also explained that they were unable to build the necessary conceptual foundation of mathematics due to the language barrier of the students. Now that teaching is in English they are worried that students will have double their misconception- misconception due to mathematics and misconception due the language. Their concern is that this will cause serious problems later because students are taught only the lower mathematical skills and the reasoning skills are not focus in class. They explained that reasoning skills requires the ability to explain mathematical concepts and how students' thinking is progressing. Students find difficulty in expressing their reasoning power because they are not proficient in the language. Some comments from the teachers in the interview:

"Mathematics is not an easy subject to teach and bila kena ajar dalam Bahasa Inggeris lagi susah nak fahamkan pelajar. Dalam bahasa Melayu pun mereka teruk..."

Teacher A

"Kita semua bantu membantu dalam pnp. Kami tak kira kelas apa pun kami mengajar, kalau kena ganti kelas tahun 6 kami akan masuk mengajar walaupun kita mengajar tahun 3 aje..."

Teacher B

"Murid kadang tak faham soalan- ramai yang tak faham bahasa dalam soalan.. satu operasi banyak perkataan,... macam 'total', 'sum', 'all together'..."

Teacher C

"... pelajar tanda buku mereka sendiri dan membuat pembetulan mengikut contoh guru... tapi ada juga yang guru mintak pelajar tukar buku dan kemudian tanda buku kawan.... Cikgu sibuk, tak ada masa nak semak buku latihan pelajar. banyak sangat kerja..."

Head of the Mathematics Panel

"... miskonsepsi... kami tak ada masa pun nak mencari miskonsepsi, nak kejar silibus, ..hmm tak sempat nak betulkan miskonsepsi budak-budak. Kami bagi banyak soalan aje..ada juga rasa nak buat kajian tindakan tapi belum ada masa lagi..."

Teacher D

" ada juga saya lihat kesilapan yang sama berulang tapi saya tak sempat nak fokus. Kami terkejar-kejar antara nak lengkapkan silibus dan kerja-kerja dan aktiviti lain dalam kelas.. kadang-kadang nak tumpukan kepada bahasa Inggeris kami jadi slow nak mengajar pelajar..."

Teacher E

"... kadang-kadang saya rasa bersalah pulak kerana tak dapat bertutur dengan baik kepada kelas dalam BI terutama kelas hujung, murid perlu lebih banyak penerangan..."

Teacher F

However, despite these problems and constraints, the teachers from this school are always prepared with teaching aids and tried their very best to make the lessons beneficial for the students. They attended to students weaknesses in the Malay Language especially when introducing new concepts for the first time.

**c) Data from students exercise books**

Two sets of students' exercise books were taken from each of the classes in Year Three to Year Six. Students maintain 2 mathematics exercise books. All exercises were either marked by themselves or by their partners in class. Errors were corrected beside the appropriate question and the corrected answers were noted down. Further analysis of the exercises showed that some common errors in a number of questions were repeated observed. A few examples from their exercises are attached as in Appendix A.

**DISCUSSION**

Findings from this research are specifically representative for this school that has been observed only. However, some aspects of this study can be used as a guide to help teachers to reflect on their own practice in their school.

This research has shown that teachers played an active role during class instruction. Teachers delivery of content and use of manipulative in their classroom helped to increase students attention and teachers keep students alert by calling out their names to

answer teachers' questions. Although the language of instruction has to be in English, teachers continue to teach classes at the lower end using the Malay. Teachers feel more confident and comfortable to teach using the Malay Language to these students who are not proficient with the English Language. It is not easy to explain mathematical ideas when students cannot follow or understand the language of instruction. This finding is in line with Echevarria et al. (2004), who placed great importance in communicating mathematical ideas as it is not a straight forward process since mathematics involve concepts, processes and applications and the development of the English Language should be done in a naturally.

Although teaching mathematics in Malay is not recommended in the curriculum policy, teachers in this school felt that they were left with no choice. This is their last resort to ensure students come into class and learn mathematics. Teachers pay less concern on the language skills but encourage students to be engaged in the mathematics content but in Malay. Looking back into literature, it seems that this method is similar to the instructional models for teaching LEP students which is the sheltered instructional model. According to Crandell et al (1985), this method can be effective for LEP students because they can learn mathematics better in their first language and also learn a second language successfully. In this study, teachers use of visual aids and hands-on activities helped to keep students focused to teachers' instruction. As Krashen (1982) asserted that language acquisition occurs when input is meaningful and understandable when lessons use concrete objects, graphics, manipulative, and hands-on activities to clarify and reinforce new concepts. It has also been reported that a child progresses if teacher explains and clarifies concepts in the child's primary language which is their mother tongue (Cummins, 1981; Tikunoff, 1983; Wong & Valadez 1985).

Somehow or rather teachers delivering in Malay can also be seen as the inadequate proficiency of themselves in the English Language. This coordinates with the data collected from the interview session with teachers who feel that they themselves are not fully confident in delivering the content of mathematics to the students because of their limited proficiency in the language. Teachers feel that facing students in the end classes requires more fluency of the language when compared to students in the first few classes. Lower achievement students need more explanation and guidance. As suggested by Noraini et al. (2006), teachers who believe that they do not have adequate professional development tends to teach mathematics in other languages interchangeably with English. These teachers feel they are not competent to face students who have learning disabilities in mathematics who needs much more explanation and examples in class when compared to the students who are able to do mathematics.

For LEP students to succeed in the mathematics classroom, it is essential that teachers connect previous knowledge and experience to new concepts that are being taught and integrate academic vocabulary to build mathematical concepts. It is critical that teachers are able to integrate language and content instruction. The teacher is the heart of the lesson. The design and planning of the lesson to the questions asked at the end of the class is all dependent on the expertise of the teacher (Ellerton 2004). But, what seems to be forgotten in these classrooms is that the teachers failed to establish

learning environments which nurture students' mathematical problem solving skills and creativity. What has been observed is that students are called to answer only low level knowledge questions; teachers do not allow time for students to answer questions on their own.

This is quite understandable since teachers still feel the dissatisfaction to teach mathematics in English. This is mainly due to their own personal reasons for not being competent in the language to give challenging questions to students and also probably understanding their own students' ability to answer the questions. During the three days observation, teachers did not reach out to students with questions leading to higher order thinking skills even in the good classes.

However, in one of the Year Five classes observed, the teacher start with asking a high level cognitive question but not allowing time for them to give their answers. But rather the teacher guided and structured the students thinking about the problem slowly by asking a sequence of low level questions. Finally both parties were satisfied on arriving at the answer but there is no guarantee that lessons has been learned. According to Brousseau (1984), guided instructions to solve higher level mathematics tasks will only deny students the opportunity to formulate and apply their own strategies. This is observed when the teacher planned the question as well as the answering technique leading the students to the answer. This is a quick way to teach problem solving but do not ensure students understanding of concepts since we deny our students the opportunity to think creatively at their own pace.

Teachers also provided a substantial amount of work in mathematics for the students to do at home. Analysis of the mathematics assignment clearly showed that students have been further reinforced at home with exercises according to the topics taught in class. However, some remarks should be highlighted and discussed. Exercises were given to reinforce and strengthen whatever is being learned in class but they were not checked by the teachers.

Research findings have shown that homework assignments are helpful to students if they were planned and have direct meaning to students as well as teachers (Paulu 1995). But the common practice in this school is that the individual student concern will mark their exercise book. So teachers are not actually aware of the errors or corrections that the students have undergone. Unmarked exercises by teachers will lead to uncorrected errors by students. If teachers do not checked for errors in students' assignment, these same errors will be repeated throughout the year. Students will not understand why they make the same mistakes. Mistakes or errors like this will become misconceptions unless corrected by teachers. According to Cooper (1989), teachers have the responsibility to attend to the mistakes that students do and he even emphasized that homework assignments should be graded and given remarks either positive or negative in order to improve the child.

To summarize, perhaps the most effective lessons are when the teacher does the work beforehand in the planning, based on what has happened before and not at the time when teaching takes place. Teachers are confronted with lots of challenges in teaching mathematics. Having said that, mathematics teachers should not make all these

challenges as an escapist route for them just to satisfy themselves and put all the blame of failures to the students. Teachers should have the enthusiasm and spirit to transform every challenge into an opportunity to improve students' ability in mathematics. In order to promote mathematics learning in class, teachers need to encourage an environment where it is OK to be wrong. As teachers, we are not expected to know what our students are thinking of the concepts we introduce in class but we have to probe and identify the misconceptions that needs to be corrected.

## CONCLUSION AND RECOMMENDATION

In this particular study the best practices observed was that knowing students limitation in English, teachers conducted classes in Malay and introducing mathematical English terms slowly to students. Teachers kept class attention by using teaching aids and supporting students with prepared written questions to sustain their focus from the beginning of the class till lesson ends. They were flexible in the teaching approach and able to manipulate students' strength and weaknesses in the language of instruction by introducing various teaching strategies according to students' ability. There is not a doubt that these are best practices in this respective school.

However, what is left to be of our concern is that when there is too much emphasis focused on the development of the English Language, there are some aspects of the mathematics curriculum not being addressed. Do we raise questions to challenge the cognitive development of the child in our daily teaching? Are we looking into issues concerned with misconceptions and errors in mathematics either in our daily instruction or in homework assignments? To what extent do we know that by drawing students' attention, they have cleared all their misconceptions and finally use the correct conceptual framework that is required for that particular topic? Is it enough to prepare our next generation of youth who will have to face challenges in a more competitive world just by asking low level mathematics question just because of the inadequate proficiency of the teachers in the English Language or the inability of our LEP students? These are some painful yet truthful issues that we have to face.

According to Valdez (2002), when a teacher conducts quality teaching there will always be checking for understanding when new concepts are introduced and continuous checking for understanding in homework assignment, vocabulary and writing activities to ensure students are engaged throughout the learning process. What seems to be the problem in mathematics classes now is that teachers work too hard, teachers solve all the problems but despite of teachers working hard and the implementation of the discovery and inquiry teaching approach, students are still 'cognitively' passive, uninvolved and not working hard enough. As teachers, it is always wise to look back and become reflective practitioners so that every action that we plan will not damage our children's future.

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