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ORIGINAL ARTICLE

Mathematics Difficulties Among Primary School Students

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Jane Gloria Philip Kelanang, Effandi Zakaria; Mathematics Difficulties Among Primary School Students

ABSTRACT

This study was carried out to investigate the effect of intervention on the improvement of numeracy and mathematics achievement among primary one students with mathematics difficulties. This study was quantitative in nature and involved 19 primary one students from primary schools within the federal territory of Kuala Lumpur. Instruments used in the study were *Texas Early Mathematics Inventories – Progress Monitoring* (TEMI-PM) and online EasyCBM. Students with mathematics difficulties were identified using TEMI-PM evaluation. Students who scored below the 25th percentile were chosen to join the intervention. Each intervention session was conducted in a small group of 5 students for 30 minutes for 10 weeks. EasyCBM test was administered every week in order to measure students' growth in numeracy. TEMI-PM was used to determine the effectiveness of intervention in improving mathematics achievement. It was found that the t-value for comparison of scores before and after the intervention by using paired sample t-test was t=-14.213 ($p<.0.05$). Results showed significant difference on the scores of pre-test and post test. Students who participated in the intervention had showed improvement in mathematics achievement. Scores of EasyCBM tests throughout the intervention were shown in the form of graphs for each student involved in the intervention. Based on the graphs, all students showed improvement in numeracy.

Key words: mathematics difficulties, mathematics achievement, numeracy

Introduction

Competency in mathematics has become a rather important skill to every individual today. Learning of basic mathematics at an early stage is the foundation for the understanding of higher level mathematics concepts. Failure in mastering the basic mathematics concepts will affect the ability in acquiring mathematics skills at a higher level. In addition, inability in understanding and learning of mathematics concepts at an early stage also affects students' interest and confidence in learning new mathematics knowledge. Students are given the exposure to basic mathematics knowledge as early as at the pre-school level. This stage plays an important role in the learning of mathematics up to a higher level. Strong mathematics foundation will ensure smooth learning of mathematics.

Competency of basic numbers are formed at an early age (Jordan & Levine 2009). Children with mathematics difficulties will have problem in symbolic number knowledge which is influenced by experience and teaching. Absence of concept formation added with difficulty in remembering basic facts result in students being not able to solve problems. Fluency in basic arithmetic combinations is a challenge to students who have difficulties in basic mathematics skills and concepts (Bryant *et al*. 2008).

Generally, most children with mathematics difficulties show weaknesses in memory and application of arithmetic facts. This shows that difficulty in remembering number facts is the most common component in arithmetic difficulty. However, it does not mean that each student who has arithmetic difficulty faces problem in remembering number facts (Dowker, 2005). Dowker (2005) discussed a few situations or types of arithmetic difficulties showed by students. There are students who do not have problem in remembering number facts but lack of strategy to solve counting problems. There are students who are able to solve single digit arithmetic but face difficulty in understanding and mastering concepts of ones, tens and place value.

Each child has different level of intelligence. Screening is often conducted in the process of teaching and learning to identify students' strengths and weaknesses for the skills being taught. The common screening done in schools are test and evaluation. Past research revealed that early intervention brings advantages to weak students (Lembke & Foegen, 2009). The Responsiveness-to-Intervention (RTI) model is often used in

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identifying students with learning problems (Powell & Seethaler n.d). RTI model is divided into three levels which are primary (tier one) intervention, secondary (tier two) intervention and tertiary (tier three) intervention.

Screening is conducted at early schooling stage to identify students who might develop difficulty in learning mathematics. Primary intervention refers to the normal teaching and learning process in the classroom. Students who achieved far below their peers will be chosen to attend secondary intervention which is conducted in a small group. The suggested period for conducting secondary research is within one and a half hour, three times a week for a period of eight weeks (Fuchs *et al*., 2005).

Secondary intervention is usually conducted by trained individuals such as teachers. Students' improvement is monitored weekly. Those students who showed improvement in secondary intervention will return to primary intervention. However, their progress will still be monitored to ensure effectiveness of the intervention. Tertiary intervention is given to students who are still weak after completing secondary intervention. Tertiary intervention is conducted individually.

In Malaysia, special remedial classes have been set up to help students overcome difficulties in acquiring basic reading, writing and counting skills (Malaysia Ministry of Education, 2001). Selection of students for the remedial class is based on students' achievement in reading, writing and counting skills, results of diagnostic test, screening test, and class test or upon parents' request. According to Malaysia Ministry of Education (2001), more than 62000 students have joined the special remedial class for mathematics in year 2000. The outcome of the remedial class showed that only approximately half of the students who joined the remedial class were able to acquire basic 3M skills.

Apart from that, the ministry of education has introduced a new policy in mathematics education in year 2003 which is the teaching and learning of mathematics in English (Lan & Tan, 2008). The teaching of mathematics in mother-tongue language has to be repeated with English language. This situation has doubled the process of mathematics learning but not the content of the lesson. Learning of mathematics in mother-tongue language has been difficult for some students. It was even more difficult with the inclusion of English language. Besides that, teachers also mentioned that more time is needed to teach mathematics in English as they have to translate the English terms for students who are weak in English (Lan & Tan, 2008). This policy has raised the issue of teachers' burden and students' mathematics achievement. However, the recently the Ministry of Education announced that the policy will be abolished starting from the year 2012.

National Key Result Areas (NKRA) for education was established to widen access to quality and affordable education. Literacy and Numeracy (LINUS) Program was one of the sub-areas which were handled by NKRA. Literacy and Numeracy (LINUS) program was introduced since it was found that about 13 percent (54 thousand) of primary one students did not master 2M skills i.e reading and writing in year 2008 (NKRA 2010). It was also found that there were students who did not master 3M skills when entering stage II of primary education.

Early screening of Literacy and Numeracy (LINUS) program has been conducted nationwide to identify the actual problems of students whether they had learning problems or students with special needs. The screening showed that more than 50 percent of primary one students have not mastered mathematics skills completely (NKRA 2010). Failure in mastering 3M skills will lead to increased rate of school-dropouts and disciplinary problems. If the problems of mastering 3M skills were ignored continuously, cumulative academic failure will be difficult to be improved when the student enters a higher schooling stage.

Therefore, primary one student should be given early intervention to prevent their problems of mastering basic skills from worsening that will affect their learning in the future. Problems of mathematics learning can be overcome by incorporating RTI model to increase academic development among students with difficulties in learning mathematics (Fuchs, Fuchs, Compton, Bryant, Hamlett & Seethaler, 2007). Thus, this study was conducted to examine the effect of intervention towards the numeracy level of primary one students with an aim to raise teachers' awareness towards importance of early intervention and encourage teachers to take the initiatives to uplift the quality of teaching and learning mathematics.

The objectives of the study are as follows:

- To examine the effect of intervention on numeracy level improvement of tier two students in the intervention model.
- To examine the effect of intervention on mathematics achievement of tier two students in the intervention.

Materials and Methods

This study was quantitative in nature and involved 19 primary one students which consisted of 14 boys and 5 girls. All students were from a selected Chinese primary schools located around the Federal Territory of Kuala Lumpur.

Instrumentation:

Mathematics achievement:

Texas Early Mathematics Inventories – Progress Monitoring (TEMI-PM) was used to identify students who have difficulties in mathematics. The instrument consisted of four sections which are magnitude comparison, number sequence, place value and subtraction/addition combination. The magnitude comparison section has 64 items requiring students to identify the smaller or equal number. The number sequence section has 42 items requiring students to complete a series of three numbers. The place value section has 45 items requiring students to calculate the ones' and tens' place values. The arithmetic combination section has a mix of addition and subtraction problems up to 40 items. Students are required to complete each section within two minutes. Students who score below the 25^{th} percentile are considered as students with difficulties in mathematics.

Numeracy level:

EasyCBM was used as a progress monitoring tool to evaluate the improvement of students in counting. EasyCBM is an online based test which prepares curriculum-based assessment. According to Clark and Shinn (2004), curriculum-based assessment is most suitable to be assessed from middle to end of primary one schooling session. Since the intervention was conducted starting from middle of second semester of the schooling year (August) until end of second semester (October), therefore curriculum-based assessment was suitable to be applied in this study. EasyCBM was constructed by a group of researchers from University of Oregon. The assessment sets chosen to be used in this study were assessment that evaluates knowledge of numbers and operations. Each assessment comprised of 16 items. A total of 10 sets of assessment were used in this study.

Findings:

There were five primary one students who achieved TEMI-PM scores in the range of 87 to 97 marks selected to join the intervention program. The intervention was conducted in a small group for 30 minutes for ten weeks. Student was given EasyCBM assessment set every week to measure their progress. The scope of mathematics in this intervention was limited to numbers 1 to 100. The list of learning objectives consisted of 22 main learning objectives.

Effect of intervention on numeracy level:

Online EasyCBM has been used to measure progress in counting capability. The EasyCBM test was given once a week for the whole intervention session for ten weeks. Table 1 shows the difference of week 1 and week 10 EasyCBM scores for all students who attended the intervention. Progress of all five students was analyzed individually. Diagram 1 to diagram 5 shows EasyCBM scores of all five students for the whole ten weeks.

In terms of magnitude comparison, the students needed more time to figure out the position of the number and decide which is the smallest number. The students also had difficulties in completing the number series because they have difficulty in remembering the number sequence. In terms of place value, the students face difficulty in breaking down a number into ones and tens position. There were also students who showed consistent difficulty in the topic of place value. In terms of addition and subtraction operations, the students' responses were almost satisfactory but still involved fingers for counting. However, it can be observed that the use of fingers was substituted with mental counting at the end of the intervention. The students also overcome the problem of recognizing the symbols of "+" and "-" at the end of the intervention and managed to count correctly. At the end of the study, all students showed improvement in counting capability.

Effect of intervention on mathematics achievement:

The students were given TEMI-PM assessment before and after the intervention. Based on Table 2, it was found that the t-value for comparison of pretest and posttest scores was $t=-14.213$ at the level of significance $p=0.000$ ($p<0.05$). Results of the analysis showed improvement in mathematics achievement after intervention. Table 3 shows TEMI-PM scores of before and after intervention along with marks increased. The range of increment for TEMI-PM was 16 to 23 marks.

Adv. in Nat. Appl. Sci., 6(7): 1086-1092, 2012

Table 1: Difference in week 1 and week 10 EasyCBM test scores.

Student	EasyCBM Week 1	EasyCBM Week 10	Score Difference
1	56	100	+44
2	75	100	+25
3	75	100	+25
4	75	100	+25
5	81	100	+19

Table 2: Results of paired sample t-test analysis.

Construct	Test	N	Min	Std Dev	t-value	Sig.
Mathematics Achievement	Pre	5	91.20	3.701	-14.213	0.000*
	Post	5	111.60	3.362		

Table 3: TEMI-PM scores before and after intervention.

Student	Pretest	Posttest	Score Difference
1	96	112	+16
2	87	110	+23
3	90	113	+23
4	89	107	+18
5	94	116	+22

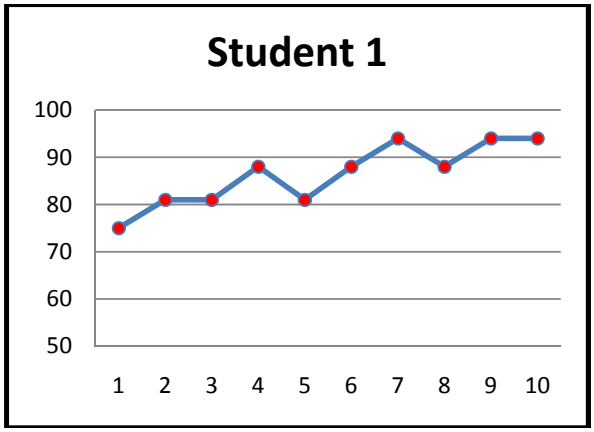

Diagram 1: EasyCBM scores for Student 1.

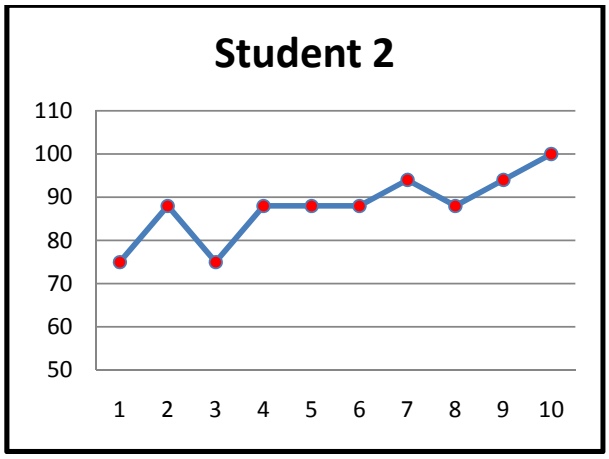

Diagram 2: EasyCBM scores for Student 2.

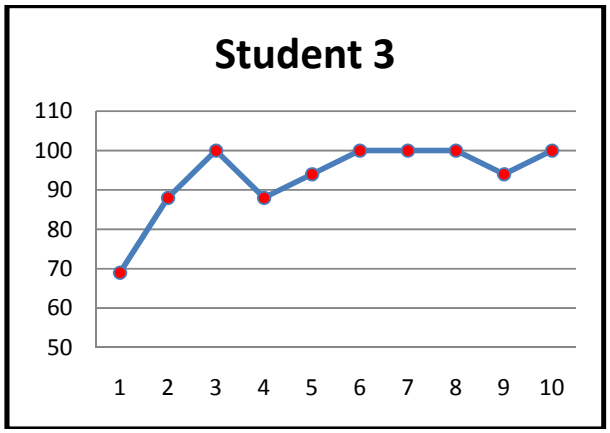

Diagram 3: EasyCBM scores for Student 3.

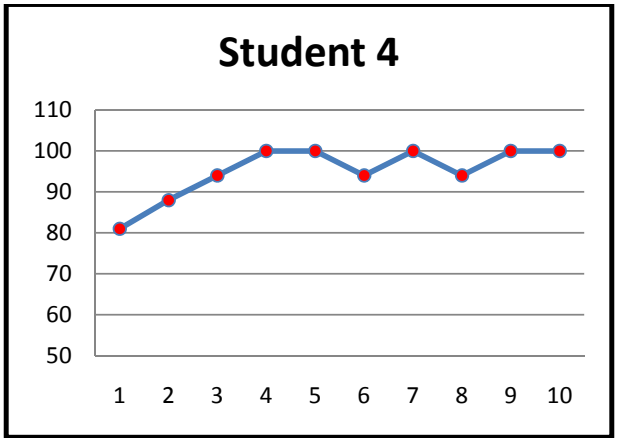

Diagram 4: EasyCBM scores for Student 4.

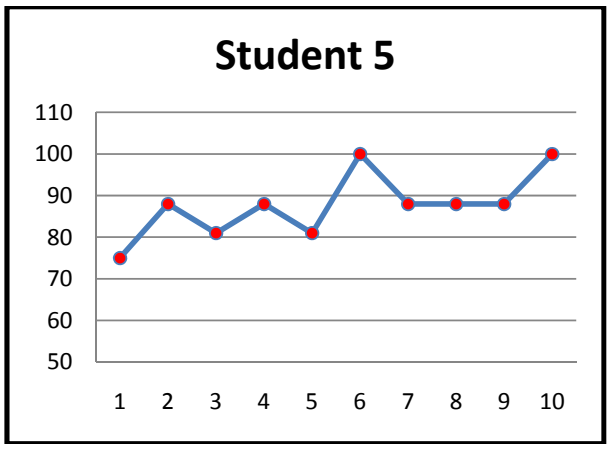

Diagram 5: EasyCBM scores for Student 5.

Discussion:

Pavlov and Skinner's conditioning theories stated that stimulus produces response and is strengthened by reinforcement. This theory was applied in the study in which frequent practice of addition and subtraction operations were given to train the students to remember the answers of the number combinations to be added or

subtracted in order to let the students be more capable in number operations. The effectiveness of this theory can be seen through the shift in number operation strategy from finger counting to mental calculation.

Geary (2004) stated that students with difficulties in mathematics showed at least medium level skills in number processing. Besides, there were students who showed consistent disability in certain arithmetic field and knowledge of counting. The mathematics concepts involved in the study were magnitude comparison, number sequence, place value as well as addition and subtraction operations.

In addition and subtraction operations, students were observed using fingers to count while their peers had already shown abilities in mental calculation. Results from the observation supported Geary's (2004) statement, which stated that students with difficulties in mathematics use problem solving procedures that are usually used by students at lower age level. Therefore, Gersten *et al* (2005) suggested that there are students who need early intervention to develop a more matured and effective counting strategy while other peers do not need it. At the end of the study, the students successfully showed the shift from finger counting strategy to mental calculation which is number combination. This shift also showed that these students who were identified as at-risk students did not have permanent cognitive difficulty or disability.

According to Dowker (2005), generally, most children with difficulties in mathematics showed weakness in remembering and applying arithmetic facts. Dowker (2005) explained that this may not necessarily happen to all children with difficulties in mathematics. In the intervention program, factual strategy was emphasized in number operations to train students' capabilities in addition and subtraction operations. Although this strategy may go against the emphasis on conceptual understanding, most studies supported the application of factual strategy for easy numbers (Meadows 1986; Dowker 2005; Bryant *et al* 2008).

According to Piaget's cognitive development theory, children of age seven are in the shifting stage from pre-operational stage to concrete operational stage. At concrete operational stage, mental images are developed in children's mind. The study on the five students who attended the intervention program revealed variations in the students' mental development. Geary (2004) stated that late development and difficulty are related to central executive function disorder, which causes difficulty in the language system. Most of the students who attended the intervention program showed improvement in number identification, magnitude comparison and number operations. However, there were students who still face difficulties in remembering number sequence while the others showed excellent mastery. This may be due to slower mental development as compared to other peers and thus causes slower information processing.

At the end of the intervention, the students had shown improvement in magnitude comparison, number sequence and number operations except place value. Bryant *et al* (2008) stated that students with difficulties in mathematics need longer instruction time to learn concept of place value. Normal daily instruction in school is insufficient to meet the needs of weaker students. Moreover, the intervention program conducted which provided remedial for 22 learning objectives in 30 minutes for ten weeks were considered short for students with difficulties in mathematics.

Conclusion:

As a conclusion, the use of RTI model has shown its effectiveness in identifying students with learning problems. Early intervention is important to address learning problems at an early stage before it become more serious. Through this study, difficulties faced by students could be identified but various reasons may explain this situation. Therefore, educators should encourage the process of screening learning problems and providing remedial to help students with difficulties in mathematics to improve their numeracy level and mathematics achievement.

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