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The Effects of *MATAS Hopscotch* Technique in the Learning of Fractions Among Year 5 Pupils

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ABSTRACT

This study is to investigate the use of *MATAS Hopscotch* technique to solve the subtraction of three types of fractions among secondary school students. The study involved 56 pupils from two Year 5 classes. A quasi-experimental, nonrandomized control group, pre-test-post-test delayed post-test design was conducted on two intact groups, randomly assigned into control and experimental groups. Paired samples t- test was conducted to evaluate the impact of the teaching method on the pupils' scores on the test among the control and treatment groups. The findings showed there was a statistically significant increase in the pupils' scores from pre-test (M=0.43, SD = .690) to post-test (M= 9.89, SD=2.424), t(27) =-23.467, p< .05 among the control group. This finding indicated the control group showed improvement in the pupils' scores after the implementation of the traditional method. The findings also showed there was a statistically significant increase in the pupils' scores from pre-test (M=0.50, SD = .745) to post-test (M= 16.07, SD=1.676), t(27) =-53.163, p< .05 (two-tailed) among the treatment group. These findings indicated the treatment group showed improvement in the pupils' scores after the implementation of the *MATAS Hopscotch* technique. However, the score gain of the treatment group was almost twice as much as that for the control group.

Keywords: MATAS Hopscotch technique, Mixed Numbers, Subtractions.

1. Introduction

Fractions are among the most difficult for students to learn (Brown and Quinn (2006), Hecht and Vagi (2010), Mazzocco and Devlin (2008)). In Malaysia, these fractions are taught to pupils as early as Year Three (Yee-Ling (2005)). This is because Fraction is an important topic in mathematics curriculum (Centre (2006)). It is also highlighted in a report by the (Panel (2008)). where Fraction is one of the important topics pupils need to successfully learn before they proceed to algebra. However, in Malaysia, pupils have also been identified as having difficulties with fractions and this has perpetuated to secondary schools (Idris and Narayanan (2011), Noordin et al. (2012), Panel (2004, 2007), Tengku Zainal et al. (2009)). Difficulties due to whole number concept are dominant among the primary school pupils and even secondary students (Noordin et al. (2012), Panel (2004, 2007)).

Many strategies are utilized to overcome these misconceptions or difficulties. One of them is the mnemonic strategies which have been successful in learning mathematics. Students who have difficulties with mathematics often benefit from mnemonic learning strategies, which provide a step-by-step process to accomplish a task Dunn (2012). Mnemonic strategies instruction is a technique with positive implications for enhancing academic learning in inclusive classroom (Mastropieri and Scruggs (1998)). These strategies enhance student learning and memory by explicitly connecting new information with prior information by means of visual and acoustic cues. However, only a study reported mnemonic strategies was utilized in learning addition and subtraction of fractions (Test and Ellis (2005)). Respondents for the study were students with disabilities.

Students using keyword mnemonics recalled more concrete than abstract words both immediately after learning and after a one-day time interval (De Graaff et al. (2007)). Research has shown that mnemonics have the potential to assist the learning process and improve formal reasoning (Laing (2010)).

Hence the need to improve the pupils in learning fractions is necessary before the problems perpetuate to secondary schools. Based on the success reports on mnemonic strategies in literatures and the lack of research on techniques in learning fractions, this study employed the mnemonic technique called the "*MATAS Hopscotch*" technique in the learning of fractions among Year 5 pupils.

This research is limited to Year 5 pupils and the results are applicable only to three types of subtraction of fractions involving the same denominator.

2. Research Questions

The research questions for this study are:

1. Are there any significant differences between the pre and post-test scores in solving the subtraction of fractions in the control group?
2. Are there any significant differences between the pre and post-test scores in solving the subtraction of fractions in the treatment group?

3. Research Hypotheses

The research hypotheses for this study are:

H_{01} There are no significant differences between the pre and post-test scores in solving the subtraction of fractions in the control group.

H_{02} There are no significant differences between the pre and post-test scores in solving the subtraction of fractions in the treatment group.

4. Literature Review

A mnemonic strategy is defined "as a word, sentence, or picture device or technique for improving or strengthening memory" (Mastropieri and Scruggs (1998)). The word mnemonic comes from the Greek word *mnemonikos*, meaning 'relating to memory' (Hunt (2010)). Through these procedures, pupils develop better ways to encode new information for easier retrieval (Mastropieri and Scruggs (1998)). Mnemonic strategies are commonly divided into imagery illustrations, such as pictures or diagrams, and word-based devices, using words to aid memory (Carney and Levin (1998)). A research was done by Manalo et al. (2000) found that students performed higher using the mnemonics and maintained higher performance over time. A qualitative research was done by Test and Ellis (2005) to evaluate the effectiveness of a mnemonic strategy called LAP Fractions to add and subtract fractions. The letter "L" referred to look at the sign and denominator. The letter "A" referred as ask yourself the question; "Will the smallest denominator divide into the largest denominator

an even number of times?". The letter "P" referred as pick your fraction type. They identified five out of six students were able to achieve mastery in solving addition and subtraction of unlike fractions. They also found all six students maintained gains over a period of six weeks. However the study was conducted for proper fractions only. Most of the students have difficulties in solving subtraction of fractions (Panel (2004, 2007)). These were also supported by a research done by Tengku Zainal et al. (2009) who also found that students have difficulties in differentiating between whole numbers and fractions.

5. Methodology

This study employed the quasi-experimental non-randomized control group, pre-test- post- test delayed post-test design. Table 1 illustrates the pupils' abilities in the control and experimental groups. The distribution in Table 1 shows there were a total of 28 pupils in each group. In the control group, out of 28 pupils, 13 were from the average ability group while 15 were from the low ability group. In the experimental group, out of 28 pupils, 10 were from the average ability group while 18 were from the low ability group. The duration of this research was four weeks.

Table 1: Pupils' abilities in the control and experimental groups.

Pupils' abilities	Control Group	Experimental Group
Average	13	10
Low	15	18
Total	28	28

The pupils in the sample were grouped into 2 different ability groupings. In the Malaysian schools, there is a grading system which is used to categorize the pupils according to their ability. Hence in this study, the categorization was based on their scores in the mathematics paper during the final year examination in Year Four. The pupils with scores between 60 and 79 were classified as "average ability". Those with scores less than 59 were classified as "low ability". Two similar lesson plans were prepared for the different teaching methods for the experimental and control groups. The instruments for the pre-test and post-test consisted of 18 questions. Paired samples t- test was conducted in this research.

In this study, a mnemonic technique was created to solve the subtractions of fractions. First, the word "MATAS" was created. MATAS was presented using the idea of playing hopscotch. Hopscotch is a children's game that can be

played with several players or alone. Hopscotch is a popular playground game in which players toss a small object into numbered spaces of a pattern of rectangles outlined on the ground and then hop or jump through the spaces to retrieve the object. There are many types of hopscotch. The diagram of hopscotch was adopted and adapted. The numbered spaces were changed. A new hopscotch called *MATAS Hopscotch* was developed. *MATAS* was written in a vertical form in the adapted Hopscotch. Five - step mnemonics, called MATAS were developed for teaching the subtraction of fractions as shown below:

Table 2: The Mnemonic Step -*MATAS*.

M	Minus 1 from the whole number
A	Add $\frac{1}{1}$
T	Take $\frac{1}{1}$ and multiply with $\frac{d}{d}$ (d: denominator)
A	Add and write it in the last row
S	Solve and simplify

MATAS Hopscotch technique was used to solve the subtraction of fractions. The *MATAS Hopscotch* technique is shown below:

Table 3: The version of *MATAS Hopscotch*.

M	
A	
T	
A	
S	

In this study, the technique began with the preparation of six rows. The second, third and the fourth rows were divided into two. MATAS was written on the left as shown above. Subtraction of fractions was written in the first row as shown below.

$3\frac{2}{7} - \frac{5}{7} =$

The left fraction/whole number moved down to the left and the right fraction moved down to the right. The letter “M" showed the pupils the need

to minus 1 from the whole number while the fraction on the right remained unchanged as shown below.

$3\frac{2}{7} - \frac{5}{7} =$	
M : $2\frac{2}{7}$	$-\frac{5}{7}$

Once the pupils completed the first task, they moved to the next step where the letter “A" was written. The pupils needed to add while the fraction on the right remained unchanged.

A : $2\frac{2}{7} + \frac{1}{1}$	$-\frac{5}{7}$

Next they moved to the third step where the letter “T" was written. The pupils needed to take $\frac{1}{1}$ and multiply it with $\frac{d}{d}$ while the fraction on the right remained unchanged.

T : $2\frac{2}{7} + \frac{1}{1} \times \frac{7}{7}$	$-\frac{5}{7}$

Then, the pupils proceeded to the next step where the letter “A" was written. The pupils added and wrote the answer in the last row while the fraction on the right remained unchanged.

A : $2\frac{2}{7} + \frac{7}{7}$	$-\frac{5}{7}$

Finally, they moved to the last row where the letter “S" was written. The pupils solved and simplified the fraction problem.

S : $2\frac{9}{7} - \frac{5}{7}$ $= 2\frac{4}{7}$

Table 4: The *MATAS Hopscotch* technique.

$3\frac{2}{7} - \frac{5}{7} =$			
M	:	$2\frac{2}{7}$	$-\frac{5}{7}$
A	:	$2\frac{2}{7} + \frac{1}{1}$	$-\frac{5}{7}$
T	:	$2\frac{2}{7} + \frac{1}{1} \times \frac{7}{7}$	$-\frac{5}{7}$
A	:	$2\frac{2}{7} + \frac{7}{7}$	$-\frac{5}{7}$
S	:	$2\frac{9}{7} - \frac{5}{7} = 2\frac{4}{7}$	

The purpose of this study was to identify pupils' performances before and after the implementation of the *MATAS Hopscotch* technique in solving the subtraction of the three types of mixed numbers. Type 1 was proper fraction subtracted from mixed numbers where the value of subtrahend was bigger than the minuend such as $3\frac{2}{7} - \frac{5}{7}$. Type 2 was mixed numbers subtracted from mixed numbers where the value of subtrahend was bigger than the minuend such as $9\frac{1}{3} - 2\frac{2}{3}$. Type 3 was whole number subtracted from mixed numbers such as $8 - 2\frac{7}{9}$.

6. Findings

RQ. 1 Are there any significant differences between the pre and post-test scores in solving subtraction of fractions in the control group?

A paired samples t-test was conducted to evaluate the impact of the teaching method on pupils' scores in the test among the control group. The mean and standard deviation of the pre and post-test for the control group and results of the paired sample t-test are provided in Table 5. There was a statistically significant increase in the pupils' scores from pre-test (M=0.43, SD = .690) to post-test (M= 9.89, SD=2.424), t(27) =-23.467, p< .05 (for the control group). The eta squared statistic was .95 indicating a large effect size. This indicated there was a significant difference in the performances between pre and post-test in the control group at a significance level of 0.05. Therefore, H01 was rejected. This finding indicated the control group showed improvement in the scores after the implementation of the traditional method with gain scores of 9.46.

RQ. 2 Are there any significant differences between the pre and post-test scores in solving the subtraction of fractions in the experimental group?

Table 5: Means, Standard Deviation, Paired samples t-test for the Pre and Post-test Scores in the Control Group.

	N	Mean	Std Deviation	t	df	Sig
Pre-test	28	.43	.690			
				-23.467	27	.000
Post-test	28	9.89	2.424			

The researcher conducted a paired samples t-test to evaluate the impact of the teaching method on pupils' scores in the test among the experimental group. There was a statistically significant increase in the pupils' scores from pre-test (M=0.50, SD = .745) to post-test (M= 16.07, SD=1.676), t(27) =-53.163, p< .05 (two-tailed). The eta squared statistic was .98 indicating a large effect size. This indicated there was a significant difference in the mean between pre and post-test in the experimental group at a significance level of 0.05. Therefore, H02 was rejected. This finding indicated the experimental group showed improvement in the scores after the implementation of the *MATAS Hopscotch* technique with gains scores of 15.57. The results of the paired sample t-test are provided in Table 6.

Table 6: Means, Standard Deviation, Paired sample t-test for Pre and Post-test Scores in the Treatment Group.

	N	Mean	Std Deviation	t	df	Sig
Pre-test	28	.50	.745			
				-53.163	27	.000
Post-test	28	16.07	1.676			

7. Discussion and Suggestions

The findings showed the pupils in both the control and experimental groups performed better on post-test scores (M= 9.89 & 16.07) than pre-test scores. However, the score gain of the experimental group was almost twice as much as that for the control group. This indicated the mnemonics technique improved pupils learning in the experimental group enormously. The findings of this research were consistent with many past studies by Manalo et al. (2000) who stated students who used mnemonics strategies for learning performed higher as compared to the pupils in the control groups. Here, it could be deduced, the Mnemonic strategies given to the treatment group did enhance memory especially in connecting new information with prior knowledge by means of

visual and acoustic cues (Mastropieri and Scruggs (1998)). Through these procedures, pupils developed better ways to encode new information for easier retrieval. Mnemonic devices could definitely accelerate the rate at which new information was acquired and improved formal reasoning (Laing (2010)). The use of mnemonics helped in developing better ways to take in information so that it would be much easier to remember (Manalo et al. (2000), Test and Ellis (2005)).

This showed the traditional method and mnemonics technique really had a positive impact on the learning of fractions among the pupils from both groups. However, the means among the treatment group in the post-test was higher than the control group. This indicated the *MATAS Hopscotch* technique taught, improved the pupils' performances even more among the experimental group. Judging from the positive effect of mnemonics technique in solving the subtraction of fractions, mnemonics technique should be implemented early in the Malaysian schools. The mnemonics technique can be adopted in the secondary school students learning. Future research should focus on the low and average ability students among the secondary school.

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