

Is Using Fingers or Conventional Teaching Methods Effective in Learning Multiplication? An Experimental Study on Under-Privileged Students

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Mastering multiplication via conventional teaching method (CTM) is a daunting task for students in elementary educations. Specifically, under-privileged students, despite abundance of teaching aids is available, they are beyond their means. A suggested method with less cost is by using fingers (UFM). The objective of this study is to decipher effectiveness of these two methods namely UFM and CTM in mathematical achievement. The study also deciphers the students' perceptions towards interest in mathematics. An experimental study was employed with non-equivalent pre-test and post-test control group design. Respondents consisted of sixty orphanage centre's children. They were divided into experimental groups (EG), treated with UFM and control group (CG) treated with CTM. Data were analysed by multivariate of MANOVA and paired sample t-test. Results indicated that both groups showed that there is a significant difference between the pre-test and post-test mathematical achievement within group. EG who received UFM has higher magnitude of effect over CG who received CTM. There is also a significant difference in mathematical achievement between groups in the post-test but not in the pre-test. Additionally, EG is more likely to increase in perceptions towards interest in mathematics as opposed to CG. The study provides useful insights to various educational communities in the context of diversifying the teaching and learning multiplication methods. Implementing UFM, along with CTM in educational curriculum would impetus students' interests in learning mathematics and boost their achievement irrespective of socio-economic status. It is hoped that this

would eventually elevate the Malaysian students' performance to be on par with other developed nations.

Key words: *Conventional, fingers, mathematics, multiplication, under-privileged.*

Introduction

Indeed, many students unable to solve simple arithmetic operations even after hitting adolescence. As mathematics gets more difficult, they would likely fall behind further and feel learning mathematic is extremely difficult and complicated. Poor foundation in arithmetic skills specifically in multiplication is the main reason for poor mathematical achievement in elementary school (Kueh, 2010). This is because to solve most mathematical questions, students need the skill of multiplication. Students who are weak in this skill may feel boredom, dullness, lack of interest and thus affect their performance in mathematical achievement. On the other hand, students who have mastered multiplication gain a solid foundation in mathematics that would help them not only in elementary education, but also in middle and higher school or even in tertiary education.

To date, rote or conventional teaching methods have been adopted by many teachers in teaching and learning multiplication (Norasmah & Shuki, 2009). This method focuses on memorization exercises but neglects the operational concepts of how numbers are multiplied (Sousa, 2006). Hence, students tend to lose interest in learning multiplication because too much time, effort and attention are needed to memorise without understand the concepts (Zainudin & Mohd. Rashidi, 2007; Kamaliah, 2006; Roslan, 2004).

To make matters worse, students with low memory capability would face difficulties in memorising specifically when dealing with big numbers. According to Liong and Mohd Yasin (2016), an effective method to assist these students is to engage them in teaching and learning activities. Teachers must therefore continuously review, modify and enrich the range of teaching methods so that the students' interests would be nurtured (Rohana, 2008). Hence, students are more likely to acquire more information when they do themselves because the activities that integrate physical, mental and affection are more effective in understanding.

Affluent students are advantaged and have greater opportunities to excel. This is because their parents are willing to spend huge investments on educational support systems in pursuit to academic excellence (Zakaria, 2017). On the other hand, students who grow up in impoverished environment are deprived of these systems. These support systems are beyond their means, albeit multitude are available in the market. The difference in socio-economic status has led to unequal access to the educational support systems between privileged and under-privileged students. The former would be more likely to perform far ahead, while the

latter would be more likely to further left behind. The underprivileged students often have trouble in solving basic mathematics operations such as addition, subtraction, division and multiplication (Zakaria, 2017). As a result, a gap exists in mathematical achievement between economic status of which the under-privileged students are always at the losing end.

The survey conducted by Programme for International Student Assessment (PISA) in 2015 found that students in developing and third world countries obtained weaker mathematical achievement as opposed to those from developed countries. PISA is an international assessment of students from the Organization of Economic Co-operation and Development (OECD) member countries. Malaysia was ranked at number 44 out of 72 countries with a score of 446. Singapore obtained the highest score of 564 while the average and lowest scores were 490 and 328 respectively. The developed or richer countries are more likely to have more funds to support their educational programs. Students from these countries gain better educational privileges as they are exposed to numerous and advanced educational support systems. On the other hand, students from less developed countries are less likely to access to those systems and therefore creating a gap in students' mathematical achievement between nations.

Deprivation in educational supports has resulted less developed nations, even worst, the underprivileged students who hailed from poor families fail to acquire the multiplication skills and always weak in mathematical achievement (Zainuddin & Mohd. Rashid, 2007; Steel & Funnell, 2001). Nevertheless, mastering multiplication skills is essential, because it *would not only help the students to obtain better grade but also solve more complex mathematics problems such as algebra, geometry and calculus in later phase of education.*

According to Hutkemri (2009) an appropriate method of teaching would foster students' interest in learning multiplication and thus improve their mathematical achievement. Liong and Yasin (2016) opined that finger counting has been proven to be an effective method in teaching and learning multiplication, apart from incurs no cost. This method requires active involvement and participation from the students. The advantage of this method is it can be easily manipulated for "hands on" activities (Liong & Mohd Yasin, 2016). This method integrates and stimulates three learning domains such as cognitive (mental), psychomotor (kinaesthetic/using finger) and affirmative (feeling fun). Consequently, this method is deemed practical and pragmatic to be adopted by all students regardless of their socio-economic status.

Prior studies have shown that using fingers in learning multiplication (UFM) is effective in mastering multiplication (Bahadir, 2017; Liong & Mohd Yasin, 2016; Kueh, 2010; Ting, 2010). However, research in mathematics education encourages students to stimulate their cognitive or mentally capability by memorising (CTM) rather than using fingers in learning

multiplication (Moeller, Martignon, Wessolowski, Engel & Nuerk, 2011). This leads to debatable views concerning to the benefits and detriments of UFM and CTM in mathematical achievement. In relation to this, the study aims to decipher the effectiveness of both methods (1) using finger method (UFM) and (2) conventional teaching method (CTM) in mathematical achievement. Apart from that this study also aims to decipher the increase in the student's perceptions towards interest in mathematics within groups from pre to post UFM and CTM.

The following section reviews prior literatures in relation to variable of interests. Next sections explain on methodology, followed by results and discussions. Finally, academic and management implications apart from limitation of the study are highlighted before ending with a conclusion.

Literature Review and Hypotheses Development

Constructive Methods in Learning Multiplication

Mastering multiplication skill is a key issue in elementary mathematics education (Gardell, 2009). Past studies have shown that the failure to master multiplication skills are the determinant factor of low mathematics achievements (Jennie & Mohd Johan, 2010; Aida, 2006; Sharifah, Habibah, Rahil, Samsilah & Tajularipin, 2006; Stanley & Julaini, 2006). This is due to most of the examination questions requiring the application of multiplication skills. It is a daunting task for students to solve mathematical problems, if they do not master those skills.

Teachers must therefore be pro-active in modifying and enriching the range of learning methods that would entice students in improving the learning outcomes. Learning methods need to be more focused with the active participation of students (Rohana, 2008; Effandi, 2003) by using constructive methods (Charlesworth, 2005). The method that can capture the student's attention towards teaching and learning would be meaningful and able to accelerate knowledge acquisition.

Through active participation in teaching and learning activities, students will have the opportunity to explore, learn, develop, evaluate and learn by constructivism. On the other hand, ineffective teaching methods will limit the amount of input received by students. This impedes their interest, instigates boredom and feelings of lack of confidence in performing multiplication and thus affects their mathematical achievement. Constructive methods of teaching are one of the crucial factors that would entice interest (Hutkemri, 2009; Copley, 2000) and several studies have found that UFM is effective in improving the students' multiplication skills (Bahadir, 2017; Liong & Mohd Yasin, 2016; Kueh, 2010; Ting, 2010).

Prior studies on using fingers (UFM) and conventional teaching (CTM) methods in learning multiplication

Liong and Mohd Yasin (2016), conducted a quasi-experimental study on 70 deaf students in Malaysia. They examined the effectiveness of using finger and conventional methods in multiplication. This prior study also examined their perceptions towards UFM. They divided the students into two groups. The first group was known as an experimental group (EG) while the second was a control group (CG). The EG was taught of UFM, while the CG was taught of CTM. Both groups attended a class conducted by the researchers for 2 hours per week, in a duration of one month, totalling to 8 lesson hours. The students were given a pre-test, a post-test and a set of questionnaires to complete. The pre-test was given before the treatment of UFM and CTM, while the post-test and a set of questionnaires were given after the treatment of UFM.

An analysis on results of post-test means score indicated that there is a significant difference in mathematical achievement between these two groups (EG and CG). However, no significant difference is found in the pre-test means scores between the two groups (CG and EG). Additionally, the analysis revealed that the EG who was treated with UFM obtains higher mathematical achievement as opposed to the CG who was treated with CTM. The results also indicated that there is a positive significant difference between the pre-test and post-test mathematical achievement means scores of those who received UFM (EG), but no significant difference was found in the pre and post mathematical achievement means scores of those who received CTM (CG). The results of descriptive analysis further indicated that the deaf students have prominent level of perceptions towards UFM in the dimensions of interest, self-confidence, persistence and motivation in learning multiplication in the post UFM and CTM.

Ting (2010) conducted an action research to examine effect of finger method in improving students' multiplication skills by using descriptive analysis. Respondents consisted of 15-year Four Malaysian primary school students, who obtained the lowest marks for Mathematics in the previous semester examination (in Malaysian educational system, all children must attend the primary school which constitutes of six levels, year one is the lowest and year six is the highest). The respondents were required to complete a pre-test, a post-test and two sets of questionnaires. Both tests had same questions but with different arrangement in the sequence of question numbers. The pre-test and a set of questionnaires were conducted in the pre UFM (before the students were taught of UFM). While the post-test and the same set of questionnaires was given in the post UFM. Results indicated that 13 students achieved significantly higher marks for mathematical achievement in the post-test as opposed to the pre-test. The results further indicated that students obtain higher score in interest towards learning mathematics in the post as opposed to the pre UFM. Finally, the

study concluded that UFM method is effective in improving the students' multiplication skills.

Kueh (2010) replicated Ting's (2010) study to examine an effective way of improving student's multiplication skills. Approximately about 20 students from year three of one of the Malaysian primary schools participated in the study. He found that UFM constructively expedites respondents mastering multiplication skills. All respondents obtained higher marks in the post-test as opposed to the pre-test, implied that UFM is very effective. Likewise to Ting (2010), the results indicated that respondents are more likely to obtain higher scores on interests towards learning mathematics in the post UFM as opposed to the pre UFM.

Bahadir (2017) analysed mathematical achievement of students who used fingers in multiplication in elementary educational school in Turkey. The analysis is based on opinion and views given by researchers, teachers, parents and students. Results indicated that UFM is an effective method, the students' motivation, interest and participation are at a prominent level during the learning session. The study found that the application is practicable, while the parents and students view that the method is easily applicable, enjoyable and effective.

However, studies of mathematics education found that finger counting is appropriate for young students in the early phase of learning computation. Moeller et al. (2011), revealed that confusion arises between counting using fingers and fostering numerical memorizing. The study recommended shifting from finger counting to perform mental computation in later phase. At this phase, numbers should no longer be represented as sequences of single units (e.g fingers) but as decomposable into larger entities. Persistent uses of fingers alone may lead to severe problems with computational tasks in the later phase. Weaker children have trouble in generating computational strategies from finger counting. In the long run, students who only use finger counting methods tend to obtain fewer correct results than those who also use other computational methods. In fact, reliance on finger-based counting is seen as one of the possible reasons for students' computing errors in later phase.

Lee and Kang (2002), conducted a study on elementary and high school students. They found that UFM is effective for elementary school students but not for those in high school. High school's students are more likely to rely on cognitive thinking rather than kinaesthetic (UFM) through performing activities. This is due to more time required to solve complex or harder mathematical problems and therefore mastering multiplication skills through memorizing is essential.

Many prior studies found that UFM is effective in improving students' mathematical achievement (Bahadir, 2017; Liong & Mohd Yassin, 2016; Kueh, 2010; Ting, 2010). On the

other hand, studies in mathematics have different views, of which it opined that UFM is not suitable for students in the higher phase (Moeller et al., 2011; Lee & Kang, 2002). Stimulating cognitive thinking through memorizing would help to reduce mathematic errors rather than relying on finger counting. The different in views becomes debatable and motivates this study to decipher the effectiveness of both methods namely UFM and CTM on students' mathematical achievement. Additionally, the study would also decipher the increase in the students' perceptions towards interest in mathematics from pre to post UFM and CTM. The difference between this study with prior studies (Liong & Mohd Yassin, 2016; Kueh, 2010; Ting; 2010) relies on the fact that, prior studies examined the student's perception on interest towards mathematics by using descriptive analysis, this study proceeded a step further, whereby, it analysed the difference in the student's perception towards interest in mathematics by empirically testing it using paired sample T-test.

Emulating prior literature, the following hypotheses are formulated.

- H1: There is a significant difference between pre-test and post-test mathematical achievements means scores within a group (EG) who received UFM.
- H2: There is a significant difference between pre-test and post-test mathematical achievements means scores within a group (CG) who received CTM.
- H3: There is no significant difference in the pre-test mathematical achievement means scores between groups (EG & CG).
- H4: There is a significant difference in the post-test mathematical achievements means scores between groups (EG & CG).
- H5: There is a significant difference between pre and post means scores of perceptions towards interest on mathematics within a group (EG) who received UFM.
- H6: There is a significant difference between pre and post means scores of perceptions towards interest on mathematics within a group (CG) who received CTM.

Methodology

This study is an experimental study with non-equivalent pre-test and post-test control group design of which the hypotheses were tested by using inferential statistics. Sixty female students who resided in the girl orphanage centre participated in the study. Almost all participants were at the elementary educational level. They were in Year Four with ages within the 10 to 12 years age group. The participants were divided into experimental (EG) and control group (CG). Each group had 30 students of which they were equally divided based on prior examination performance. These steps were taken to ensure a homogenous composition of participants in both groups with regards to the level of mathematical performance.

Three instruments were used for this study namely pre-test, post-test and a set of questionnaires. A pre-test (O) was conducted for both groups, the EG and CG. The pre-test contains 45 basic multiplication questions, ranging from multiplication table 1 until 9 with five questions for each multiplication table. Marks would be awarded for each correctly answered item. The maximum score is 100 and the minimum score is 0. After completing the pre-test, the EG was taught of using finger method in learning multiplication (UFM) (X_1) while the CG was given a conventional teaching method (CTM) (X_2) treatment. The first researcher taught EG the UFM, while the second researcher taught CG the CTM. UFM is a method by using fingers in learning multiplication (Anghileri, 2008; Copley, 2000), that requires active participation involving psychomotor/kinaesthetic and cognitive abilities (Bobis, Mulligan, & Lowrie, 2004).

CTM is a usual teaching method by using a marker, white board, talking and written notes, while learning is based on memorizing. To ensure that the teaching adopted a purely UFM/CTM, the researchers explained the participants on the meaning of the UFM/CTM method, scopes of multiplication, schedule and duration of teaching session before the teaching were conducted.

The teaching multiplication for EG and CG was conducted with the same scope, schedule and duration. They had a similar lesson plan for each session. To ensure that both researchers have properly conducted UFM or CTM, the sessions were monitored by a checklist. The checklist contains 13 items that describe the situation or behaviour of a teacher when handling the teaching and learning sessions. The researcher was required to indicate either “yes” or “no” to each item based on the situation or what was usually done by the teacher. The checklists are important to ensure that there is no bias against EG or CG. The study focussed on multiplication tables from numbers 1 to 9. The sessions were conducted once in a week during weekend for a period of one month. Every session took about two hours totalling to 8-hour lessons. As the contents only covered multiplication tables of one to nine, the period of teaching for two hours per week is deemed appropriate.

After the treatments of X_1 and X_2 were completed, participants of both EG and CG were required to answer the post-test (O_1). Both post and pre-tests contained the same items but differed in arrangement. The time allocation for each test was 40 minutes. These two tests were carried out to examine whether there is a significant difference in multiplication achievement before and after the treatment was given for EG and CG. During the test sessions, all respondents were in good health and willing to answer. They were provided with comfortable and conducive surroundings without any disruptions. Table 1 depicts the research design.

Table 1: Research Design

	Pre-test	Treatment	Post-test
Experimental group	O	X ₁	O ₁
Control group	O	X ₂	O ₁

Note. O = Pre-test Experimental Group (EG) / Control Group (CG)

X₁ = Treatment (teach students in learning multiplication by UFM)

X₂ = Treatment (teach students in learning multiplication with CTM)

O₁ = Post-test Experimental Group (EG) / Control Group (CG).

The means scores for mathematical achievement of pre-test and post-test UFM/CTM were analysed using paired samples T-test and multivariate analysis of variance (MANOVA). The paired samples T-test is to test whether the means of two variables are different for one sample or population (within group). On the other hand, the MANOVA is used to test whether there is a significant difference in two or more vectors or means (dependent variables) (between group). Hypotheses 1 and 2 would be tested by paired samples T-test while MANOVA test was employed for hypotheses 3 and 4 testing.

Both groups namely EG and CG were also asked to complete a set of questionnaires in relation to their perception towards interest on learning multiplication in the pre and post UFM /CTM. The questionnaires were adopted from Ting (2010) that consists of 8 items using the 5 Likert scale in the continuum from 1 (strongly disagree) to 5 (strongly agree), with the maximum and minimum means score are 5 and 1 respectively. The difference between pre and post means scores on perceptions towards interest on mathematics within group (EG and CG) would be tested by hypotheses 5 and 6 by using paired samples T-test.

Results

Normality Test

A Shapiro-Wilk test was carried out in post-test and pre-test for both EG and CG to assess the normality of data. Results showed that the pre-test and post-test values for mathematical achievement for EG were 0.29 and 0.4 respectively. While the pre-test and post-test for CG were 0.39 and 0.24 respectively, indicating that data are within normal distribution. Additionally, results for perceptions towards interest in mathematics indicated that the pre and post UFM were 0.722 and 0.34 for EG. The pre and post CTM for CG were 0.63 and 0.54, which also showed that they are normally distributed.

Reliability Analysis

A reliability test is conducted to examine whether a measuring instrument consistently represents the items it is measuring (Sekaran & Bougie, 2010). The results of Kuder Richardson (KR 20) of pre-test and post-test reliability Cronbach alpha for EG were 0.88 and 0.75 respectively. The results of CG pre-test and post-test Cronbach alpha were 0.73 and 0.70. The reliability test performed on questionnaire items in relation to interest in learning mathematics indicated that the Cronbach alphas for students' interest in learning mathematics in the pre-test and post-test were 0.81 and 0.85. All values were greater than 0.7 as recommended by Sekaran and Bougie (2010). These values indicate that the data is reliable for further analysis (Nunally, 1978).

Hypotheses Testing

The effectiveness of UFM and CTM in learning multiplication

The first hypothesis states that there is a significant difference between pre-test and post-test mathematical achievement means scores within a group (EG) who received UFM. The EG's means scores for pre-test and post-test were 32.10 and 68.23 respectively, while the standard deviations for pre-test and post-test were 3.03 and 6.08 respectively. The results supported hypothesis 1 of which it indicated that there is a significant difference in the mathematical achievement means scores of the EG between the pre-test and post-test ($t = 28.89, p < 0.05$). Table 2 depicts the results of the paired samples T-test for experimental group who received UFM.

Table 2: Paired samples T-test for an experimental group who received UFM

Test	Nu. of respondents	Means	Standard deviation	t value	Significant
Pre-test	30	31.10	3.03	28.89	0.000***
Post-test	30	68.23	6.08		

* $p < 0.05$, t value is greater than 1.96 ** $p < 0.01$, t value is greater than 2.33 *** $p < 0.00$, t value is greater than 2.58

The second hypothesis states that there is a significant difference between pre-test and post-test mathematical achievements mean scores within a group (CG) who received CTM. Results indicated that the mathematical achievement means scores for pre-test and post-test were 32.17 and 40.27, while the standard deviation was 3.07 and 3.03 for pre-test and post-test respectively. The results supported the hypothesis two and indicated that there is a significant difference in the mathematical achievement mean scores obtained by the CG between the pre-test and post-test ($t = 13.34, p < 0.05$). Table 3 depicts the paired samples T-test for a control group who received CTM.

Table 3: Paired samples T-test for a control group who received CTM

Test	Nu. of respondents	Means	Standard deviation	t value	Significant
Pre-test	30	32.17	3.07	13.34	0.000***
Post-test	30	40.27	3.03		

* $p < 0.05$, t value is greater than 1.96 ** $p < 0.01$, t value is greater than 2.33 *** $p < 0.00$, t value is greater than 2.58.

The third hypothesis proposes that there is no significant difference in the pre-test mathematical achievement means scores between experimental and control groups before treated with UFM and CTM. Results indicated that the mathematical achievement means scores for EG and CG was 32.10 and 32.17 respectively. The results further indicated that the t -value was 0.07, ($p > 0.05$), indicating that there is no significant difference in the mathematical achievement means score between the groups and thus hypothesis 3 is supported. This showed that both groups consist of students with equal mathematical achievement performance before the treatment was given, which is a pre-requisite for experimental study criteria. Table 4 depicts the MANOVA results for a pre-test mathematical achievement for EG and CG before treated with UFM and CTM.

Table 4: MANOVA results for a pre-test mathematical achievement for experimental and control groups before treated with UFM and CTM

Group	Nu. of respondents	Means	Standard deviation	t value	Significant
EG	30	32.10	0.54	0.07	0.933
CG	30	32.17	0.50		

$p < 0.05$, t value is greater than 1.96 ** $p < 0.01$, t value is greater than 2.33 *** $p < 0.00$, t value is greater than 2.58.

The fourth hypothesis postulates that there is a significant difference in the post-test mathematical achievement means score between EG and CG after treated with UFM and CTM. The results showed that the means score for EG and CG was 40.27 and 68.23. The results supported hypothesis 4 that there is a significant difference in the mathematical achievement means score between the two groups ($t = 508.85$, $p < 0.05$). Table 5 depicts the MANOVA test results for EG and CG after treated with UFM and CTM.

Table 5: MANOVA results for a post-test for mathematical achievement for experimental and control groups after treated with UFM and CTM

Group	Nu. of respondents	Means	Standard deviation	t-value	Significant
EG	30	40.27	0.89	508.85	0.000***
CG	30	68.23	0.57		

$p < 0.05$, t value is greater than 1.96 ** $p < 0.01$, t value is greater than 2.33 *** $p < 0.00$, t

value is greater than 2.58

The Students' Perceptions towards interest in learning mathematics

The total means scores for students' perceptions towards interest in learning mathematics in the pre and post UFM were 25.02 and 34.11 respectively. The highest means score for pre UFM was 'mathematics is fun' (3.63) and for post UFM was 'I can understand finger' (4.57). The total means scores for CG's perceptions towards interest in learning mathematics in the pre and post CTM were 25.01 and 28.58 respectively. The highest means score for pre CTM was 'I like mathematics' (3.73), while for post was 'I like multiplication (3.87). Table 6 depicts the pre and post means score for students' perception towards interest in learning mathematics.

Table 6: Pre and Post UFM and CTM means scores for students' perceptions towards interest in learning mathematics

	Question item	UFM (EG)		CTM (CG)	
		Means Pre (s.d)	Means Post (s.d)	Means Pre (s.d)	Means Post (s.d)
1	I like mathematics	3.57 (1.22)	4.08 (1.06)	3.53 (1.20)	3.83 (1.10)
2	Mathematics is fun	3.63 (0.79)	4.20 (0.71)	3.54 (0.75)	3.75 (0.78)
3	I like multiplication	3.50 (1.02)	4.20 (0.85)	3.53 (0.82)	3.87 (0.87)
4	Multiplication is easy	3.03 (1.38)	4.08 (1.13)	3.27 (1.28)	3.37 (1.12)
5	I can answer multiplication	3.30 (1.26)	4.23 (1.33)	3.10 (1.36)	3.43 (1.21)
6	I can understand finger	3.27 (1.52)	4.57 (0.63)	3.30 (0.82)	3.37 (0.78)
7	I can do multiplication	2.46 (1.52)	4.20 (1.07)	2.55 (1.07)	3.33 (1.09)
8	I can use finger multiplication	2.26 (0.99)	4.55 (0.79)	2.47 (0.79)	3.63 (0.89)
	Total means scores	25.02	34.11	25.29	28.58
	Means scores per question item	3.13	4.26	3.16	3.57

The fifth hypothesis postulates that there is a significant difference between the pre and post UFM of experimental group's means scores on perceptions towards interest on mathematics. Results of paired samples T-test showed that there is a significant difference between the pre and post UFM means scores on EG's perceptions towards interest in Mathematics. The results as shown in Table 7.

Table 7: Paired samples T-test for EG's perceptions towards interest in Mathematics between the pre and post UFM

	Number of respondents	Means	Standard deviation (s.d)	t-value	Significant
Pre	30	25.02	0.89	6.20	0.00
Post	30	34.11			

$p < 0.05$, t value is greater than 1.96 ** $p < 0.01$, t value is greater than 2.33 *** $p < 0.00$, t value is greater than 2.58.

The sixth hypothesis proposes that there is a significant difference between the pre and post CTM of control group's means scores on perceptions towards interest on mathematics. Results of paired samples T-test showed that there is no significant difference between the pre and post CTM of EG's means scores on perceptions towards interest in Mathematics. The results are indicated in Table 8.

Table 8: Paired samples T-test for CG's perceptions towards interest in Mathematics between the pre and post CTM

Test	Number of respondents	Means	Standard deviation	t-value	Significant
Pre-test	30	25.29	0.688	0.282	0.78
Post-test	30	28.58			

$p < 0.05$, t value is greater than 1.96 ** $p < 0.01$, t value is greater than 2.33 *** $p < 0.00$, t value is greater than 2.58.

Discussion

The first research objective is to examine whether there is a significant difference between pre-test and post-test of the mathematical achievement means scores within group (students who receive UFM or an experimental group). Results indicated that there is a significant difference in the pre-test and post-test means scores of the multiplication achievement within experimental group ($t = 28.89$, $p < 0.05$, $n=30$). This is in tandem with prior studies (Bahadir, 2017; Liong & Mohd Yasin, 2016; Kueh, 2010; Ting, 2010) that conclude UFM has a significant positive effect on students' mathematical achievement.

The second research objective is to examine whether there is a significant difference between pre-test and post-test of the mathematical achievement means score within group (students who receive CTM or a control group). Results indicated that there is significant difference between the pre-test and post-test means score for CG's mathematical achievement ($t = 13.34$, $p < 0.05$, $n = 30$). However, the magnitude of effect of CTM on CG is lesser than the UFM had on EG. The results are inconsistent with the work of Liong

and Mohd Yasin (2016), which impliedly indicated that CTM does not have any significant effect on students' mathematical achievement.

The third research objective is to examine whether there is no significant difference in the pre-test means scores of the mathematical achievement between EG and CG. Results supported for which it indicated that there is no significant difference in the means scores of the mathematical achievement between those 2 groups ($t = 0.007, p < 0.05$). The results indicated that both groups (before the treatment of UFM and CTM) had equal composition of students in relation to mathematical achievement performance. This fulfils the experimental study criteria of the homogeneity of the group in relation to the level of mathematical performance before embarking the study.

The fourth research objective is to examine whether there is a significant difference in the post-test means scores for mathematical achievement between EG and CG. Results showed the post-test means score for EG and CG were 40.29 and 68.23 respectively. The results supported hypothesis 4 of which it indicated that there is a significant difference in the post-test mathematical achievement means score between these 2 groups ($t = 508.85, p < 0.05$). The results are aligned to the studies carried out by Bahadir (2017); Liong & Mohd Yasin, (2016); Ting, (2010), Kueh, (2010) indicating that the mathematical achievement for students who received UFM is significantly difference from those who received CTM.

The fifth research objective is to examine EG's perceptions towards interest in learning mathematics in the pre and post UFM. Results showed that the EG's interest towards learning mathematics from pre to post UFM has a huge increased, that is from 25.02 to 34.11, equivalent to an accumulation of 9.9 or 36.33%. The results also is supported hypothesis 5, indicating that there is a significant difference in the pre and post UFM of EG's means scores for interest towards mathematics ($t=6.20, p < 0.05$). In other words, interests towards learning mathematics, multiplication proficiency and skills are enhanced and inculcated after a period of extra time spent on learning a new method and performing activities (Moores, 2001).

Mohd. Hanafi (2005) found that the main stumbling block in improving the mathematical achievement among under-privileged students is lack of interest due to low self-confidence. It is noted that UFM succeed to motivate and enhance students' interest towards learning mathematics that would boost their self-confidence in performing multiplication. Ting (2010) found that UFM has enticed students in finding multiplication solutions and eventually transforms them to positive attitude towards mathematics. Interestingly, other good values such as teamwork, leadership and tolerance are nurtured as the students indirectly learn how to cooperate and work together with their peers in performing UFM.

Indeed, UFM does not require a lot of tools and exorbitant cost (Iskandar & Abdullah, 2010). In this context, financial is not an obstacle, students just only use their mind, fingers and participate in the activities. As interests exacerbates, it stimulates a feeling of fun and with strong commitment, the steps of UFM are easy to follow. All this would accelerate the smoothness of multiplication learning. Implementing UFM as one of the mathematics curriculums would require teachers and students to spent time on the activities. Hence, this would nurture students' interests towards learning mathematics and thus help them in obtaining high mathematical achievement.

The sixth research objective is to examine CG's perceptions towards interest in learning mathematics in pre and post CTM. Results revealed that the CG's means scores on interest towards learning mathematics for pre and post CTM were 25.29 and 28.58 respectively, a slight increment of 3.29 or 13.01%. The results further indicated that there is no significant difference between the pre and post CTM on CG's means scores of perceptions towards interest in learning mathematics ($t=0.28, p > 0.05$). This is because for CTM, the students were taught of similar methods. No new knowledge and activities are imparted, albeit extra time spent on teaching and coaching them to perform multiplication. Despite there was a minimal increased in the CG's means scores (from pre to post CTM), the increment is not significant or trivial.

Implication to Academics

This study contributes to the body knowledge of mathematics literature on the importance of both methods namely UFM and CTM in learning multiplication specifically to underprivileged students who have lack of educational and financial supports. Specifically, UFM, it shows that its ability in capturing students interests towards learning mathematics. Apart from less cost, students' participation in the learning activities and learned by experiencing makes the UFM more effective. The UFM method enhances the students confident and understanding in performing multiplication operation. They tend to enjoy and have fun when using this method, and thus are intrigued to acquire for more knowledge. This is aligned to the goal of Malaysian education blueprint (2013-2025) that students must acquire basic mathematical operation at elementary education level.

Implication to Management

This study provides implications to many parties namely students, teachers, parents, school management, ministry of education, researchers and the liked on the importance of diversifying the methods of teaching and learning multiplication. Students should be ready and familiarize themselves with many methods of multiplication, specifically UFM. As UFM method is found effective in learning and teaching multiplication, this method is

highly suggested to be implemented and embedded in school education curriculum, along with CTM.

Teachers should be furnished with further information and training about the purpose and the application of UFM. UFM is based on student centred that emphasises on understanding rather than memorizing, whereby the students perform and participate in learning activities. CTM on the other hand is based on teacher centred; teaching is confined to verbal and written, while learning is heavily relied on memorizing. Adopting an appropriate teaching method is important in contributing quality outcomes because this would stimulate interest and eventually motivate students to learn (Lee & Sharifah, 2005). The UFM method fulfils the learning criteria as it enhances students' cognitive (stimulate mental thinking), psychomotor (kinaesthetic through finger movement) and affirmative (fun and enjoyable) skills to the fullest. The CTM also should not be neglected, as both methods have a significant effect on mathematical achievement.

The parents should also involve in improving their children multiplication skills and therefore is suggested to learn and participate in UFM activities. Despite strengthening family bonding, the learning would be fun and enjoyable. The school management on the other hand, should provide conducive support systems for teachers and students in realising UFM. Finally, the Ministry of Education, apart from CTM, should implement and embed UFM in school education curriculum as one of the multiplication methods. Hence, UFM, apart from effective and inculcating students' interests, it saves huge public monies.

Limitation of the studies

A few limitations are acknowledged after the study was carried out. The first limitation encountered was several students could not attend all the UFM/CTM sessions due to commitment with co-curricular school activities. As a result, they missed a few lessons and may not be at the same pace with other participants in terms of multiplication skills. However, the number is minimal, and it does not affect the whole results of the study.

This study is conducted in quantitative mode, whereby the participants are required to answer and response to structured questions. They cannot freely express their views and highlight the problems encountered in learning multiplications. This limits the in-depth understanding of the problems that should be unleashed. As such, future studies are suggested to be conducted in a qualitative method to explore the multiplication problems from the students, parents, teachers and ministry of education point of views so that the problems can be resolved in a holistic manner.



Conclusion

This study found that both UFM which is based on finger counting, active involvement of students, mental reactions and physical reflection and CTM, that emphasizes on teaching on instruction and writing, while learning is on memorizing have a significant effect on students' mathematical achievement. Indeed, both methods are important and complementing each other. However, the magnitude of effect of UFM on mathematical achievement is greater than CTM. Results further indicated that the interests of experimental group towards learning mathematics has tremendously increased and is significantly different from pre and post. On contrast, there is no significant difference between the pre and post CTM, albeit a slight increase in the means scores. As UFM is more likely able to stimulate students' interest, therefore, the method is recommended for students in the early phase of learning education. This would entice them towards mathematics and incite the feeling of mathematics is fun and enjoyable before shifting to mental computation or memorize as they move to harder equations. It is common for students to initially use fingers in performing basic multiplication skills such as addition, subtraction, multiplication and division. Once the students develop interest towards mathematics and gain multiplication competency, they would become prowess and relying on mental ability rather than finger counting. Diversifying and mastering many multiplication methods would not only make the learning fun and enjoyable but also effective and workable. The study provides implications to students, teachers, parents, school management and ministry of education to play concerted efforts either individually or collectively to support, adopt and practice UFM apart from CTM in learning and teaching multiplication. Finally, it is hoped that apart from improving the students' mathematical achievement irrespective of socio-economic status, the adoption of UFM would elevate the mathematical achievement of Malaysian's student to be on par with other developed nations.

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