

Use and effectiveness of multiplication alternative method in Mathematics learning: A systematic review

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Abstract: Higher mathematical ability hierarchically depends on lower mathematical ability. Students' failure to master and understand a concept makes it difficult for them to understand more complex teaching. The use of alternative method in teaching multiplication operation is less commonly used in teaching and facilitating processes in school. Teachers are still using traditional methods despite the many discoveries of alternative methods introduced as a result of teacher innovation from abroad. This article discusses the use of alternative methods of multiplication in Mathematics learning based on 20 articles found using two databases, Google Scholar and Eric. The chosen publishing year is from 2014 to 2019. A systematic review was conducted to determine the extent to which the use and effectiveness of alternative methods in learning multiplication at home and abroad. The findings show that there are strengths related to learning Mathematics using multiplication alternative method. Thus, this systematic review can give teacher another alternative in Mathematic learning process.

Keywords: Alternative method in multiplication, learning Mathematics, literature review.

1. INTRODUCTION

In current educational era, there is a need for all educators to invest their energy to conduct research in education. From a research, there will be new methods that will benefit educational institutions in Malaysia. Unfortunately Mathematics education lacks of research accumulation and consequently affects the pedagogical practice and government education policy (Lesh & Sriraman, 2010). The lack of accumulated research in the field of Mathematics education will cause teachers to be short on ideas for innovation in teaching and learning.

The existence of alternative methods for learning multiplication in the Mathematics syllabus can help teachers to diversify the method of their teaching and learning. The current educational situation is that teachers do not dare to apply new discovered methods from any research and innovation from other individuals. This systematic review is conducted to prove that there are many alternative methods that can improve students' achievement, especially in multiplication skills.

In fact, according to Burns, Ysseldyke, Nelson and Kanive (2015), learning Mathematics especially for multiplication as the topic of needs much more effort from the students. Besides the help needed from teachers in the classroom, teachers also need help from parents at home as one of reinforcement efforts. The analysis conducted on these articles is to carry out a systematic review on alternative multiplication methods in Mathematics learning. From this systematic review, there are two things to be identified, namely the extent to the use of alternative methods of multiplication during the time period from 2014 to 2019 as well as the effectiveness of alternative methods that have been applied onto students.

Supposedly, students of at least two years of schooling should be able to arrange and visualize in solving simple multiplication problems (Sullivan, Clarke, Cheesemen and Mulligan (2001)). Students no longer need to count

individually to answer simple questions. For example, how important is the mental method as one of the alternative methods that can certainly change classroom’s pedagogical practice.

Therefore, this systematic review was conducted to determine whether alternative methods that were found can have an impact on the students or vice versa. From the analysis of previous studies, a detailed assessment could be conducted. The term of teaching method according to Rahil Mahyuddin et. al (1997) is a set of actions or steps taken by teachers to conduct the teaching and learning process. While the alternative method is a teaching method adapted from other researchers or self-modified by the teachers based on the problems they have encountered during the learning process.

2. METHODOLOGY

2.1 Criteria of Study

There are several criteria that have been specialized before the data search process was conducted. Among the criteria is selected articles must be either in English or Malay, and conducted in and outside the country. Studies in the form of imperial are quantitative or qualitative studies. Literature study selected is only from articles. The publication years for selected articles are from 2014 to 2019. The selection of these criteria helps to make the data search process to have more detailed scope.

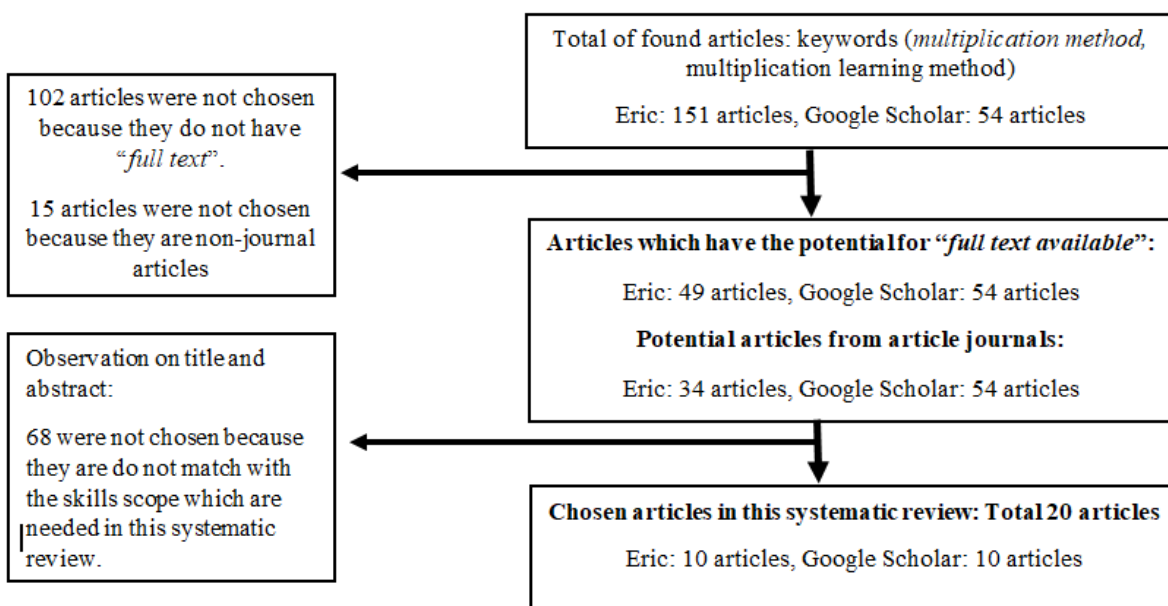
2.2 Search Strategies

This systematic review was conducted using two databases, Google Scholar and ERIC. The keyword used for the ERIC database is the "Multiplication Method" while for Google Scholar is the "Multiplication Learning Method".

3. FINDINGS

There are 151 articles found in Eric's database and the total number of articles found in the Google Scholar database is 54 articles. Both articles obtained a total of 205 articles. A total of 102 articles were removed from Eric's data base due to lack of full text. The next 15 articles were excluded from the total number of articles obtained from Eric as they are not journal studies. After evaluating the remaining 88 articles, 20 relevant articles were selected, 11 articles by Eric and 10 articles by Google Scholar.

Diagram 1: Diagram on choosing articles



3.1 Participants

Based on the 20 research articles studied and analyzed, the study sample is among those who are specifically engaged in education. The study sample consists of primary and pre-school students. This is because the topic of the specialty is

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multiplication that is to master the multiplication basic facts as well as solving the question of multiplication in a minimal number. Multiplication operation is a basic operation that is often difficult for preschool and primary students to master. Table 1 below is a sample summary of all the articles analyzed.

Table 1 : Research sample

Sample	Number	Author (Year)
Pre-school students	1	Siti Rahimah & Farah (2017)
Primary school students	19	Mohd Ismail bin wahid (2017), Alfredo Saputra & Al Jupri (2018), Ahmat et al. (2017), Thai, & Mohd Yasin (2016), Mohamad Nurizwan (2014), Muhamad Shahlyme & Suziyani Mohamed (2017), Ang Mei Chin et. Al (2014), Fazura Mohd Noor, Sharifah Norul Akmar Syed Zamri & Leong Kwan Eu (2015), Nur Aniza Elias & Roslinda Rosli (2016), Jacob & Mulligan (2014), Kaufmann (2018), Allen-Lyall (2018), Hurst, & Hurrell (2017), K. Watson (2016), Ng et al. (2016), Shanty & Wijaya (2017), Franklin et. al (2017), Hurst (2018), Elif Bahadır (2017)

3.2 Locations

All the selected articles were studies conducted in Malaysia and outside Malaysia.

Table 2: Locations of the selected studies

State/Country	Number	Author (year)
Malaysia	Sabah	1 Mohd Ismail bin wahid (2017)
	Kelantan	1 Siti Rahimah & Farah (2017)
	Perak	1 Ahmat et al. (2017)
	Selangor	2 Thai, & Mohd Yasin (2016) Ang Mei Chin et. al (2014)
	Kuala Lumpur	1 Fazura Mohd Noor, Sharifah Norul Akmar Syed Zamri & Leong Kwan Eu (2015)
	Negeri Sembilan	1 Muhamad Shahlyme & Suziyani Mohamed (2017)
	Johor	1 Mohamad Nurizwan (2014)
	Melaka	1 Nur Aniza Elias & Roslinda Rosli (2016)
Overseas	Australia	4 Hurst (2018) Jacob & Mulligan (2014) Hurst, & Hurrell (2017) K. Watson (2016)
	United States	2 Allen-Lyall (2018) Franklin et. al (2017)
	Norway	1 Kaufmann (2018)
	Indonesia	2 Alfredo Saputra & Al Jupri (2018) Shanty & Wijaya (2017)
	Singapura	1 Ng et al. (2016)
	Turki	1 Elif Bahadır (2017)

Based on Table 2, the selected studies are not limited to either overseas or domestic studies only. Selected study locations are local and overseas. This selection was made to look at the differences in the use of methods between Malaysian and foreign countries. The number of articles demonstrating the use of any alternative method for foreign countries is relatively limited compared to our country.

3.3 Alternative Method Assessment Results

Various findings are obtained on alternative methods used in learning from the 20 articles studied and analyzed. Among the alternative methods highlighted in these studies are mental, fingerprint, dot (array or point), cross and other methods. Research review was conducted on all alternative methods to determine whether these methods can enhance students' mastery of learning multiplication operation and thus improve students' achievement.

3.3.1 Multiplicative Thinking Methods

There are four studies (Allen-Lyall, 2018; Ang Mei Chin et al., 2014; K. Watson, 2016; Hurst, & Hurrell, 2017) that study alternative mental models of learning operations. All four studies had a positive effect on students after their use on students. All four of these studies were conducted for primary school students. According to K. Watson (2016), students need mental method during the transition from the use of concrete material to abstract.

From this mental method, students will master the Mathematics skills more clearly (Ang Mei Chin et al., 2014). Furthermore, this mental method can also enhance students' interest in the teaching and learning process. This mental method can be applied to students who are often careless and weak in making calculation to answer any question. From this method, students will be better able to answer questions quickly and will be able to strengthen the multiplication basic facts of the students. Students' skill of mental calculation is also increasing.

3.3.2 Magic Finger Methods

Elif Bahadir (2017) who conducted this study on 11 students in Turkey studied fingerprint method in multiplication operation learning. The findings of this study show that this study helps students to correctly count. From this study, this finger method helps students to visualize and facilitate students to store information visually for longer period of time.

Besides, this study was also conducted by Ahmat et al (2017), the study shows that there is an increase in students' achievement after teaching using the fingerprint method. This method is easily accepted and implemented by the primary school students as it is not complex and able to attract students' attention. A study on this method was also highlighted by Thai, & Mohd Yasin (2016).

The study conducted by Thai and Mohd Yasin (2016) was conducted on 70 deaf students. The findings show that this method did not only enhance students' mastery of learning but also engage students in the learning process. Students who experienced problems which were made as a sample of the study responded to mental and physical reactions throughout this method. The findings of this study not only benefit the students but also influence their parents to be aware and take the initiative together to make this method easy to be implemented.

3.3.3 Dot, Array and Point Methods

The point or array or point method has the same method usage even with different dot position or array or arranged point. This method puts priority on students to count carefully. There are three studies that highlighted this method which are (Nur Aniza Elias & Roslinda Rosli, 2016; Jacob & Mulligan, 2014 and Shanty & Wijaya, 2017).

Overall, this method helps students to visualize simple questions that are given to facilitate their answers. Students will then be able to apply this method to more complex questions. Students will calculate the points drawn to determine the multiplication result. It is an interesting method that guides students to count accurately.

In fact, the findings of these three studies also show that this method can have a positive impact on students' achievement and improvement in multiplication learning in Mathematics subject.

3.3.4 Cross Methods

Cross-method was highlighted by (Mohd Ismail bin wahid, 2017 and Alfredo Saputra & Al Jupri, 2018). Mohd Ismail bin Wahid (2017) conducted a study on 3 year 4 students in Beluran, Sabah. The study which aimed to see the effectiveness of this method on students' achievement can be proven when the results of the study show that the use of cross-method can enhance respondents' skills in multiplication.

Meanwhile, Alfredo Saputra & Al Jupri (2018) conducted a study on 83 primary school students in Bandung. This method has proven to strengthen the basic concepts of multiplication for students when the findings show a positive impact. The

cross method was introduced by a Japanese national, which is still used until today. The concept of a game-like method will be more appropriate for students. Students will compete to solve the questions given the teacher. Students' engagement in learning process becomes active.

In conclusion, there are other methods which are also mentioned in these 20 studies, namely Huntto Square (cognitive method), Magic Maths Kit, Missing-Value, "Addictive Reasoning", Model Method, Regrouping Method and Abstract Sequence Method. The findings of this study show that all of these methods have a positive impact on the achievement of multiplication learning in Mathematics.

4. DISCUSSION AND CONCLUSION

The main focus of this systematic approach is to identify the usage extent and effectiveness of alternative method of multiplication in Mathematics learning. Based on the 20 research articles analyzed, two research questions can be raised in this systematic review which are: (1) Is there a usage of multiplication alternative method used in Mathematics learning? and (2) To what extent does this alternative method of multiplication affect students' achievement?

Based on the first question of whether there is any usage of alternative multiplication methods in Mathematics learning. The analysis shows that the use of alternative method is more widely practiced in Malaysia than abroad. Articles on alternative method of multiplication abroad are minimal. For the period of the articles from 2014 to 2019, many published articles in Malaysia were more concerned on these methods. Articles that were published abroad have a preference on using mental method.

However, the methods outlined in the published articles in Malaysia are mostly innovation projects done by overseas researchers. For example, cross method is an innovation method invented by researchers from Japan. If the article period was extended to the previous year, there were more articles on these alternative methods found both locally and abroad. Of course, as the years change, the previous methods that were found will be replaced by new ones. For example, there was no article found in the 2014-2019 time-limit study on the effectiveness of lattice method, sullam or ladder method and so on.

This clearly shows that education in Malaysia is racing rigorously to search for and study new alternatives. Even though studies have been published in a minimum quantity, the efforts of the researchers to study all of these alternative methods deserve a compliment. The researcher's effort to study in detail able to provide an overview of the implementation of the method to other educators is capable to transform and improve the teacher's practices in teaching and pedagogical.

Next is the second question which is to what extent does this alternative method of multiplication affect students' achievement. All of these 20 articles gave positive results to students' achievement. The methods that are highlighted in this study have shown that the use of these methods can help to improve students' achievement.

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