Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 12, Issue 8, July 2021: 1036-1044

Effects of Paperlator on Multiplication Fact Performance and Pupils' Emergent Behaviour among Special Remedial Program Pupils

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Abstract

The Ministry of Education Malaysia commenced home-based teaching and learning during the Covid-19 pandemic. Online learning and lack of teaching aids at home affected pupils' multiplication fact performance and their emergent behaviour in online classes. Thus, this study aims to examine the effects of Paperlator on multiplication fact performance and pupils' emergent behaviour among two schools of Year Two and Year Three special remedial program (SRP) pupils in the state of Malacca, Malaysia. This study employed the convergent parallel design mixed method. 32 SRP pupils aged between 8 to 9 years old were involved in this study. The experimental group of SRP pupils was exposed to Paperlator intervention, whilst the control group of SRP pupils was exposed to the traditional memorisation method. Quantitative data were analysed by using descriptive and inferential statistics of independent sample T-Test and paired sample T-Test. The findings of the study showed a significant difference between the two groups. Paired sample T-Test also showed that there is a significant difference in the experimental group exposed to Paperlator. The statistical data showed that there is a positive effect of Paperlator on SRP pupils' multiplication fact performance. Qualitative data were collected through observation of SRP pupils' emergent behaviours when solving multiplication fact problems. The observation data supported quantitative data that most SRP pupils in experimental group were active and showed interest in learning multiplication fact. This study concluded that the use of Paperlator can improve the SRP pupils' multiplication fact performance and positive emergent behaviours.

Keywords: Emergent behaviour, multiplication fact, Paperlator, special remedial program.

1. Introduction

UNESCO (2021) reported that near to half the world's students are still affected by school closures after one year into the Covid-19 pandemic. This has affected school education to change from physical classes into online classes immediately. Most of the countries in the world are facing challenges to adapt to new teaching and learning method **(Shahzad et al., 2020)**. To ensure the continuation of education for the Malaysian, the **Ministry of Education Malaysia (2021)** has commenced home-based teaching and learning throughout Malaysia.

Based on the Special Remedial Program (SRP) Mathematics Teaching and Learning Guidebook **(Special Education Division, 2019)**, the SRP has been implemented by the Ministry of Education Malaysia since 1960s. SRP is a program that helps weak pupils to master basic skills such as reading, writing and counting. In terms of Mathematics, pupils who have not mastered counting skills will be sent to remedial classes to be given interventions according to the pupil's abilities.

Malaysia's primary school Mathematics education aims to build and develop pupils' understanding of the concept of numbers and the basics of counting **(Ministry of Education Malaysia, 2016)**. It is supported by **The**

National Council of Teachers of Mathematics (2014) that four basic Mathematics operations such as addition, subtraction, multiplication and division are the basis for building competence and fluency in Mathematics.

Past studies showed that Malaysia's pupils face difficulty in mastering multiplication operations at primary school levels **(Hadi, Sa'diyah&Iswanto, 2017; Jing & Spiritual, 2016)**. Mastering multiplication and division operations are said to be more difficult compared to addition and subtraction operations **(Croft & Grove, 2006; Harries &Barmby, 2007)**. This causes pupils to face problems in other topics such as fractions, which involve multiplication operations.Multiplication operation is often associated with the memorisation of multiplication tables **(Coles & Scott, 2015)**. Pupils should be allowed to explore the basic fact of Mathematics before memorising numbers **(Susan & John, 2015)**. This is because memorising numbers does not guarantee pupils' understanding of multiplication operations.

In addition, the interaction between students and teachers is arbitrated by technology during online classes. Thus, the design of learning environments has a direct effect on pupils' learning outcomes **(Bower, 2019; Gonzalez et al., 2020)**. Teachers play an important role in fostering pupils emergent behaviours in online learning by encouraging pupil's involvement **(Hartnett, 2015)**. Nevertheless, the pressure of online learning tasks, which require pupils to use online media that they have just learned and need to be comprehended instantly has contributed to pupils' stress rate **(Irawan et al., 2020)**. Indirectly, pupils were discouraged and less emergent during online classes.

2.Literature Review

According to Malaysia's Mathematics Primary School textbook **(Marzita et al., 2018)**, four strategies are suggested to teach multiplication fact which namely repeated addition, objects in groups, arrays and multiplication tables. Creative teaching aids were proven to be more effective than traditional methods of using a textbook **(Im, Hokanson& Johnson, 2015)**. Scholars from overseas **(Nelson, 2018; Ok & Bryant, 2016; Peters, 2017)** and Malaysia **(Liong & Mohd Hanafi, 2016; Mohd Rino, 2019; Yusnita et al., 2019)** have conducted a study on pupils' with learning difficulties in multiplication fact with their creative teaching aids. There are ICT-based teaching aids, game-based teaching aids, manipulative teaching aids and others. Regardless of the type of teaching aids used, all studies are reported to be effective in improving multiplication fact among pupils with learning difficulties. However, all the studies above are conducted in physical classes. Therefore, lack of studies on the use of teaching aids through the fully online learning platform during the Covid-19 pandemic.

As above mentioned, pupils are forced to convert from physical classroom to online learning **(Sutarto et al., 2020)** using the various online systems **(Nasir et al., 2018)**. Online learning is also reported to have a risk of increasing pupils' stress rate **(Irawan et al., 2020)**. Besides, SRP pupils also have negative behaviours such as slow response, like relying on the help of others, have destructive, disruptive behaviours, lack of motivation to learn because they often cannot master a skill **(Nurul Haniza, 2017)**. **Merriam and Brockett (2011)** also found that the use of teaching aids can foster a better attitude of pupils towards Mathematics. Thus, SRP pupils' emergent behaviour problem in the online learning process need to be solved immediately to ensure their learning outcome.

As a result, Paperlator was invented as a teaching aid for SRP pupils during home-based teaching and learning to help Year Two and Year Three SRP pupils to master the multiplication fact and improve their emergent behaviour during the online classes. Year Two and Year Three pupils were chosen because multiplication fact are taught in these years. This study is designed to identify the effects of Paperlator on multiplication fact performance and pupils' emergent behaviour among special remedial program pupils.

3.Purpose

This study examines the effects of Paperlator on multiplication fact performance and pupils' emergent behaviour among two schools of Year Two and Year Three special remedial program (SRP) pupils in the state of Malacca, Malaysia.

4.Methodology

This study employed a convergent parallel mix-method design. This design is a concurrent approach which involves the simultaneous collection of qualitative and quantitative data, followed by the combination and comparisons of these multiple data sources **(Cresswell, 2009)**. In this study, quantitative data were the test scores of multiplication fact, whilst the qualitative data were the SRP pupils' emergent behaviours. Both data were collected and analyzed individually, but happened at the same time. The purpose of convergent parallel mix-method design is to provide a holistic analysis of the research problem by merging both quantitative and qualitative data. Both data were prioritized equally, data were analyzed independently, and mix the result during the overall interpretation in a single phase.

The experimental group of pupils was exposed to Paperlator intervention, whilst the control group of pupils was exposed to the traditional memorisation method. Both groups were taught multiplication fact from multiplication of one to nine over three weeks of home-based teaching and learning. Pre-test was given and observation was made before the intervention on both groups. After three weeks of intervention, both groups were given post-test and observation was made. The effect of Paperlator on multiplication fact performance and pupils' emergent behaviour were examined. **Table.1.** showed the research framework of this study.

Table.1. Research Framework.

Groups	Pre-test and observation	Teaching method over three weeks	Post-test and observation
Experimental	O	X_1	O_1
Control	O	X_2	O_1

Note. O = Pre-test and observation on experimental group/ control group,
X_1 = Intervention with Paperlator,
X_2 = Traditional memorisation method,
O_1 =Post-test and observation on experimental group/ control group.

4.1.Participants

32 SRP pupils aged between 8 to 9 years old from two government-funded schools were involved in this study. Both schools are in the state of Malacca, Malaysia. Random sampling was used in this study to choose two schools involved. Random sampling can avoid sampling bias in a study **(Noraini, 2011)**. In addition, some conditions also were set to avoid bias in the study. Both schools must meet the requirement such as having the same numbers of SRP pupils, from the same district, all SRP pupils were taught with the same curriculum, conducted online learning during implementing home-based learning, yet to master multiplication fact and are pupils from the special remedial program.

Both schools have 16 SRP pupils from Year Two and Year Three. One school was assigned as the experimental group. The SRP pupils in the experimental group were exposed to Paperlator intervention. Another school was assigned as the control group. The SRP pupils in the control group were exposed to the traditional memorisation method.

4.2.Data Collection Instruments

Pre-test and post-test were used to collect quantitative data, which was SRP pupils' multiplication fact score. Items for pre-test and post-test were adapted from the Multiplication Fact Table, which involved multiplication of one to nine. The same items were used in both pre-test and post-test, which only differed from the arrangement of items. The service of two experts was used in face validation and content validation. One SRP Expert Teacher (*Guru Cemerlang*) and one SRP officer were involved in the validation process. Both experts claim 100% agreement on both instruments used to measure pupils' multiplication fact performance. Both instruments had 20 items to evaluate SRP pupils' multiplication fact performance. One mark was given to one correct answer and the total marks were 20. The quantitative data were analyzed and compared using the Statistical Package for Social Sciences (SPSS) software. Descriptive statistics and inferential statistics of

independent T-Test and paired sample T-Test were used in this study. The null hypothesis testing was set at a 0.05 level of significance.

Qualitative data was obtained through observation. The observation sessions were video-recorded via Google Meet to observe SRP pupils' emergent behaviour. All pupils were required to open their webcam during the observation sessions. Researchers observed SRP pupils' emergent behaviour through repeated playing the recorded videos. A field observation log was used to record important actions of every SRP pupils' emergent behaviour when solving multiplication fact problems. The observational findings were checked by the teachers involved to increase the reliability of the study.

A side-by-side comparison analysis was used to merge both quantitative and qualitative data. The researcher reported the quantitative statistical results first and followed by the qualitative findings to confirm or dis-confirm the statistical results **(Alzgool, 2019; Creswell, 2009)**. Thus, this research design is suitable to test the effect of Paperlator on SRP pupils' multiplication fact performance and their emergent behaviour during online classes.

5.Findings

In convergent parallel mix-method design, both quantitative and qualitative data were prioritized equally and analyzed independently. The researcher started the analysis by quantitative and followed by qualitative data. In this study, quantitative data were the test scores of the multiplication fact, whilst the qualitative data were the SRP pupils' emergent behaviours.

5.1.Test Scores of Multiplication Fact (Quantitative Data)

Thirty-two SRP pupils from two schools were involved in this study. Hypothesis null 1 and 2 were tested through independent T-Test, whilst hypothesis null 3 and 4 were tested through paired sample T-Test in this study.

Ho1: There are no statistically significant differences in the mean score of pre-test multiplication fact performance among SRP pupils between experimental and control groups.

Table.2. Pre-test analysis between experimental and control groups.

Group	N	Mean	Std. Deviation	df	T-value	Sig.
Experimental	16	3.25	2.29	30	-0.22	0.825
Control	16	3.44	2.45			

Table.2. above showed pre-test analysis between experimental and control groups. Levene's test was significant, $p>0.05$. Thus, equal variances could be assumed. From Table 2, the independent sample T-Test showed that there was no significant difference between experimental and control groups before the treatment, $t(30) = -0.22$, $p>0.05$. Thus, hypothesis null 1 was failed to reject. This means that there are no differences in the mean score of pre-test between both groups before any intervention. In other words, SRP pupils from both schools were the same in terms of multiplication fact performance level.

Ho2: There are no statistically significant differences in the mean score of post-test multiplication fact performance among SRP pupils between experimental and control groups.

Table.3. Post-test analysis between experimental and control groups.

Group	N	Mean	Std. Deviation	df	T-value	Sig.
Experimental	16	17.69	2.55	30	8.08	0.000
Control	16	7.25	4.49			

Table.3. above showed post-test analysis between experimental and control groups. Levene's test was significant, $p>0.05$. Thus, equal variances could be assumed. From Table 3, the independent sample T-Test showed that there was a significant difference between experimental and control groups after the treatment, $t(30) = 8.08$, $p<0.05$. Thus, hypothesis null 2 was rejected. This means that there is a differential effect of Paperlator and memorisation method on SRP pupils' multiplication fact performance. In other words, SRP

pupils with Paperlator intervention (mean = 17.69, Standard Deviation = 2.55) has a positive significant effect on pupils' multiplication fact performance compared to traditional memorisation method (mean = 7.25, Standard Deviation = 4.49). Thus, this study reveals that Paperlator supports SRP pupils in mastering multiplication fact better than traditional memorisation method.

Ho3: There are no statistically significant differences in the mean score of multiplication fact performance for those SRP pupils who received Paperlator intervention between pre-test and post-test.

Table.4. Pre-test and post-test analysis for experimental group.

Test	N	Mean	Std. Deviation	df	T-value	Sig.
Pre-test	16	3.25	2.29	15	-13.61	0.000
Post-test	16	17.69	2.55			

Table.4.above showed pre-test and post-test analysis for the experimental group. Paired sample T-Test showed that there was a significant difference in the mean score of multiplication fact performance for those pupils who received Paperlator intervention between pre-test and post-test, $t(15) = -13.61$, $p<0.05$. Thus, hypothesis null 3 was rejected. This means that there is a differential effect of Paperlator on SRP pupils' multiplication fact performance. In other words, Paperlator intervention has a positive significant effect on pupils' multiplication fact performance. Thus, this study reveals that Paperlator supports SRP pupils in mastering multiplication fact.

Ho4: There are no statistically significant differences in the mean score of multiplication fact performance for those SRP pupils who received traditional memorisation method between pre-test and post-test.

Table.5. Pre-test and post-test analysis for control group

Test	N	Mean	Std. Deviation	df	T-value	Sig.
Pre-test	16	3.44	2.45	15	-6.28	0.000
Post-test	16	7.25	4.49			

Table.5.above showed pre-test and post-test analysis for the control group. Paired sample T-Test showed that there was a significant difference in the mean score of multiplication fact performance for those pupils who received traditional memorisation method between pre-test and post-test, $t(15) = -6.28$, $p<0.05$. Thus, hypothesis null 4 was rejected. This means that there is a differential effect of the memorisation method on SRP pupils' multiplication fact performance. In other words, the memorisation method has a positive significant effect on pupils' multiplication fact performance. Thus, this study reveals that memorisation method also supports SRP pupils in mastering multiplication fact.

5.2. SRP Pupils Emergent Behaviour (Qualitative Data)

The qualitative data reported the SRP pupils' emergent behaviour when solving multiplication fact. The observation was used and the Google Meet session was video-recorded. Observation before the treatment and after the treatment of both groups was recorded via observation log. The data were analyzed to capture general themes and emergent approaches. Tables 6 and 7 below summarize the findings base on the 32 SRP pupils' emergent behaviour when solving multiplication fact.

Table.6. Pre-test and post-test observed behaviour of experimental group SRP pupils when solving multiplication fact.

SRP Pupils	Observation during pre-test	Observation during post-test	Changes
E1, E4, E5, E8, E9, E11	Passive and not interested	Active, show interest and can solve the problems independently	Positive changes
E2, E3, E14, E16	No motivation to answer the questions and easily affected by the situation	Passive but show interest in solving problems. Still rely on the teacher but can solve the problems independently with Paperlator teaching aid.	Positive changes
E6, E7,	Active and show interest	Very active and eager to solve multiplication fact	Positive

E10, E12		problems.	changes
E13, E15	Active and show interest	Active and show interest	No changes

Table.6. above showed that almost all SRP pupils in the experimental group had positive changes in their emergent behaviour after the intervention except for pupils E13 and E15. Nevertheless, all SRP pupils showed positive emergent behaviour during post-test observation. This showed that Paperlator supports the multiplication fact learning process for SRP pupils.

Table.7. Pre-test and post-test observed behaviour of control group SRP pupils when solving multiplication fact.

SRP Pupils	Observation during pre-test	Observation during post-test	Changes
C1, C5, C8, C16	Active and show interest	Active, show interest and can solve the problems independently	Positive changes
C2, C10, C15	Passive but show interest	Active and show interest in solving problems.	Positive changes
C3, C7, C13	No motivation to answer the questions and easily affected by the situation	No motivation to answer the questions and easily affected by the situation	No changes
C4, C11, C12, C14	Passive and not interested	Passive and not interested	No changes
C6, C9	Passive and not interested	No motivation and refuse to answer the questions	Negative changes

Table.7.above showed that seven out of sixteen SRP pupils in the control group had positive changes in their emergent behaviour after the intervention. Seven SRP pupils showed no changes, whilst two SRP pupils had negative changes. Thus, this study showed that less than half of the SRP pupils showed positive emergent behaviour during post-test observation. This showed that the traditional memorisation method could not fully support the multiplication fact learning process for SRP pupils. SRP pupils need more concrete and hands-on activities to support their multiplication fact learning process.

5.3. Side-by-side Comparison (Quantitative and Qualitative Data)

Both results from the quantitative data and qualitative data were mixed and compared. **Table.8.**below showed the side-by-side comparison between the quantitative and qualitative results.

Table.8. Side-by-side comparison.

Quantitative		Qualitative	
Independent sample T-Test	**Paired sample T-Test**	**Emergent behaviours of experimental group**	**Emergent behaviour of control group**
Before intervention: There are no differences in the mean score of the pre-test between both groups. SRP pupils from both schools were the same in terms of multiplication fact performance level before any intervention. **After intervention:** There are significant differences of Paperlator and memorisation method on SRP pupils' multiplication fact performance. SRP pupils with Paperlator intervention have a positive significant effect on pupils' multiplication fact performance compared to the traditional memorisation	**Experimental group and control group:** Both groups showed that there was a significant difference in the mean score of multiplication fact performance for those pupils who received Paperlator intervention and traditional memorisation method between pre-test and post-test. Both Paperlator intervention and memorisation method has a positive significant effect on pupils' multiplication fact performance. Thus, this study reveals that both Paperlator and	Almost all SRP pupils in the experimental group had positive changes in their emergent behaviour after the intervention except for pupils E13 and E15. All SRP pupils showed positive emergent behaviour during post-test observation. Paperlator supports the multiplication fact learning process for SRP pupils.	Seven out of sixteen SRP pupils in the control group had positive changes in their emergent behaviour after the intervention. Seven SRP pupils showed no changes. Two SRP pupils had negative changes. Less than half of the SRP pupils showed positive emergent behaviour during post-test observation. The traditional memorisation method could not fully support the multiplication fact learning process for

method. Paperlator supports SRP pupils in mastering multiplication fact.	memorisation methods can support SRP pupils in mastering multiplication fact.		SRP pupils.

The quantitative data reported Paperlator support SRP pupils in mastering multiplication fact better than traditional memorisation method. SRP pupils who used Paperlator achieved better performance in mastering multiplication fact. The qualitative data confirm and support the quantitative data where it showed that all SRP pupils in the experimental group were active and showed interest in solving multiplication fact problems with the use of Paperlator. With the help of a Paperlator teaching aid, SRP pupils could learn multiplication fact through manipulating concrete teaching aid at home during home-based learning. Hands-on learning guided pupils to gain knowledge through experience. It could help SRP pupils to build concrete images and knowledge in Mathematics.

The quantitative data reported that the traditional memorisation method also could support SPR pupils in mastering multiplication fact. Nevertheless, it was reported that it is less effective compared to the use of Paperlator. In addition, the qualitative data confirm and support the quantitative data. Less than half of the SRP pupils showed positive emergent behaviour towards solving multiplication fact with the traditional memorisation method. The traditional memorisation method required SRP pupils' working memory to store the multiplication fact in their minds. However, SRP pupils have weak working memory and could not understand abstract knowledge of multiplication. Thus, the traditional memorisation method only works for a minority of SRP pupils.

6.Discussion and Conclusion

Independent T-Test of the pre-test score between the experimental group and the control group shows the SRP pupils in both groups were homogeneous. It is important as it showed that SRP pupils from both groups were the same before implementation of any intervention. Both Paperlator and traditional memorisation method have a significant positive effect on the multiplication fact performance among SRP pupils. However, Paperlator showed a significant effect on the multiplication fact performance among SRP pupils when compared to the traditional memorisation method. Besides, SRP pupils who used Paperlator also showed more positive emergent behaviour than those who used the traditional memorisation method. Thus, this study revealed that Paperlator is more suitable for SRP pupils to master multiplication fact.

This study supports the fact that Malaysia's pupils face difficulty in mastering multiplication operations at primary school levels **(Hadi, Sa'diyah, &Iswanto, 2017; Jing, & Spiritual, 2016)**. SRP pupils' multiplication fact performance in both groups before the intervention was poor. This is because pupils require more working memory on memorisation of the multiplication fact. It is supported by **Yoong and Ahmad (2021)** which stated that pupils who have difficulty in mastering basic counting skills have poor number senses and working memory impairment. Thus, researchers and teachers need to solve the problem and find a suitable way to help SRP pupils to master multiplication fact with ease.

The use of the intervention, Paperlator was done to help SRP pupils to master multiplication fact. Throughout the intervention, pupils can build a conceptual understanding of multiplication fact. The exploration of the multiplication fact before memorising the numbers also trigger SRP pupils' interest in learning Mathematics which is supported by **Susan and John (2015)**. Memorisation without understanding the concept of Mathematics limited the development of pupils' Mathematics ability **(Parwines&Noornia, 2019)**. In addition, this study fills in the gap from past studies that creative teaching aids were proven to be more effective even through online learning medium **(Liong & Mohd Hanafi, 2016; Mohd Rino, 2019; Nelson, 2018; Ok & Bryant, 2016; Peters, 2017; Yusnita et al., 2019)**.

This study is supported by Dale's Cone of Experience **(Cerya et al., 2019)**, which stated that pupils remember 90% from what they do. SRP pupils involve themselves actively in investigating and building multiplication fact with the help of Paperlator. The help of concrete and visual teaching aid at home helps SRP pupils to show interest and be active in the learning process during home-based teaching and learning. This

study also supports that visual teaching aid can help teachers to explain, create and correlate with accurate concepts and understandings **(Shabiralyani et al.,2015)**. Thus, Paperlator helps SRP pupils to make learning more meaningful, active, and significant.

Paperlator intervention helps SRP pupils to construct multiplication fact through concrete learning. SRP pupils can build their concrete teaching aid at home. This has lowered the risk of pupils' stress rate on online learning **(Irwan et al., 2020)** because they do not need to study and learn various online systems **(Nasir et al., 2018)** which are new to them. Pupils from age 8 to 9 are still in Concrete Operational Stage **(Piaget, 1965)** who needs concrete materials to understand the abstract concept of Mathematics. This study also supports that the use of teaching aids can foster a better attitude of pupils towards Mathematics **(Merriam & Brockett, 2011)** even though through online teaching and learning.

In conclusion, Paperlator is effective to help SRP pupils to master the multiplication fact and improve their emergent behaviour during home-based teaching and learning in Malaysia. This study gives implications for SRP pupils, teachers and the Ministry of Education Malaysia on implementing different techniques in mastering multiplication fact. Paperlator helps SRP pupils to master multiplication fact concretely through hands-on learning. Besides, it also helps SRP teachers to master more teaching methods that are pupils-centered and help SRP pupils to build their teaching aid at home. Last but not least, this study also gives implications to the Ministry of Education Malaysia to improve Mathematics' curriculum for multiplication topics. Easily made teaching aid can be considered to be implemented into Malaysia Mathematics curriculum as it can help SRP pupils to study effectively and improve their emergent behaviour even though through online teaching and learning.

7.Acknowledgements

This research has been done with the help and support of the Ministry of Education Malaysia through the HLP scholarship program.

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