

The Effectiveness Of Colour Triciare Model In The Topic Addition And Subtraction Of Algebra

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Abstract: This article presents the effectiveness of Colour Triciare Model in the topic addition and subtraction of algebra. The methods used in the research were inferential and descriptive analysis. The sample consist of sixty form one students of a secondary school in Raub district, Pahang state. Samples divided into two groups, control group which learnt the topic by using conventional method and experimental group which learnt the topic with the Colour Triciare Model. The instruments consist of two sets of tests which are pre-test and post-test. Both sets of instruments contained 26 subjective questions. The findings showed a significant difference in the mean scores in post-test on the topic of addition and subtraction of algebra between the control group and the experimental group. In conclusion, the Colour Triciare Model improved the achievement scores of students in addition and subtraction of algebra compared with using conventional methods.

Keywords: algebra, Colour Triciare Model, teaching manipulative

1 Introduction

Manipulatives are concrete learning materials that allow students to comprehend abstract concepts through concretizing them (Boggan, Harper, & Whitmire, 2010). Hinzman (1997) did an eighteen week study on eighth grade pre-algebra students. Her research did not show any dramatic gains in student grades, but her conclusions in the support of manipulative use came in response to student attitude. She discovered that students' overall feelings, as well as their attitude toward mathematics, were greatly improved.

Manipulatives help students develop conceptual understanding of mathematical ideas by representing the ideas in multiple ways. Using mathematics manipulatives and models offers many benefits. Just as a picture can be worth a thousand words, manipulatives can provide visual representations of ideas, helping students to know and to understand mathematics better. Manipulatives enhance the abilities of students at all levels to reason and communicate (Jean M. Shaw, 2002).

There were a lot of researches about investigating the effects of teaching manipulative in mathematics. According to the findings of those studies, they found that manipulative increased the mathematics achievement (Nisih Freeman, 2014 ; Clements, 1999 ; Yuting Liu, 2014). Furthermore, some of the researches also suggested that, students become more active, their motivation towards learning was increased and they adopt a positive attitude towards mathematics lesson when teaching manipulative are employed in mathematics classes. Learning through activities by using teaching manipulative gave students pleasure and increased their motivation and allowed them to learn while having fun. (Hinzman, 1997 ; Caryn Ross, 2008 ; Clements, 1999).

Nisih Freeman's (2014) had conducted a research on a group of low performing year one children in United Kingdom school over a period of 10 weeks, investigates the benefits of using the Japanese abacus. The Japanese abacus (soroban) is a tactile tool which has been adopted as part of mathematics curriculum by many primary schools in Asia in addition to being taught outside the formal school settings as part of out-of-school activities. Japanese abacus is an instrument used to do calculations based on the decimal system. It investigates the rate of progress of children who have participated in the abacus sessions. Pre-test and post-

test are used to examine a number of features of the children's performance, including computational skills, oral counting, identification of numbers, objects counting and language. The result showed that two out of the three children in the group performed very well in their computational skills. The knowledge of understanding and recognition of numbers, mathematical language and place value concepts of students were improved. The lowest rate of progress obtained within the experimental group was still higher than the best performing child in the control group. Students also enjoyed the class activity by using abacus and they were more confidence after the intervention.

The objectives of this paper is to investigate the effects of using the Colour Triciare Model on form one students' achievement in improving student achievement in the topic addition and subtraction of algebra, analyze the mean score of the control group and experimental group students before using the Colour Triciare Model and analyze mean score of students' control group and experimental group after using Colour Triciare Model.

2 Literatue Review

Many researches about the effectiveness of teaching manipulates in mathematics were conducted. The results showed the use of teaching manipulative can improve students' achievement. Besides that, students feel more enjoy, fun and interested when they are learning mathematics with the use of teaching manipulative. Teaching manipulative let students learn abstract concept in a concrete way, it can concretizing the abstract concepts.

Crystal Allen (2007) had conducted a research on a group of fifth grade mathematic students on the effects of manipulative towards student attitudes and learning patterns on geometry. The research was to determine the use of manipulative in a mathematics classroom will increase students' achievement in mathematics. The study took place over three days of time. Both groups were given the same pre-test. The pre-test was graded based on the number of correct answers attained out of ten problems. Each group received one full class period of instruction for one day, the next day the students took the post-test. As a result of geometry instruction using manipulative, the experimental group increased their skills and showed

more interest and enjoyment when learning was done through the use of manipulative. The students were visibly more active in class and develop more self confidence in their mathematics skills. In conclusion, the results revealed that students using a manipulative improved their level of achievement, increased their understanding, and promoted a positive attitude to a mathematical concept that they previously struggled with before using a manipulative.

A study has found that tangram is a useful teaching manipulative in developing the concept of geometry (Lin *et al.*, 2011). A tangram is the oldest Chinese puzzle that consists of seven geometric pieces of shapes, called *tans*. The seven pieces include a square, a parallelogram, two big right triangles, a medium sized right triangle and two small right triangles. The three basic shapes consist of a triangle, a square and a parallelogram, which fit together in various ways to form polygons such as a large square, rectangle or triangle. These *tans* can be arranged in a variety of figures such as birds and animals (Tian, 2012). Tangrams allow children to develop geometric concepts by categorising, comparing and working out the puzzle and thereupon to solve problems in geometric contexts. In this study, participants consisted of twenty five sixth graders of a suburb elementary school of Tai-Chung City. The results showed that children's competency in rotation and space of shapes had been improved and the mean scores gap between lower and higher achievers had been narrowed. Researcher found that the collaborative puzzle shaping with the tangram puzzle can enhance the shapes rotation and spatial ability. Moreover, the students' competency in spatial reasoning and sensing had also been improved.

A study on twenty-seven eighth grade students of Tygarts Valley Jr/Sr High School in Randolph County, West Virginia was carried out by Hinzman (1997), the results showed that student's performance was enhanced by the use of manipulative materials. Besides that, students' attitudes toward mathematics are significantly become more positive compare with the previous years. With the use of teaching manipulative, students understand some algebraic concept better.

Ashlee Cockett and Peter W. Kilgour (2015) proposed that students were engaged actively in the learning activity when manipulative were used rather than when they were not used in the research. In general, majority of the students enjoy the use of teaching manipulative in learning and manipulative also

improve their development of mathematics concepts as well. The perception of students was that mathematics manipulative help them be more efficient in their learning, better understand in their learning and receive greater enjoyment from the learning process.

Hakki Kontas (2016) had conducted a research on the effect of manipulative (concrete learning materials) both on the academic achievement of secondary school students in mathematics and on their attitudes towards mathematics. The results showed that the post-test mathematics academic achievement scores of experimental and control groups were found a significant different in post-test in control and experimental group. The scores of attitude towards mathematics for experimental and control groups were significantly different in post-test in experimental group, it can be seen that mean scores of post-test were less than mean scores of pre-test at a statistically significant level which shows that there was a significant decrease in the attitude of control group students towards mathematics lesson. This results revealed that manipulative are effective in increasing the achievement scores of the experimental group significantly.

3 Colour Triciare Model

The term of Triciare comes from the word triangle, circle and square which are the geometric shapes used in the model. This model consists of three basic geometric shapes that are triangle, circle and square. All the geometric shapes consists of two different colors which are yellow and red. Geometric shapes in red represents a positive algebraic term, while the geometric shapes in yellow represents a negative algebraic term.

Colour Triciare Model is a physical manipulative that developed with the purpose to teach the topic of addition and subtraction of algebraic terms. The advantages of using this model are it can assist and help moderate and weak students to understand algebra concept more easily since they can visualize the terms or unknowns concretely.

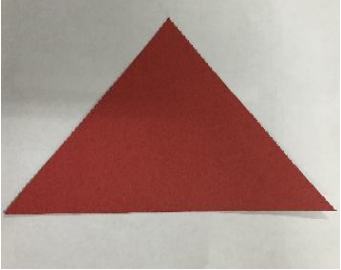
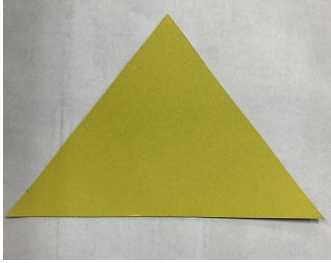
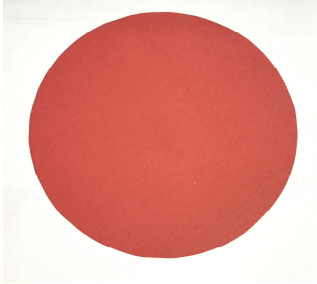
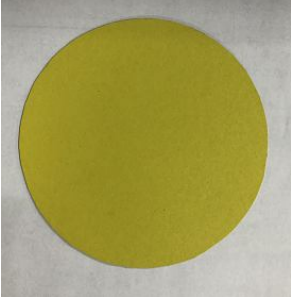
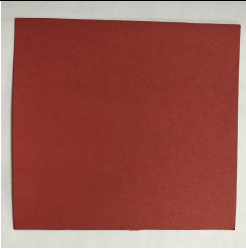
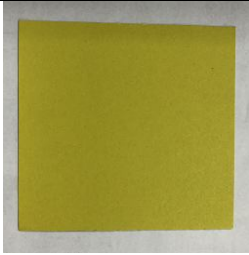
Positive Integer	Negative Integer
Triangle	
	
Circle	
	
Square	
	

Figure 1 : Color Triciare Model

Figure 1 depicts the part of the set of the Colour Triciare Model. The model contains of ten pieces of red triangles, ten pieces of yellow triangles, ten pieces of red circles, ten pieces of yellow circles, ten pieces of red squares and ten pieces of yellow squares. Colour Triciare Model was built in order to overcome the problem of students in solving operation of addition and subtraction of algebra.

3.1 Example of addition and Subtraction of Algebra

$$2p - (-3p) + 5q + (-2q)$$

$$= 2p + 3p + 5q - 2q \quad (\text{Simplify the signs})$$

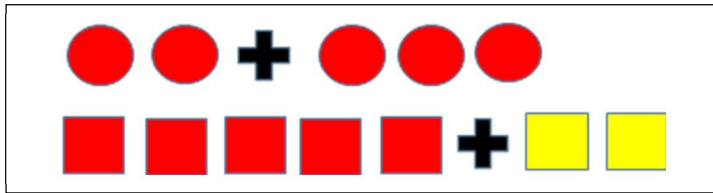


Figure 2: Representative of shapes of different terms

In this example, the term p was represents by circle and the term q represents by square. Figure 2 depicts the term of $2p$ is represents by two red circles and the term $3p$ is represents by three red circles. While the term $5q$ is represents by five red squares and the term $-2q$ is represents by two yellow squares.

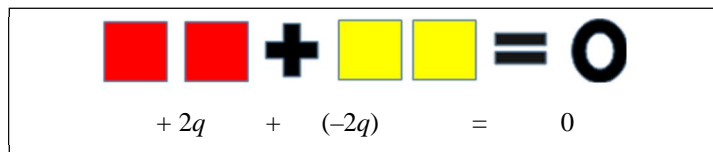


Figure 3: Two pairs of zero pairs

In figure 3 depicts there are two pairs of zero pairs for the square shape. Zero pairs means a pair of numbers whose the sum is zero. The sum of two red squares ($+2p$) and two yellow squares ($-2q$) are zero. Zero pairs must consist of the same geometric shapes.

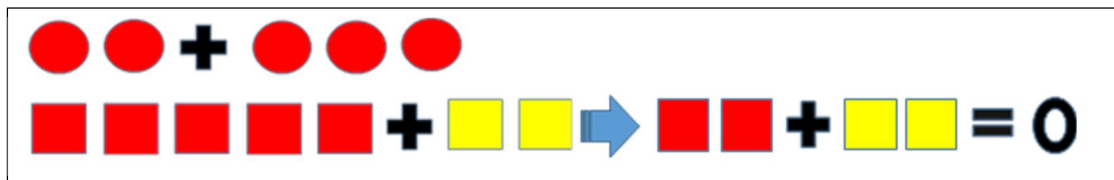


Figure 4: Remove two pairs of zero pairs

Figure 4 depicts users remove the zero pairs, then they calculate the cards remain. The figure 5 shows the cards that remain were five red circles which represents term of $5p$ and three red squares which represents term of $3q$. Hence, the final answer for the example shown is $5p + 3q$.

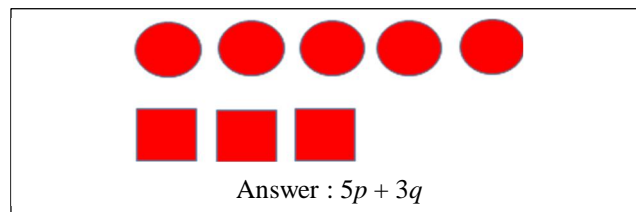


Figure 5: Cards Remain

4 Method

This research adopted quasi-experimental design, where control group was taught by using conventional method and experimental group was taught by using Colour Triciare Model. The pre-test and post-test were administered to the two groups, in order to compare their addition and subtraction of algebra skill and investigate the effects of Colour Triciare Model in the topic addition and subtraction of algebra. Class 1D was randomly selected as the experimental group, whereas class 1C is taken for the control group. Both groups are evaluated once before the experimental and once after it.

The study group of this research consists of 60 form one low perform students (30 students in experimental group and 30 students in control groups). The control group consisted of students who were studying at class 1C and the experimental group consisted of students who were studying at class 1D in a secondary school in Raub district of Pahang state in year 2017. The students in experimental group (13 females & 17 males) and control group (14 females & 16 males) were between 13-14 years of age. Since the study group was selected from among groups that had already been formed, convenience sampling was used. As the mathematics lesson academic achievement scores was equivalent between the two groups, one of the groups was randomly assigned as the experimental group, and the other one as the control group. A pilot study was conducted on fifteen form one low perform students to ensure the students can understand each items well. Research fixed the items which was not clear after the pilot test conducted.

This research was taking place of a time span of four weeks. The pre-test was carried out on control and experimental group at the same time. After one week, the experimental group was taught by using Colour Triciare Model, while the control group was taught by using conventional method. Two session of

teaching and learning activity in the topic addition and subtraction of algebra for one hour was conducted on both groups for two weeks. The session was conducted once a week. The post-test was carried out after two hour sessions were delivered in both groups. The post-test was carried out on control and experimental group at the same time as well.

Scores from the pre-test and post-test were used for collecting the research data. One mark will be given for each correct answer. The data were collected and analyzed by using the software of *SPSS Version 22.0*. The instruments were consisted of two set of tests consisting of 26 items. All item were related to the topic addition and subtraction of algebra of form one mathematics syllabus in secondary school. Both tests consisted of twenty-four subjective items and two problem solving questions. The difficulty level of pre-test and post-test were same. Both groups were given 60 minutes to solve the problems in pre-test and post-test. The instruments was checked by two experienced mathematics teachers for purpose to get the reliability and validity of the tests as an instruments in the study before the pre-test and post-test carry out.

5 Results and Discussion

In order to test whether the distribution of the scores obtained from the tests are normal, normality test was conducted. If the sample size of the group is less than 50, Shapiro-Wilk test is used while Kolmogorov-Smirnov test is used if it is more than 50 (Shapiro & Wilk, 1965). Shapiro-Wilk test was carried out in this study, as the sample size was less than 50 and it was found that the observation values displayed normal distribution (Table 1). The results of the normality test were shown in Table 1. Since the data distribution was normal ($p > 0.05$), hence two tailed t-test were used in the study.

Table 1: Results of Normality test

	Shapiro-Wilks		
	Statistic	df	Sig.
Post test (Control Group)	0.931	30	0.051
Post test (Experimental Group)	0.949	30	0.173

The research was carried out in two form one classes. Both classes were consisted of low perform students. One of the classes was assigned as the experimental group and the other as the control group. Both of the

groups were applied the pre-test and post-test. During the study, four sessions were delivered to both groups, the sessions were include pre-test and post-test. Colour Triciare Model was designed in accordance with the topics of addition and subtraction of algebra. The model was used in the experimental group, whereas the lesson activity was conducted by using conventional methods in the control group.

Table 2: Result of Pre-test and Post-test for Experimental Group of two tailed t-test

	N	Mean	Std. Deviation
Pre-test	30	0.00	0.000
Post-test	30	55.33	22.164

As shown in Table 2, the mean scores of the experimental group was increased from zero to 55.33. According to this finding, the achievement of the experimental group was improved 55.33% by using the Colour Triciare Model. Mean score of zero shown that the students in experimental group have no knowledge about the topic addition and subtraction of algebra. The increased in mean score of post-test shown Colour Triciare Model improved the understanding the skills of students in the topic of addition and subtraction of algebra.

Table 3: Result of Post-test of two tailed t-test for control and experimental group

	Group	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Post-test	Control	30	42.83	25.898	-2.009	0.049
	Experimental	30	55.33	22.164		

According to the findings in Table 3, there was a significant difference between the achievement post-test mean scores of experimental and control groups ($p < 0.05$). This finding indicates that Colour Triciare Model are effective in increasing the achievement scores of the experimental group significantly since mean score of experimental group was found increased 13% more higher than mean score of control group. According to this finding, the achievement scores in the topic addition and subtraction of algebra of the experimental group was improved by using the Colour Triciare Model.

Comparing the pre-test and post-test scores of addition and subtraction of algebra of the experimental group, it can be seen that mean scores of post-test were more higher than mean scores of pre-test, which showed that an better improvement of achievement in the topic of addition and subtraction of algebra by using the Colour Triciare Model compared with the control group who was using conventional method.

6 Conclusion

Through the review of the research on the effectiveness of using manipulative in mathematics, the researcher uncovered a lot of studies that supported the use of concrete, pictorial, and virtual manipulative. For decades, researchers have been demonstrating the positive effects of using concrete mathematics manipulative with their students in certain topics. Although some studies have reported insignificant or even negative results when using mathematics manipulative, but it seems that these outcomes are associated with the instructional methods used. Educators who follow the best practice recommendations for manipulative use are likely to experience positive results.

In conclusion, with usage of teaching manipulative is beneficial for concretizing abstract concepts, an increased usage of teaching manipulative in the classroom are encourage. The study showed that the use of Colour Triciare Model increased the mathematics achievement of the low perform students in the topic of addition and subtraction of algebra.

References

- Allen, C. (2007). *An Action Based Research Study On How Using Manipulatives Will Increase Students' Achievement In Mathematics*. Chicago : Marygrove College.
- Boggan, M., Harper, S., & Whitmire, A. (2010). Using Manipulatives to Teach Elementary Mathematics. *Journal of Instructional Pedagogies*, 3, 1-6.
- Clements, D. H. (1999). "Concrete" Manipulatives, Concrete Ideas. *Contemporary Issues in Early Childhood*, 1(1), 45-60.
- Cocket, A. & Kilgour, P. W. (2015). *Mathematical Manipulatives : Creating an Environment for Understanding, Efficiency, Engagement, and Enjoyment*. Teach Collection of Christian Education, 1(1), 47-54.
- Freeman, N. (2014). Does the Japanese Abacus Improve Underachieving Children's Performance in Mathematics? *Proceedings of the British Society for Research into Learning Mathematics*, 13-18.
- Hinzman, K. P. (1997). *Use of Manipulatives in Mathematics at The Middle School Level and Their Effects on Students' Grades and Attitudes (Degree's Thesis)*. Salem-Teikyo University, Salem.
- Kontas, H. (2016). The Effect of Manipulatives on Mathematics Achievement and Attitudes of Secondary School Students. *Journal of Education and Learning*, 5(3), 10-20.
- Lin, C. P., Y.J. Shao, L. H., Wong, Y. J., Li and Niramitranon, J. (2012). The Impact of Using Synchronous Collaborative Virtual Tangram in Children's Geometric. *The Turkish Online Journal of Educational Technology*. 10(2), 250-258.
- Liu, Y. (2014). *Tangram Race Mathematical Game : Combining Wearable Technology and Traditional Games for Enhancing Mathematics Learning*. Massachusetts : Worcester Polytechnic Institute.
- Ross, C. J. (2008). *The Effect Of Mathematical Manipulative Materials On Third Grade Students' Participation, Engagement, And Academic Performance*. Master's Thesis. University of Central Florida, Orlando.
- Shapiro, S. S. and Wilk, M. B. (1965). An Analysis of Variance Test for Normality. *Biometrika*. 52(3/4), 591-611
- Shaw, J. M. (2002). *Manipulatives Enhance The Learning of Mathematics*. [Online] Available: <http://www.eduplace.com/state/author/shaw.pdf> (May 8, 2017)
- Tian, X. X. (2012). The Art and Mathematics of Tangrams. *Proceedings of Bridges Towson Proceedings 2012*, 553-556.