INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY: APPLIED BUSINESS AND EDUCATION RESEARCH
2022, Vol. 3, No. 12, 2692 – 2698
http://dx.doi.org/10.11594/ijmaber.03.12.21

Research Article

The Efficiency of Hand Tricks in Learning Trigonometric Ratios

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Article history:
Submission December 2022
Revised December 2022
Accepted December 2022

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ABSTRACT

This study investigated how hand tricks influenced the students' achievement in trigonometric ratios. Using a quasi-experimental design and purposive sampling, twenty students were the survey respondents: ten of whom took as a control group, and ten took as an experimental group. Through limited face-to-face classes, the researcher selected respondents from Grade 9 students at Bonifacio National High School. The research instruments used in this study are two sets of lesson plans, a pretest, and a post-test. The study revealed that the traditional method and hand tricks effectively teach trigonometric ratios. However, results also found that it was more effective to teach trigonometric ratios when using the hand tricks. The study concluded that the traditional and hand tricks were considered effective in teaching trigonometric ratios. Though, those students who participated in the use of hand tricks in teaching performed better in solving trigonometric ratios than those students who trained using the conventional method. The use of hand tricks helps students with difficulty in memorizing trigonometric ratios. The researcher recommended that we always use hand tricks in teaching trigonometric ratios. It is also recommended for complete and thorough teaching of mathematics topics throughout the year to reinforce mathematics teaching and learning. Moreover, hand tricks are used in learning trigonometric ratios and preparing for advanced trigonometric lessons.

Keywords*: Hand Trick, Trigonometric ratios, Trigonometry*

Introduction

School is considered uninteresting because children do not see how the lessons apply to their daily lives (Brophy, 2004). These student actions have various negative effects on the teaching and learning process. Lack of interest in the subject, dislike towards mathematics, lack of parental involvement, child labor, motivation, and instructional methods teachers use all affect pupils' ability to learn mathematics (Gur, 2009 & Acharya, 2017).

Additionally, teachers are essential for mathematics instruction, yet research has shown that they frequently lack conceptual understanding, which results in poor learning outcomes (Malambo, 2021; Nabie et al., 2018;

How to cite:
Delima, C. M. (2022). The Efficiency of Hand Tricks in Learning Trigonometric Ratios. *International Journal of Multidisciplinary: Applied Business and Education Research. 3* (12), 2692 – 2698. doi: 10.11594/ijmaber.03.12.21

& Kusyamadi & Sujadi, 2017). Trigonometry instruction is also regarded as a crucial but difficult to understand an idea in mathematics (Rahman & Puteh, 2016; Moore, 2012; & Zengin, Furkan, & Kutluca, 2012). Moreover, lessons on trigonometric ratios are seen to be challenging for teachers to explain and understand.

Rahman and Puteh (2016), cited in Bakar (2010), stressed that when students appreciate what they are learning, they improve their performance and become more motivated (Mata, Monteiro, & Peixoto, 2012). Moreover, effective teachers also employ strategies that encourage critical thinking in their students and help those with learning issues (Villavicencio, 2011 & Stronge, 2018). Therefore, teachers must offer tasks that improve students' motivation and cognitive abilities.

A brief background on the teachers' and learners' experiences, this paper showed hand tricks as an alternative way of learning trigonometric ratios. It focused only the grade 9, wherein trigonometric ratios are in topic lists.

Conceptual Framework

The study dealt with teaching trigonometric ratios using hand tricks. The conceptual framework in Figure 1 is divided into four areas: input, process, result, and feedback.

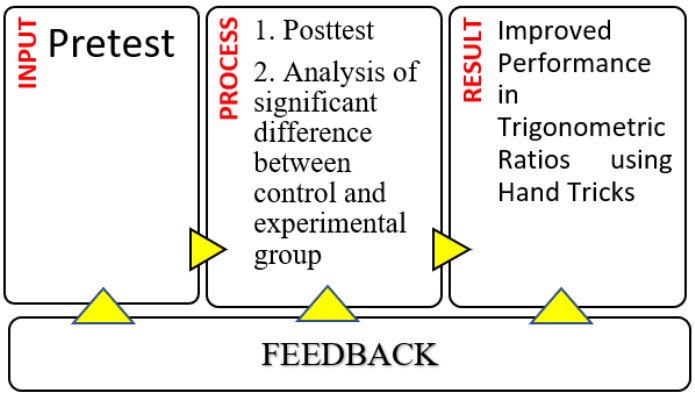

Figure 1. Conceptual Model showing the Utilization of Hand Tricks in teaching Trigonometric Ratios

Research Questions

The study wanted to answer the following questions:

1. What are the students' performance levels in their pretest in the control and experimental groups?
2. What are the students' performance levels in their post-test in the control and experimental groups?
3. Is there a significant difference between students' performance under control and experimental groups in the pretest?
4. Is there a significant difference between students' performance under control and experimental groups in the post-test?
5. Is there a significant difference between students' performance under the control group in their pretest and post-test?
6. Is there a significant difference between students' performance in the experimental group's pretest and post-test performance?

Hypothesis

1. There is no significant difference between the student's performance under control and experimental groups in the pretest.
2. There is no significant difference between the student's performance under control and experimental groups in the post-test.
3. There is no significant difference between the student's performance under the control group in their pretest and post-test.
4. There is no significant difference between the student's performance in the experimental group's pretest and post-test performance.

Methods

Research Design

The researcher used a quasi-experimental design to determine the significant difference between the student's performance using the conventional way and the hand tricks method

in teaching trigonometric ratios. The conventional way used the existing teaching method, while the hand tricks method used hand tricks in teaching trigonometric ratios.

Population and Sampling

The researcher conducted the study at Bonifacio National High School, Division of Quezon Province. It was composed of twenty students as target samples: ten for the control group and the other ten for the experimental group. The target participants have participated through limited face-to-face as the school implemented this learning modality. Due to the small number of respondents being compared, the researcher used a purposive sampling technique. Also, the researcher considered the grade level where trigonometric ratios are taught. According to Bhardwaj (2019), the purposive sampling technique is used according to the judgment or purpose of the researcher.

Before the experiment was conducted, the researcher sent a letter request from the school head. He also asked permission from parents and students who participated in the investigation.

Instrumentation

The instruments of the study are one (1) teacher-made material using the table of trigonometric ratios, teacher-made material using hand tricks, and pretest and post-test. The research instrument has undergone content validity by asking experts in the field and judging the appropriateness of tools, including the pretest and post-test.

The teacher-researcher discussed the lessons and assessed to determine the significant difference between the two lesson materials.

Ethical Consideration

The researcher submitted a letter of permission from the principal to conduct the study at Bonifacio National High School. The researcher also asked permission from the respondents for their awareness of the investigation flow. The data in this study were treated with the utmost care, and the information remained confidential.

Statistical Analysis

After experimenting, the data were gathered, encoded, tabulated, and analyzed to test the significant difference between the conventional ways of teaching and using hand tricks in teaching trigonometric ratios.

The researcher used mean and standard deviation to determine the level of the two groups of students in trigonometric ratios. He also used a t-test to determine the significant difference between the means of the two groups, which may be related to certain features. The t-test is used as a hypothesis testing tool, which allows testing of an assumption applicable to a population (Konietschke, F. & Pauly, M., 2014).

Kim (2015) claimed that the t-test was a type of statistical test comparing the significant difference between the mean scores of two groups.

Statement of the Problem	Statistical Treatment
1. The level of Performance of control and experimental groups in their pre-test	Mean, Standard Deviation
2. The level of Performance of control and experimental groups in their pre-test	Mean, Standard Deviation
3. The significant difference in the means of control and experimental groups in the pre-test.	Unpaired t-test
4. The significant difference in the means of control and experimental groups in the post-test.	Unpaired t-test
5. The significant difference in the means of the control group in their pre-test and post-test.	Paired t-test
6. The significant difference in the means of the experimental group in their pre-test and post-test.	Paired t-test

Results and Discussion

The researcher wanted to determine students' performance levels in control and experimental groups before and after the treatment. The significant difference between the control and experimental groups in their pretest and post-test is also sought to determine.

Performance of the Students in the Control and Experimental Groups in their Pre-test and Post-test

Table 1 presents the students' performance of the control and experimental groups in their pretest. As seen in the result of the study, the mean scores of the students in both control and experimental groups are statistically low, with 7.200 and 7.500, respectively. In addition, the standard deviation of the control and experimental groups are 0.790 and 0.970, respectively. The data revealed that trigonometric ratios could not be clearer to understand. Ferrer (2016) supported the claim that students have difficulty transforming trigonometric functions into their equivalent and weaknesses in solving fundamental operations in algebra. Byers (2010) found in her research that gaps and omissions in trigonometry lessons cause difficulties for students in learning trigonometry, especially when they enter college. The difficulties can lead to less competent engineers in the future.

Table 1. The Level of Performance of the Control and Experimental Groups in their Pre-test

Groups	$\bar{x}$	SD	VI
Control	7.200	0.790	FS
Experimental	7.500	0.970	FS

Legend:
$\bar{x}$ – Mean
SD – Standard Deviation
VI – Verbal Interpretation
FS – Fairly Satisfactory

Table 2. The Level of Performance of the Control and Experimental Groups in their Post-test

Groups	$\bar{x}$	SD	VI
Control	9.900	1.37	VS
Experimental	11.800	1.75	VS

Legend:
$\bar{x}$ – Mean
SD – Standard Deviation
VI – Verbal Interpretation
VS – Very Satisfactory

Table 2 below shows the student's performance under control and experimental groups in their post-test. In terms of the student's Performance in the post-test, the results showed that both groups have the verbal interpretation of very satisfactory. Data revealed that the mean of the experimental group is statistically higher than the control group. The Experimental group has a mean score of 11.800 with a standard deviation of 1.75, while the control group has a mean score of 9.900 with a standard deviation of 1.37.

Table 3. The Results of Performance of the Control and Experimental Groups in Pretest

	$\bar{x}$	SD	t-value	p-value	Decision	I
Ctrl	7.200	0.790	-0.76	0.458	Failed to reject	NS
Exp	7.500	0.970				

Legend:
$\bar{x}$ – Mean
Ctrl – Control Group
Exp – Experimental Group
SD – Standard Deviation
I – Interpretation
NS – Not Significant

Data revealed the students' performance under control and experimental groups in the pretest. Table 3 revealed that the students' mean scores of the control group in the pretest were lower than the experimental group, with mean values of 7.200 and 7.500, respectively. The standard deviations of the control and experimental groups are 0.790 and 0.970, respectively. Moreover, using these data in determining the significant difference between the two groups, the computed p-value is 0.458, which is lower than 0.05 ($p<0.05$), and thus the null hypothesis failed to reject. It shows no significant difference between the student's performance in the control and experimental groups regarding their pretest results.

Table 4. The Results of Performance of the Control and Experimental Groups in Post-test

	$\bar{x}$	SD	t-value	p-value	Decision	I
Ctrl	9.900	1.370	-2.7	0.015	Reject	S
Exp	11.800	1.750				

Legend:
$\bar{x}$ – Mean
Ctrl – Control Group
Exp – Experimental
SD – Standard Deviation
I – Interpretation
S - Significant

Table 4 shows the performance of the control and experimental group in the post-test. The table shows that the experimental group has a higher mean value than the control group. Additionally, the experimental group got a mean score of 11.800 with a standard deviation of 1.750, while the control group got a mean value of 9.900 with a standard deviation of 1.370. In determining the significant difference between the two groups on the post-test, the computed p-value is 0.015, which is lower than 0.05 ($p<0.05$), and thus the null hypothesis is rejected. Data showed a significant difference between the student's performance in the control and experimental groups in their pretest results.

Table 5. The Performance of the Control Group in their Pre-test and Post-test

Statistics	Control	
	Pre-Test	Post-Test
Mean	7.200	9.900
Standard Deviation	0.790	1.37
T – value	-6.38	
P - value	0.000	
Cohen's D (Effect Size)	2.414	
Decision	Reject H_o	

Table 5 shows the student's performance in the control group in their pretest and post-test. The post-test of the control group increased by 9.900 with a standard deviation of 1.370 compared with its pretest. A computed p-value is 0.000, lower than 0.05 ($p<0.05$); thus, the null hypothesis is rejected. Although the control group's mean score in the post-test is not relatively high, the conventional teaching method is also considered adequate. It has a significant effect on increasing the students' performance.

The results of the t-test between averages of a control group in the pretest and post-test are statistically significant. Therefore, the difference between the performance of the students of a control group in the pretest and post-test is significant.

Table 6. The Performance of the Experimental Group in their Pretest and Posttest

Statistics	**Experimental**	
	Pre-Test	Post-Test
Mean	7.500	11.800
Standard Deviation	0.970	1.75
T – value	-5.76	
P – value	0.000	
Cohen's D (Effect Size)	3.039	
Decision	Reject H_o	

Table 6 shows the experimental group's performance in their pretest and post-test. The post-test results of the experimental group increased by 11.800 with a standard deviation of 1.75, which means that scores are scattered away from the mean compared to the pretest. A computed p-value is 0.000, lower than 0.5 ($p<0.05$); thus, the null hypothesis is rejected.

The result of the t-test between the averages of the post-tests experimental group is statistically significant. Therefore, the difference between the student's performance in the experimental group in their pretest and post-test is significant. The treatment used in teaching trigonometric ratios was effective, and the degree of effect in using hand tricks is large. The use of hand tricks helps students in learning trigonometric ratios.

Conclusion

The study found that the conventional method and hand tricks effectively teach trigonometric ratios. However, those students who participated in the use of hand tricks in teaching performed better than those students who taught teaching conventional methods. The study was limited to the Grade 9 students at Bonifacio National High School.

Based on the conclusions and limitations of the study, the researcher recommended that the students' basic mathematics competency skills be improved to address gaps or difficulties in learning trigonometry. Hence, the study has verified a significant difference between the post-test performance of the control and experimental groups. It is recommended that we always use hand tricks in teaching trigonometric ratios. Moreover, the hand tricks are used in learning trigonometric ratios and be used as preparation for advanced trigonometric lessons.

Acknowledgment

Sincere thanks to all who share their time in finishing this piece.

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