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Self-guiding Worksheets: Strategy in Improving Students' Performance in Trigonometry

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Abstract **– This action research sought to determine the effectiveness of self-guiding worksheet as a strategy in presenting the topic Trigonometric Identities in Trigonometry among the freshman Bachelor in Secondary Education students of the University of Antique, Sibalom, Antique, Philippines, during the second semester, school year 2013 – 2014. Forty-three (43) students were taught using 10 self-guiding worksheets. After the 5-week intervention, only 40 students took the post-intervention performance test. In the post-intervention performance test, the students got a higher mean score than the pre-intervention performance test, that is, from below average to average. The improvement in the performance of the students was found to be significant. The finding shows that the use of self-guiding worksheet has improved the performance of the students in proving and operating expressions or simplifying identities involving trigonometric functions. The self-guiding worksheet is also their avenue of practicing their mathematical skills in solving trigonometric identities.**

Keywords **– Self-Guiding Worksheets, Trigonometry, Trigonometric Identities.**

I. INTRODUCTION

Students nowadays are lax in studying their lessons. In a classroom setting, they are easily interrupted and distracted by their seatmates and some of them get bored with the activities given to them. One of the findings shown in the Trends International Mathematics and Science Studies [1] revealed that Filipino students have poor performance in advanced mathematics; the Philippines placed 10th among 10 participating countries in the world.

Students often struggle in mathematics because of difficulties in organizing mathematical information spatially [2]. In trigonometry, specifically the topic "trigonometric identities", students have difficulties in solving and proving identities involving trigonometric functions. The teacher-researcher's students, although majoring in mathematics, expressed the difficulties they had encountered when they were in high school learning trigonometric identities. The students also mentioned that they wanted to learn more techniques in proving identities. Moreover, they suggested that lessons should be interesting and easily learned by giving more examples.

Classroom teachers provide various activities such as recitation, discussion, and seatwork to presumably encourage students' processing of information at a level that will facilitate knowledge acquisition and retention. Research findings revealed that seatwork is a category of classroom-activity to which greatest amount with an average of 50 percent of pupil time is assigned [8]. A particular format for seatwork activities is a worksheet.

One of the enrichment programs mentioned among researchers was the Kumon worksheet. According to Ukai [9], the Kumon method is a system developed in 1954 by Mr. Kumon Toru in Japan to support his son in improving his mathematics performance. Features of the curriculum include self-paced, timed, sequential, and incremental content and skills in the exercises.

The Kumon method made the self-guided worksheet and is designed to promote mastery learning through chunking and sequencing of the content, providing the examples and problems, and providing exercises to consolidate student's learning [3]. Oakley, et al. [7] studied Kumon method in Pontiac, Michigan, United States, and found that it appeared beneficial to at-risk students who had little or no support at home. According to Would [10], Kumon's strategies are effective teaching techniques for children who are struggl--ing in mathematics. Behavioral psychologists believe that skills are acquired by systematically progressing through the learning hierarchy: acquisition, fluency, generalization, and then adaptation and if instruction does not follow the learning hierarchy, the student's foundation will be shaky and the skill will not be mastered. Kumon's intervention starts at the fluency level, expecting students to master accuracy and speed simultaneously.

With the benefits the worksheet could provide, the teacher - researcher determined to use self - guiding worksheets patterned after the Kumon method in teaching trigonometry to improve the students' performance.

II. RESEARCH QUESTIONS AND HYPOTHESIS

A. *Statement of the Problem*

This study aimed to determine the effectiveness of self-guiding worksheet in teaching trigonometry among first year Bachelor of Secondary Education students. Specifically, it sought answers to the following research questions:

1) What is the level of pre-intervention and post-intervention performance in trigonometry of students?
2) Is there a significant difference in the pre-intervention and post-intervention performance in trigonometry of students?

B. *Hypothesis*

Based on the aforementioned problem, the following hypothesis was tested: There is no significant difference in the pre-intervention and post-intervention performance in trigonometry of students.

III. METHODOLOGY

A. *Self-guiding Worksheets*

The intervention utilized by the researcher was "self-guiding worksheets". These worksheets, prepared by the

teacher-researcher herself, were patterned after the Kumon method. There were 10 worksheets which discussed the topics in trigonometric identities for five weeks. Each worksheet was composed of three parts. The first part discussed the concept with examples to be learned and the second part dealt with problems for the students to work on. These problems were provided with scaffolding, like visual cues and instructions, to help the students. The third and last part was the set of exercises to consolidate students' learning and the scaffoldings were gradually reduced.

B. *Respondents*

The respondents were the 40 first year Bachelor of Secondary Education (BSEd) major in mathematics students enrolled in Mathematics 4 with a descriptive title Plane and Spherical Trigonometry at the University of Antique, second semester of school year 2013-2014. These students were from an intact class of 43, of whom only 40 were considered as respondents since the other three had not taken the post-intervention performance test. The students attended the trigonometry class scheduled Mondays, Wednesdays, and Fridays from 8:30 to 9:30 in the morning.

C. *Intervention*

The topics tackled were fundamental identities, sum and difference of two angle identities, double-angle identities, and half-angle identities using lecture and discussion.

The worksheets were given at the start of the class. The first two parts of the worksheet was introduced by the teacher-researcher. The lessons done inductively started with review, motivation, introducing the lesson by giving the concepts or definition or history to be learned, with sets of examples through the use of the worksheet as its first part. The second part of the worksheet was answered by the students; Thereafter, they were asked to generalize the lesson learned. The third part of the worksheet was answered in the remaining 10 to 15 minutes of the class time or if time allowed, the students could answer the third part at home. Finally, the teacher-researcher checked their work and gave them feedback.

D. *Data Collection Procedure*

To diagnose the students' problems in mathematics, the teacher-researcher conducted a writing activity to elicit their expectations in their trigonometry class and their suggestions to make their learning experience in trigonometry more meaningful. Some students wrote their suggestions to make the lessons in trigonometry easy. Essays were read and the problems encountered summed up.

The students' performance was obtained through an assessment given to them before and after the intervention period. The students' pre-intervention and post-intervention performance in trigonometry was determined through a 30-item validated multiple-choice test. Each correct answer was given one point. Test papers were checked, scores were tallied, and the means were computed. A student's total score was interpreted as follows: 25-30 Excellent, 19-24 Above average, 13-18 Average, 7-12 Below average, and 0-6 Poor.

E. *Data Analysis Procedure*

Descriptive analysis was done with the use of frequencies, mean, and standard deviation. The hypothesis was tested through t-test for related samples since the two scores were repeated measures. It is also used in a single group quasi-experimental study in which the same assessment is used as the pretest, before the intervention, and as the posttest, after the intervention [6]. Statistical significance level was set at 0.05.

IV. Results and Discussions

A. *Students' Pre-intervention and Post-intervention Performance in Trigonometry*

Table 1 shows that the students' post-intervention performance (M = 15.03; SD = 3.56) was higher than their pre-intervention performance (M = 7.98; SD = 2.40). The standard deviations for the groups showed that the pre-intervention performance of the students fell closely about the mean. Students had "below-average" performance in the pre-intervention test and "average" performance in the post-intervention test. This means that there was an improvement in the students' level of performance.

Table 1. Pre-intervention and Post-intervention Performance of Students in Trigonometry.

Variable	SD	M	Description
Pre-intervention Performance	2.40	7.98	Below-average
Post-intervention Performance	3.56	15.03	Average

B. *Difference in the Pre-Intervention and Post-Intervention Performance*

Table 2 shows that the significance level for the comparison of the average performance of the students was p = .000; thus, the difference in the students' performance was statistically significant. The trigonometry post-intervention performance of students was significantly higher than their trigonometry pre-intervention performan-ce.

The effect size is much larger than typical (d = 1.97), this is interpreted using Cohen's (1988) guidelines [6]. It means that the use of worksheets was practically important in improving the performance of the students. The use of worksheets indeed helped in improving the performance of the students in trigonometry.

Table 2. The t-test Result for Difference between the Students' Pre-intervention and Post-intervention Performance in Trigonometry.

Variable	M	SD	t	df	p
Pre-intervention Performance	7.98	2.40	12.479*	39	.000
Post-intervention Performance	15.03	3.56			

*significant at α= .05 (p < .001)

V. Conclusions

The use of self-guiding worksheets in this study somehow answered the problem on students' low performance in mathematics as shown by the significant change of the scores of the students. This implies that a worksheet has a potential in improving students' performance and has an impact on struggling students in mathematics. Therefore, mathematics teachers should be informed of the benefits that self-guiding worksheets can contribute to improving students' performance and teachers should utilize them in their mathematics classes.

The use of self-guiding worksheets helps teachers not just in focusing on subject matter alone but also in the process of teaching and learning. The strategy also gave the teacher-researcher direction to focus on students' progress and needs. Furthermore, the basic mathematical concepts were identified that the students need to learn first before continuing to complex ones.

VI. Recommendations

It is thus recommended that the teacher should develop students' positive perception in mathematics and interest in the use of self-guiding worksheet for the improvement of their performance. Teachers should also provide more meaningful and relevant learning experiences for students in a mathematics classroom to reinforce active learning. Utilization of the self-guiding worksheets should be adopted among mathematics teachers as a classroom activity.

This action research was conducted in only five weeks. It is recommended that teaching using worksheets be continued to cover the entire semester. Revisions to improve the worksheets should include the longer exposure of students to the worksheets, giving them feedbacks, and lesson development.

Topics should be chunked into simpler and specific subtopics emphasize each concept. The worksheets should be formulated with care and creativity in order to stimulate students' learning and interest.

Topics like sum and difference, double-angle, and half-angle identities application should be given more time since students have problems in manipulating fraction operations and cancellation of the same terms in a ratio, and have difficulty in combining similar terms.

Moreover, teachers may be guided to implement related activities such as collaborative learning or cooperative learning, peer tutoring, and small group discussion to reinforce the findings of the study.

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