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Empowering Success: Harnessing Crafted Modules to Support At-Risk Students

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ABSTRACT:

This study investigated the impact of crafted modules on mathematics performance among grade eight Open High School Program (OHSP) students at Bukidnon National School of Home Industries. The modules, designed using the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model and incorporating the Review- Real-life context-activity- Examine- Engage- Derive- Evaluate (RREEDE) Model, enabled flexible, self-paced learning. A sequential embedded experimental design and statistical analysis (frequency counts, percentages, mean, standard deviation, paired sample t-test) were employed. Results showed that the crafted modules significantly enhanced students' mathematics performance. This study demonstrates the effectiveness of integrating RREEDE and ADDIE models in modular instruction. Further research could include a discussion of applications toward more diverse populations and institutions.

KEYWORDS: *ADDIE model, Flexible learning, Mathematics performance, Modular instruction, RREEDE Model.*

1. INTRODUCTION

Educational research prioritizes strategies enhancing academic outcomes for students facing adversity. Whereas educational research focuses on instructional strategies that improve academic achievement for students experiencing adversity, this study explores the mathematics performance of students confronting challenging circumstances through modular instruction that utilizes a context-based model of instruction.

The academic careers of these students are frequently shattered by obstacles to learning progress and well-being. This study looked at modular instruction as the potential driver for positive change and made mathematical concepts relevant and applicable through real-life contexts and challenges to induce deeper understanding and engagement.

The study offered empirically grounded evidence based on quantitative and qualitative analyses to inform educational intervention. Ultimately, the goal is to offer real commendations for educators, policymakers, and course designers through practical strategies that can improve educational experiences, reduce dropout risk, and promote academic success.

2. LITERATURE REVIEW

The Open High School Program has its challenges, especially regarding the provision of quality service to students who have diverse needs, including financial and socio-economic differences, limited resources, varied learning styles, and socio-economic disparities (DepEd, 2020). To solve these problems, an innovative approach to instruction should be adapted. Modular instruction and context-based models offer promising solutions (Kulai & Kulai, 2018; Brown et al., 2015).

Grounded in Contextual Learning Theory (Brown et al., 2015) and Self-Directed Learning Theory (Siyahhan, 2017), this study investigated the effectiveness of the RREEDE model in OHSP mathematics education. The RREEDE model encourages active learning and deeper understanding through the application of real-world contexts, collaborative learning, and assessment.

Modular instruction-based research has shown that students are better engaged in the understanding of mathematics. It brings the students to the forefront by making abstract concepts meaningful in real-life contexts, thereby enhancing understanding and retention in better ways. Real-world contexts teach abstract ideas, while research gaps include, among others, its impact on OHSP students' mathematics performance, the effectiveness of modular instruction in different student populations, and student experiences and challenges in implementing modular instruction.

This will fill the gaps to finally form evidence-based instructional approaches in OHSP mathematics education.

3. RESEARCH QUESTIONS/OBJECTIVES

This study investigated the effectiveness of integrating the context-based instructional model (RREEDE) into grade eight mathematics modules for students in Open High School Program (OHSP). The study addressed the following research questions: Specifically, it sought to answer the following questions:

1. What are the pretest and posttest mathematics performance scores of OHSP students using RREEDE-integrated modules?

2. Is there a significant improvement in mathematics performance after using RREEDE-integrated modules?

3. What are the challenges and opportunities associated with implementing RREEDE-based modular instruction in OHSP?

4. PARTICIPANTS

The experiment participants were the Grade 8 OHSP students at Bukidnon National School of Home Industries (BNSHI), Maramag II District. The ages of these students range from 14 to 16 years old. They are enrolled in the OHSP mainly because some are working students, they cannot attend school every day, and some are tasked to care for their younger siblings. The residences of some students are far from school, and they need help to pay the daily fare to go to school. Within the municipality with twenty-two (22) barangays, only BNSHI offers the open high school program (OHSP). Thus, these students are in the OHSP because this is more convenient.

5. METHODOLOGY

5.1 Research design

Determining the effects of using the modules on the participants' mathematics performance employed the sequential embedded experimental design. This research design consists of two distinct phases: quantitative and qualitative. The researcher first collects and analyzes the quantitative data in this design. The qualitative data are collected and analyzed second in the sequence to help explain on the quantitative results obtained in the first phase. The quantitative experimental methodology establishes the priority of this model, and the qualitative dataset is embedded within that methodology. The sequential embedded experimental design is illustrated in Figure 1. The rationale for choosing this approach is that this sequential approach is practical when a researcher needs qualitative information after the intervention to explain the results of the intervention (Jaen et al., 2010).

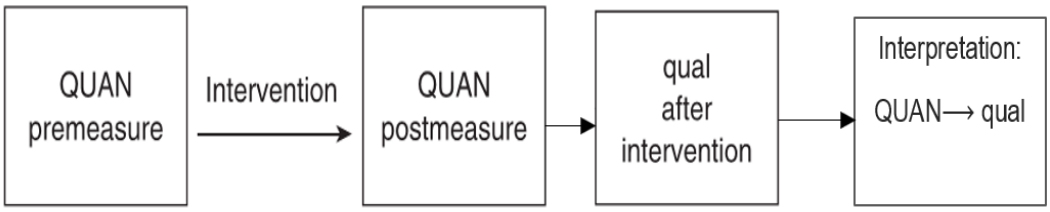


Figure 1 Visual model for sequential embedded experimental design

5.2 Instruments

The instrument used in this part of the study is the teacher-researchers-made pretest-posttest questionnaire; it is a multiple-choice type of test that consists of only 37 items covering the topic of Triangle Congruence. These items were scored using two scales, 0 or 1, 0 if the response is wrong and one if it is correct. A group of experts, the adviser, and the mathematics expert evaluated the pretest-posttest questionnaire for face and content validation. For the validity and reliability testing, the instrument was administered to the grade 9 students at Valencia National High School through an online platform using Google Forms. There were 60 items at the start, but after the item analysis, only 37 items met the criteria for validity. The test items obtained a KR20 reliability coefficient of 0.83 using the test checker and item analyzer (item analysis software) developed by Bermundo, Bermundo, and Ballester (2004).

5.3 Procedures or Data Collection

Before experimenting, the researcher asked consent from the Division of Bukidnon Schools Superintendent to use the Grade 8 Open High School Program students of Bukidnon National School of Home Industries (BNSHI) as the research participants in her study. The school principal and OHSP coordinator approved the letter. Arrangements were then made about how and when the study would be conducted.

The researcher just coordinated with the regular open high school program coordinator, who facilitated the distribution and retrieval of the modules. The modules were retrieved one week after being distributed to the students, so the students had a one-week duration for their independent study of the topic in the modules. The researcher oriented the grade 8 OHSP coordinator on administering the crafted modules to the students for the whole grading period.

Before the first module, the grade 8 OHSP coordinator administered the pretest on mathematics performance to the participants of this study. The participants personally appeared in school to take the pretest. After the students submitted the said tests, the first set of the modules was distributed. The students then brought these to their respective houses for them to independently study the self-learning modules. After a week, the students are required to return the module and get another set of modules. This is the usual routine in distributing and retrieving modules for the entire grading period of eight (8) weeks. In the ninth week, the students were again requested to appear in school to answer the posttest of the mathematics achievement test.

After the quantitative data from the experiment were analyzed, the name of the students was arranged based from their scorers, from highest to lowest, and then collected a sample of twenty (20) modules. Ten modules from the lower group and ten from the upper group were randomly collected for document analysis. Ten samples per group are enough for a homogeneous population (Sandelowski, 1995). The researchers coded the data so that no identity of the participant will be revealed. Each student was assigned a number. The code adopted was that of the gender of the student and their number. For example, if the participant is male and student number 7, the code is *MS7*. If the participant is a female with student number 28, the code is *FS28*.

5.4 Data Analysis

A data examination was conducted before data analysis. Data examination entails finding out whether there are missing values or values, whether the data is encoded correctly or otherwise, whether there are any outlier scores, and if the data is normally distributed or otherwise. Data examination is a very crucial step for any data analysis since it lets the researcher evaluate the influence of missing data and diagnose outliers (Hair et al., 2010).

The results of examination of data indicate there is no missing value; additionally, the data are adequately coded. Moreover, the paired differences of the mathematics performance pretest-posttest scores met the normality assumption.

The mathematics pretest-posttest scores were evaluated using the mean, standard deviation, and paired t-test. The mean and standard deviation were used to analyze, summarize, and describe the students' mathematics performance because these data are continuous. The paired t-test was employed to determine if a difference exists in the pretest and posttest scores.

The qualitative data that was carried out in this study were from the participants returned modules. Document analysis was performed on the returned modules. The researchers conducted skimming on the sampled modules and reading thoroughly those modules with answers, then, wrote observations of each sampled module. Next, performed a conventional content analysis, an inductive category development (Mayring, 2000), because the researchers do not have a preconceived category. The researchers grouped the text or phrases with the same meaning and then created a category for the text or phrases.

6. FINDINGS AND DISCUSSION

Table 1 below presents a summary of mean, standard deviation, and the paired t-test between pretest and post-test mathematics performance score. From the table above, it shows that the

mean score of the pretest is 9.50 out of 37 with a standard deviation of 2.96. This means that the scores could be higher and more dispersed. This indicates that the participants of this study need more background in the topic.The mean score in the posttest is relative as it is 13.07 compared to the pretest, while the standard deviation is 3.17, which is relatively higher than in the pretest. This reflects that the scores in the posttest are more dispersed than those in the pretest. This would depict the existence of students who gained high marks in the posttest.

Table 1. *Mean, standard deviation, and paired T-test summary between mathematics performance pretest and posttest score*

Mathematics Performance	Mean	n	SD	*t*	*df*	*p*
Pretest	9.50	30	2.96	5.21	29	.001
Posttest	13.07	30	3.17			

Perfect score: 37

Moreover, the paired sample t-test using an alpha level of $.05$ revealed a statistically significant result $t\,(29) = 5.21,\ p = .001$, which means that the posttest score $(M = 13.07,\ SD = 3.17,\ n = 30)$ is significantly higher than the pretest score$(M = 9.50,\ SD = 2.96,\ n = 30)$.

The above result shows that there is a statistically significant improvement in the mathematics performance of the students. However, from a practical point of view, the posttest score is still considered low, 13.07 out of 37, which is less than 50% of the perfect score. The reason might be that there was no face-to-face interaction or consultation with the teacher. Consultation in modular instruction is essential because modularization requires continuous follow-up and assessment of student's progress throughout the module/course to guide students on what they can do to improve (Wondifraw, 2019).

To explain the intervention's results further, the researcher analyzed the returned modules. She got ten modules from the group of students who got shallow scores (lower group) in the posttest and ten modules from the group who got a high score (upper group). Ten samples per group are enough for a homogeneous population (Sandelowski, 1995).

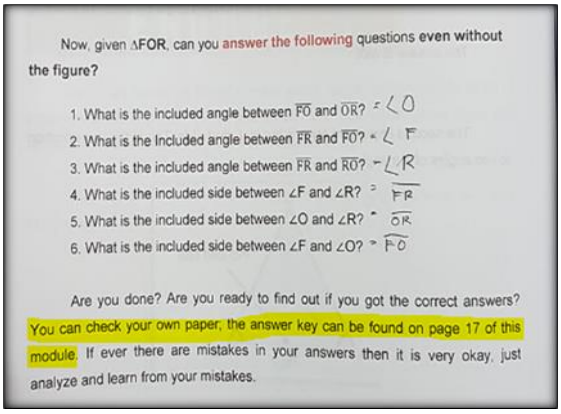
Based on the analysis of the returned modules of these two groups of students, the researcher found that most of the modules have no answers; some have answers but no traces that the students checked their modules, and only a few checked their answers. Table 2 compares students' returned modules from the lower and higher groups.

Table 2. *Frequency and percentage of modules with no answers, with answers but not checked, with answers and checked from lower and higher group*

Modules	Lower Group (n=10)		Higher Group (n=10)	
	f	%	*f*	%
with no answers	9	90	0	0
with answers but not checked	1	10	9	90
with answers and checked	0	0	1	10

The researcher found that most students who got low scores did not answer the module formative assessments. The modules have several formative assessments with answer keys

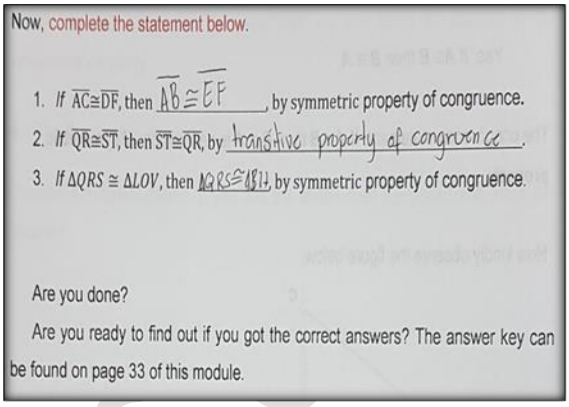
given towards the end of the module. In the RREEDE model, every section except ***the Review*** and ***Real-life context activity*** sections has formative assessments with instructions to check the students' paper (see example Figures 2-3). This probably means that students who got low scores in the posttest did not study their modules or, worse, did not even read the module's content. Most of the returned modules from the higher group answered the modules but did not check their answers.


Now, given ΔFOR, can you answer the following questions even without the figure?

1. What is the included angle between $\overline{FO}$ and $\overline{OR}$? ∠O
2. What is the included angle between $\overline{FR}$ and $\overline{FO}$? ∠F
3. What is the included angle between $\overline{FR}$ and $\overline{RO}$? ∠R
4. What is the included side between ∠F and ∠R? $\overline{FR}$
5. What is the included side between ∠O and ∠R? $\overline{OR}$
6. What is the included side between ∠F and ∠O? $\overline{FO}$

Are you done? Are you ready to find out if you got the correct answers? You can check your own paper; the answer key can be found on page 17 of this module. If ever there are mistakes in your answers then it is very okay, just analyze and learn from your mistakes.

Figure 2 *Returned module of female student number 8 (FS8)*


Now, complete the statement below.

1. If $\overline{AC}\cong\overline{DF}$, then $\overline{AB}\cong\overline{EF}$, by symmetric property of congruence.
2. If $\overline{QR}\cong\overline{ST}$, then $\overline{ST}\cong\overline{QR}$, by transitive property of congruence.
3. If $\Delta QRS \cong \Delta LOV$, then $\Delta QRS\cong\Delta LOV$, by symmetric property of congruence.

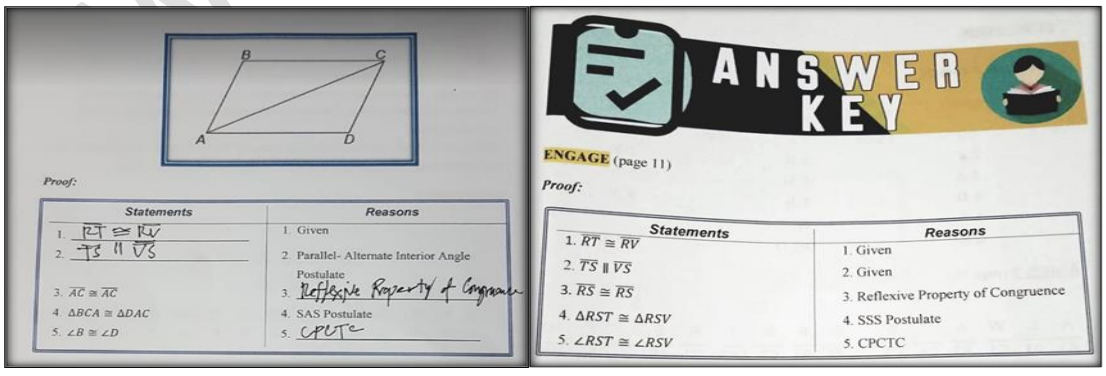
Are you done?

Are you ready to find out if you got the correct answers? The answer key can be found on page 33 of this module.

Figure 31 *Returned module of male student number 16 (MS16)*

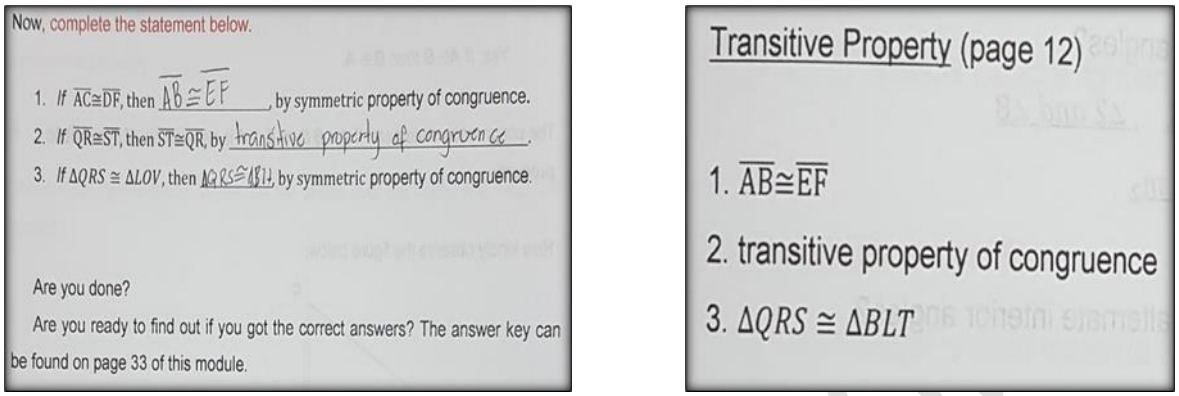
Moreover, the researcher further analyzed the 11 modules with answers (ten from the lower group and ten from the upper group). She found that some answers in the formative assessments were correct, but some copied the answers from the answer key and placed them in the wrong formative assessment task (see figures 2-3). Figure 4 shows the returned module of male student number 6 (MS6). In the engaging part, the students were asked to complete the two-column proof by filling in the blank (figure 4*a*). This formative assessment used the quadrilateral ABCD, but the MS6 answers used the letters R, S, T, and V, like "$\overline{RT}\cong\overline{RV}$."

On the other hand, figure 4*b* is the answer key attached to the module. We can see that MS6 answers in the formative assessments are the same as statements 1 and 2 in the answer key. In Figure 5, male student number 16 (MS16) copied the answer key for the activity on page 12 and placed the answers in the activity on page 10. The activity on page 10 is about the symmetric property, and the answer key is about the transitive property.



(a) *(a) Formative assessment* *(b) Answer key*

Figure 4 *Returned module of male student number 6 (MS6)*



(a) *Formative assessment on page 10* ***(b)*** *Answer key*

Figure 5 *Returned module of male student number 16 (MS16)*

Some students got the correct answers but needed help explaining their answers (see Figure 6). For example, the students were asked to fill out the concept map and explain briefly in the derive section. In the figure, MS18's answer in the concept map is correct, but he said he could not explain it because he did not know how to use it. This indicates that MS18 only copied the answers from the answer key.

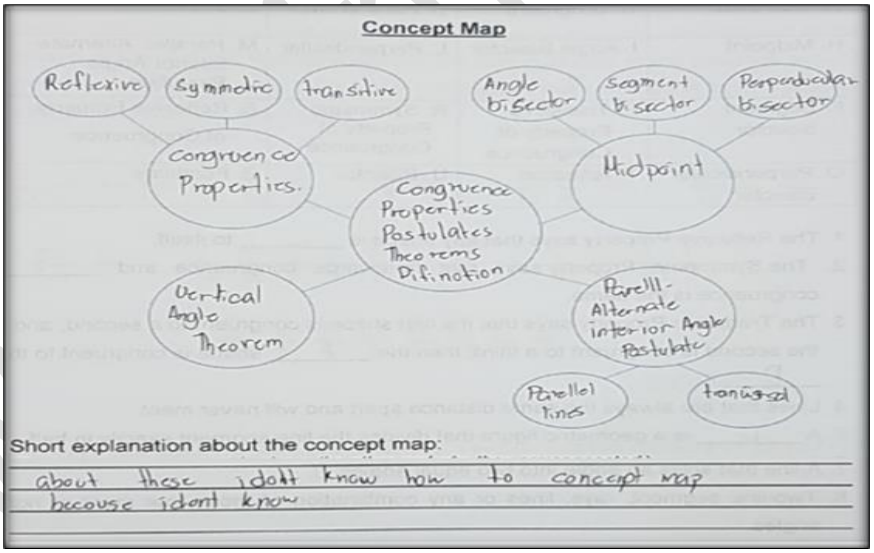


Figure 6 *Returned module of male student number 18 (MS18)*

In addition, in ***part A*** of the ***evaluation,*** some students unlocked the secret message (activity 2) but needed to answer correctly the pre-requisite activity (activity 1). In this part, there are two connected activities. Answers in Activity 2 come from the answers in Activity 1; the students fill out the "decoder" using the answers in Activity 1 (see Figure 7).

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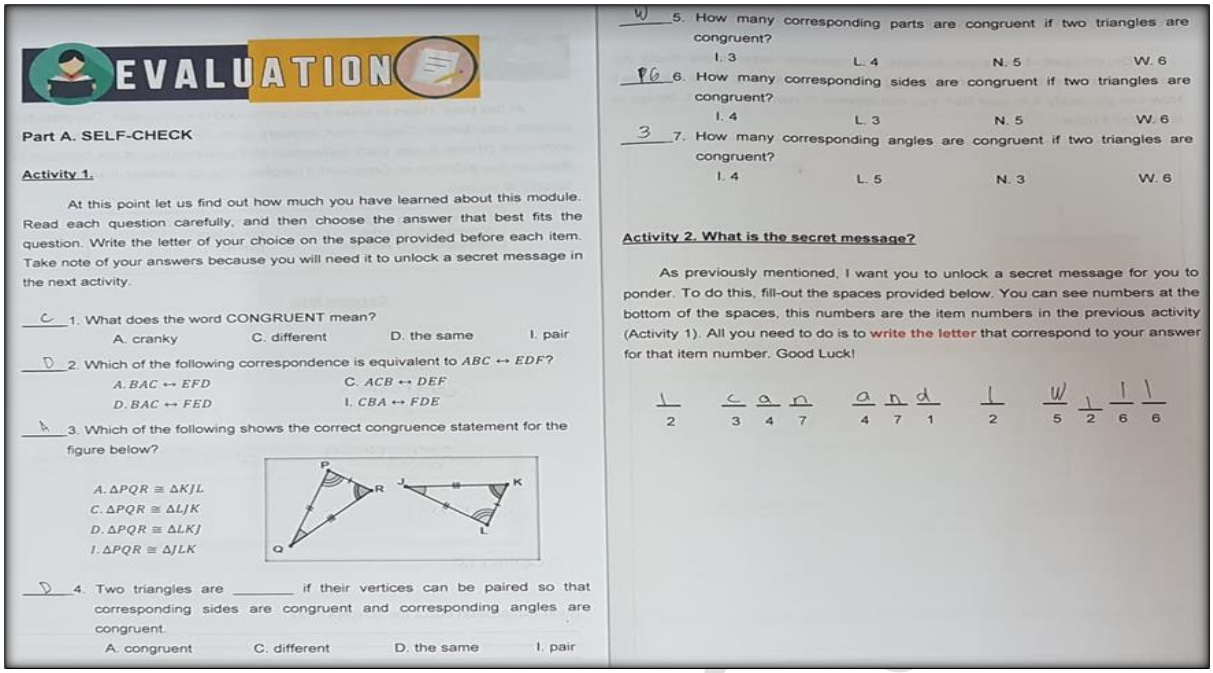

EVALUATION

Part A. SELF-CHECK

Activity 1.

At this point let us find out how much you have learned about this module. Read each question carefully, and then choose the answer that best fits the question. Write the letter of your choice on the space provided before each item. Take note of your answers because you will need it to unlock a secret message in the next activity.

C 1. What does the word CONGRUENT mean?
A. cranky C. different D. the same I. pair

D 2. Which of the following correspondence is equivalent to $ABC \leftrightarrow EDF$?
A. $BAC \leftrightarrow EFD$ C. $ACB \leftrightarrow DEF$
D. $BAC \leftrightarrow FED$ I. $CBA \leftrightarrow FDE$

A 3. Which of the following shows the correct congruence statement for the figure below?
A. $\Delta PQR \cong \Delta KJL$
C. $\Delta PQR \cong \Delta LJK$
D. $\Delta PQR \cong \Delta LKJ$
I. $\Delta PQR \cong \Delta JLK$

D 4. Two triangles are _____ if their vertices can be paired so that corresponding sides are congruent and corresponding angles are congruent.
A. congruent C. different D. the same I. pair

W 5. How many corresponding parts are congruent if two triangles are congruent?
I. 3 L. 4 N. 5 W. 6

P6 6. How many corresponding sides are congruent if two triangles are congruent?
I. 4 L. 3 N. 5 W. 6

3 7. How many corresponding angles are congruent if two triangles are congruent?
I. 4 L. 5 N. 3 W. 6

Activity 2. What is the secret message?

As previously mentioned, I want you to unlock a secret message for you to ponder. To do this, fill-out the spaces provided below. You can see numbers at the bottom of the spaces, this numbers are the item numbers in the previous activity (Activity 1). All you need to do is to write the letter that correspond to your answer for that item number. Good Luck!

I		c	a	n		a	n	d		I		W	I		I	I			
2		3	4	7		4	7	1		2		5	2		6	6			

Figure 72 *Returned module of male student number 1 (MS1)*

Furthermore, the research summarized the observations in the answered modules, as reflected in Table 3. It can be perceived in the table that the majority, about 55%, of the returned modules with answers had incorrect answers, more than 9% had wrong answers, more than 18% copied the answer key and placed it in a different formative assessment, and more than 27% did not have an explanation. This means that even the students in the upper group need more focus because the answer keys were provided to them. This could be one of the reasons the posttest score is still low: if the learner has no focus, the learning process is distorted (Tumuhimbise, 2019).

Table 3. *Summary of the researcher's observations in the answered modules (n=11)*

Observations	f	%
1. Wrong answers.	1	9.10
2. Answer key for a particular formative assessment was copied and placed in a different formative assessment	2	18.20
3. The answer is correct, but cannot explain the answer	3	27.30
4. Answers are correct	5	45.4

7. IMPLICATIONS

The results of this study have far-reaching implications for mathematics education in Open High School Programs. Using context-based instructional modules, particularly the RREEDE model, can enhance the performance of grade 8 students in mathematics. Moreover, the RREEDE model is an effective teaching strategy for Triangle Congruence, and its implications can be extended to mathematics education. Regular monitoring, feedback, and assessment have to be part of the modular instruction so that there is development of knowledge and understanding in the subject matter for the students. Moreover, it can be applied in face-to-face math classes because interesting and substantial learning experiences are promoted with the RREEDE model. Lastly, this study reiterates the need to

further research the issue in the applicability of modular learning to different populations considering the need for inclusive and flexible strategies in teaching.

8. CONCLUSION

This study proved the efficiency of modular instruction through the RREEDE model in improving mathematics performance among Open High School Program grade 8 students. The study findings show that modular instruction using context-based instructional modules, constant monitoring, and feedback can be effective. The applications of the RREEDE model in face-to-face mathematics classes and its efficiency in teaching Triangle Congruence are also noteworthy. Further research into how modular learning impacts those students who differ in more diverse student populations would need to be conducted. Finally, the results of the study impact mathematics education tremendously because of the need for creative, inclusive, and adaptive methods of instruction.

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