



Development and Evaluation of a Digitized Teaching-Learning Package for Grade 7 Geometry

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Abstract

The study developed and evaluated a digitized teaching-learning package for Geometry 7, adapted from the K-12 curriculum, that addressed the diverse needs of the students crucial in today's educational context. Development and evaluation and quasi-experimental research design utilizing the ADDIE model were used to develop and examine the effects of interventions and to guide the development and evaluation of effective digitized teaching-learning materials. The package presented detailed lesson plans with developed learning modules, teacher's guides, and PowerPoint presentations integrated with the GeoGebra application. The evaluation of the package based on content, instructional, and technical quality attained an excellent rating. The package's contents of each activity were relevant, well-organized, evaluative, illustrative, student-suited, and curriculum-aligned—the instructional materials presented clear and efficient explanations. Moreover, the technical presentation of the PowerPoint lessons was logical and sequential, and GeoGebra was integrated effectively. The study involved two regular sections of a public school, in which one section served as the group that utilized the package while the other group did not. Researchers determined the effectiveness of the package by comparing the posttest scores of both groups and the pretest and posttest scores of the experimental group. The evaluations significantly improved the experimental group students' geometric conceptualization and problem-solving skills. The results from implementing the package underscore its potential to enhance students' performance. By incorporating similar instructional materials, educational institutions could provide students with engaging and compelling learning experiences in Geometry.

Keywords: *ADDIE Model, Digitized, Geometry, Mathematics Performance, Teaching-Learning Package.*

A. Introduction

Digitization of education represents an effective effort to redesign education by applying digital platforms as a medium to provide enhancement services in the educational field. Utilizing digital tools can minimize the difficulties in teaching mathematics and improve learners' spatial intelligence and visualization in dealing with numbers, symbols, geometric objects, and mathematical statements (Djidu & Retnawati, 2022). Magsambol (2020) reported that the Trends in International Mathematics and Science Study (TIMSS) shows that the Philippines scored

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significantly lower than any other country that participated in Math and Science assessments, which is one manifestation of students' poor performance in Mathematics. Consequently, there must be an efficient investigation into the suitable strategies for teaching and learning mathematics that can increase the ranking of the 21st generation. Students often face challenges in mathematics due to a lack of prior knowledge, which hinders their ability to comprehend and apply newly acquired knowledge (Gafoor & Kurukkan, 2015). Creating and developing engaging teaching-learning materials that strengthen students' understanding and problem-solving proficiency in mathematics is essential to overcome these difficulties.

Furthermore, as stated in the study of (Hohenwarter 2009a, 2009b, Lavicza, et al., 2009), GeoGebra's design and graphical interface are straightforward and user-friendly, enabling students to use it as a learning tool intuitively without possessing any prior advanced computer skills. Dahar and Faize (2011) highlight in their study, *Effect of the Availability and the Use of Instructional Material on Academic Performance of Students in Punjab (Pakistan)*, that the teaching-learning package is an essential tool in delivering effective instruction. It encompasses a wide range of resources, both in print and digital formats, that teachers use to transmit knowledge to learners. Moreover, a teaching-learning package can help address the gaps in learning geometry because, according to the study of Sawangsri (2016), a teaching-learning package plays a vital role in high learning achievement. Effective geometry instruction must highlight visualization and understanding of abstract objects (Berthelot & Salin, 2013).

This study developed and evaluated a digitized teaching-learning package through GeoGebra as a tool for implementing mathematics subjects, specifically Geometry 7. The specific problem that the researchers want to address is whether using a digitized teaching-learning package significantly affects the teaching process and learning development. The researchers also aim to collect information supporting students' learning and understanding progress in Mathematics concepts in Geometry 7. The study aims to develop and test the effectiveness of a specific digitized teaching-learning package on the student's learning and understanding of Geometry 7. The digitized teaching-learning package is a supportive tool in their teaching, demonstrating how it develops students' understanding of Geometry and enhances their engagement and performance during the teaching-learning process. The implications of the results and findings focus on providing additional support for teaching and learning development. It also provides insights into the effectiveness of technology in enhancing students' understanding and engagement in mathematics concepts, especially in Geometry 7.

B. Methods

This section summarizes the research design, locale, respondents and subjects, and data gathering procedure and analysis used in the study.

1. Research Design

This is a quantitative research design utilizing development and evaluation research design utilizing a quasi-experimental approach. The quasi-experimental approach allowed researchers to investigate the effect of the intervention on the experimental group and compare it with the control group. Using one section with the digitized teaching-learning package and another without from the same school, a pretest was conducted for both groups to ensure they had the same baseline knowledge. The experimental group utilized the digitized teaching-learning package, while the control group used their regular setup. Afterward, a posttest was conducted on both groups to compare the results and performance of the students and determine the effectiveness of the digitized teaching-learning package. The quasi-experimental design strengthened evidence for intervention impacts, enhancing the validity of findings. The main focus of the development and evaluation of the digitized teaching-learning package was to help

and intervene in the challenges faced by students in constructing regular polygons and solving the sides and angles of a polygon. The digitized teaching-learning package was developed and evaluated by delivering lessons showcasing the step-by-step process and clearly visualizing polygons.

The ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model provided a systematic and comprehensive framework for designing and evaluating educational interventions. This model served as a guide or base for the researchers in designing and evaluating the teaching-learning package. It helped the researchers organize instructional design and determine appropriate learning goals, contents, materials, and practical tools in constructing and implementing the digitized teaching-learning package. The outcomes of this study were more significant and effective due to this structured approach, which improved both the development and evaluation of interventions. The researchers also created a reliable study outline using the ADDIE model, the quantitative quasi-experimental method, and the research and development design. The thorough approach strengthened the study's overall rigor, validity, feasibility, and efficacy, fostering progress and producing significant findings across different fields.

2. Locale of the Study

This study was conducted in South Cotabato, Philippines, where the digitized teaching-learning package was evaluated. Sto. Niño National High School, located at Purok Lapu-lapu, Barangay Poblacion, Sto. Niño, South Cotabato, is a public school and prominent educational institution that caters to educational programs from Junior High School to Senior High School. Grade 7 had one Special Science Curriculum (Sci-Curr) section, one Special Program in the Arts (SPA) section, and nine regular sections. There were thirteen Mathematics teachers overall, but only four taught for Grade 7 students in the academic year 2023-2024. Additionally, the evaluated and developed digitized teaching-learning package was implemented at Sto. Niño National High School offers a quality secondary curriculum to foster holistic student development. The school's classrooms have digital teaching materials such as Smart TVs, which teachers can utilize to deliver their lessons. This specific school was chosen to assess the effectiveness of the developed and evaluated digitized teaching-learning package for Grade 7 students.

3. Respondents and Subjects of the Study

The researchers selected three respondents to evaluate the digitized teaching-learning package: two (2) Mathematics professors and one (1) Science professor from Notre Dame of Marbel University. These respondents evaluated the study's digitized teaching-learning package's content, instructional, and technical quality. The study's subjects consisted of one public school with two regular sections. Two sections of Grade 7 pupils were chosen as the subjects for the experimental group and the control group. The control and experimental groups were kept apart for the experiment's reliability and validity because the control group did not employ a digitized teaching-learning package in contrast to the experimental group.

4. Research Instruments

The developed research instruments for evaluating the digitized teaching-learning package were created to examine the package's efficacy and impact on students thoroughly. The package was a thoughtfully chosen instructional resource to improve students' knowledge and critical thinking skills in a particular subject or area. It promoted an independent and collaborative digitized teaching-learning package by providing an organized set of resources, tasks, assessments, and instructions to maximize the learning experience of the target audience. The package's validation tool provided an essential evaluation instrument for assessing the package's relevance and quality. It allowed researchers, teachers, and other interested parties to carefully

analyze the instructional methodologies, learning objectives, and teaching-learning resources included in the package. By utilizing this tool, they could determine whether the digitized teaching-learning package aligned with the intended learning outcomes and effectively catered to the diverse needs of the learners. In order to ensure a well-rounded and thorough assessment, the Table of Specifications (TOS) was utilized to develop both the pretest and posttest. The precise format specified the allocation of assessment items across various cognitive levels and content areas, providing researchers and educators with a framework for constructing the tests. Moreover, the TOS indicated the number of questions corresponding to each learning outcome, the weight assigned to specific topics, and the questions' difficulty level. Compliance with the TOS ensured that both the pretest and posttest effectively assessed learners' knowledge and development, which aligned with the intended goals of the digitized teaching-learning package.

The pretest and posttest were both vital components of the evaluation process. The pretest reviewed the students' initial knowledge, while the posttest assessed the students' knowledge gained. By comparing the pretest and posttest scores, researchers could determine the overall impact of the digitized teaching-learning package in terms of efficacy in enhancing students' knowledge retention and problem-solving skills. The pretest and posttest consisted of multiple-choice questions, focusing on constructing a regular polygon and solving its sides and angles. It was determined that the digitized teaching-learning package was adequate for the students.

Pretest and posttest validation tools were used to verify the assessments' validity and reliability. This tool evaluated the test questions' clarity and relevance regarding learning objectives and appropriateness for the intended audience's level of intelligence. Using this tool, researchers and educators could identify any inconsistencies, confusion, or difficulties in the pretest and posttest, thus facilitating necessary revisions that enhanced the accuracy and validity of the assessment results. At last, the validation tool for the pretest and post-test improved the overall research findings on the effectiveness of the digitized teaching-learning package.

5. Data Analysis

The digitized teaching-learning package, composed of lesson plans, a learning module, a teacher's guide, GeoGebra, and a PowerPoint presentation, was evaluated in terms of its quality. The digitized teaching-learning package was evaluated into three categories: content quality, instructional quality, and technical quality. The interpretation of the evaluation tool for the digitized teaching-learning package involved several statistical measures and methods. The mean and the standard deviation of each expert's rating were then combined to determine the grand mean and the total standard deviation representing an overall evaluation score regarding content quality, instructional quality, and technical quality. Item analysis was carried out to ensure the quality and validity of the test questions in the evaluation tool. Several statistical measures, such as the difficulty index, discrimination index, and item-total correlation, were utilized to identify problematic or ineffective questions. Addressing and eliminating poor-quality questions improved the evaluation tool's validity and reliability. After the 30-item questionnaire was developed, it was implemented to assess student's knowledge and skills before and after utilizing the digitized teaching-learning package. The researcher used Aiken's V to determine the evaluation tool's content validity. Aiken's V is a statistical measure that assesses the extent of agreement between expert evaluations.

The mean score from these questionnaires provided perceptions of the digitized teaching-learning package's effectiveness in developing the students' mathematical comprehension. It is facilitated to determine the range to which the experts' ratings aligned, reflecting the evaluation tool's content validity level. A higher Aiken V value implies a more substantial agreement among the experts and strengthens the validity of the evaluation process. The validity of the pretest and posttest questions were evaluated by three validators using Aiken's V. Aiken's V was used to evaluate content validity, and item analysis examined the quality of test questions.

Moreover, the pretest and posttest questionnaires were validated for reliability tests. Cronbach's Alpha was utilized as a measure of reliability to evaluate the internal consistency of the evaluation tool (Morales, 2012). Cronbach's Alpha assessed the ranges to which the items in the pretest and posttest were interconnected and reliably measured the intended construct. A higher Cronbach's Alpha coefficient highlighted a more significant internal consistency, indicating that the evaluation tool was reliable in measuring the intended factors of the digitized teaching-learning package. This indicated that the test's items consistently measured the intended construct Cronbach's Alpha evaluated internal consistency. The chi-square test of independence examined the influence of demographics on pretest scores. The chi-square test for independence was conducted to examine the relationship between age and scores and sex and scores. The chi-square test for independence is a statistical analysis used to determine whether there is a significant association between two categorical variables.

The study intended to determine whether the posttest scores of the students with the digitized teaching-learning package and those without the digitized teaching-learning package were usually distributed. The normality test is a statistical process to evaluate whether a given data set follows a normal distribution. It is an essential step in statistical analysis as many parametric tests, like t-tests, assume that the data are typically distributed. The normality test supplies evidence on the data distribution's forms, features, and characteristics so the researchers can determine if the parametric tests' assumptions are met. The most frequently used normality test is the Shapiro-Wilk test. It analyzes a test statistic (W) and compares it to critical values to identify whether the data significantly varies from a normal distribution. In this measure, a non-significant p-value highlights no substantial evidence to reject the null hypothesis, indicating that the data can be normally distributed. The T-tests for dependent and independent means were conducted to evaluate the effectiveness of the digitized teaching-learning package. These statistical analyses provided insights into the impact of the digitized teaching-learning package, effectiveness across different groups, and potential interactions.

C. Findings and Discussion

This part presented the results from data on evaluating and implementing the digitized teaching-learning package.

1. The Developed Digitized Teaching-Learning Package

The developed digitized teaching-learning package in Geometry for Mathematics 7 consisted of the following instructional tools: Detailed Lesson Plans, Learning Modules, Teacher's Guides, GeoGebra Application, and PowerPoint Presentations.

Lesson Plans

The detailed lesson plan in Geometry for Mathematics 7 included various components that helped guide teachers in delivering effective instruction on Polygons. It began by stating clear objectives aligned with the learning competencies, specifying what students should have achieved by the end of the lesson. The lesson plan listed the required materials and resources to support instruction and student activities, such as textbooks, the GeoGebra application, and worksheets. The lesson plan involved an introduction activity to engage students and activate their prior knowledge of polygons. It then outlined the teaching strategies and procedures in a step-by-step process, breaking down the lesson into smaller parts and providing detailed instructions for each area. Figure 1 shows a screenshot of the preliminary part of the lesson plan.

 LESSON PLAN in MATHEMATICS		School: DepEd National High School	Grade Level: 7
Teacher: _____		Learning Area: Mathematics	Quarter: 3rd
Teaching Date: _____		Teacher: _____	_____
Teaching Time: _____		_____	_____
I. OBJECTIVES A. Content Standards The learner demonstrates understanding of key concepts of geometry of shapes and sizes, and geometric relationships. B. Performance Standards The learner is able to create models of plane figures and formulate and solve accurately authentic problems involving sides and angles of a polygon. C. Learning Competencies The learner constructs triangles, squares, rectangles, regular pentagons, and regular hexagons. (M7GE-III-a-1) D. Learning Objectives At the end of the lesson, the students should be able to: a. construct accurately regular polygons through ruler in compass and GeoGebra; b. synthesize their understanding clearly of the step-by-step construction process for triangles, squares, rectangles, regular pentagons, and regular hexagons, through justifying their approaches in constructing said polygons; and c. develop a sense of appreciation and confidence sincerely in their ability to construct regular polygons through consistent practice.			
II. CONTENT (Subject Matter)		Constructing regular polygons	
III. LEARNING RESOURCES			
A. References			
1. Teacher's _____			

 LESSON PLAN in MATHEMATICS		School: DepEd National High School	Grade Level: 7
Teacher: _____		Learning Area: Mathematics	Quarter: 3rd
Teaching Date: _____		Teacher: _____	_____
Teaching Time: _____		_____	_____
I. OBJECTIVES A. Content Standards The learner demonstrates understanding of key concepts of geometry of shapes and sizes, and geometric relationships. B. Performance Standards The learner is able to create models of plane figures and formulate and solve accurately authentic problems involving sides and angles of a polygon. C. Learning Competencies The learner solves problems involving the sides and angles of a polygon. D. Learning Objectives At the end of the lesson, the students should be able to: a. solve correctly problems involving the sides and angles of a polygon using the GeoGebra application; b. engage in real-world applications by effectively solving practical problems involving measurements, showcasing critical thinking skills and creativity in polygonal scenarios; and c. recognize their progress effectively and feel more confident in their ability to figure out number problems by making them ready to tackle even tougher challenges.			
II. CONTENT (Subject Matter)		Solving problem involving sides and angles of a Polygon	
III. LEARNING RESOURCES			
A. References			
1. Teacher's _____		Pages 3 - 18, Grade 7, Angles and Sides of a Polygon, MELC	
2. Learner's _____		Lesson 1 - 18, Angles and Sides of a Polygon, MELC	

Figure 1: Screenshots of the Lesson Plans

The researchers followed the format of the DepEd Order No.42, series of 2016, for the lesson plan. The researchers used the DepEd Order No.42, series of 2016, to create the detailed lesson plan, which included Objectives, Content/Subject Matter, Resources, Procedures, Assessment, and Assignment. The utilization of the GeoGebra application was integrated into the students' first and second formative assessments, as well as their assignments, created with a QR code to quickly scan the instructions of their assignments in the lesson plan.

Learning Modules

The two learning modules in the digitized teaching-learning package for Mathematics 7 provided a comprehensive, detailed, and structured system for understanding and applying concepts related to polygons. These parts included the cover page, pre-assessment, lesson proper, checkpoint, application, generalization, assignment, and post-assessment. Figure 2 shows the two learning modules' cover pages in different competencies containing the title, grade level, quarter, the topic's name based on the learning competencies, designed figures aligned with the topic, the title of the researcher's study, and the names of the researchers.

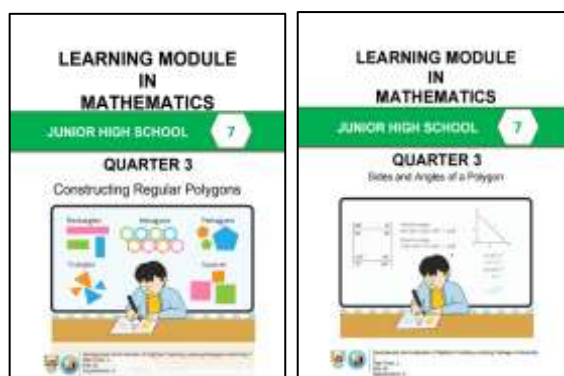


Figure 2: Screenshots of the Learning Modules Cover Pages

The learning module was the guide for the lesson in Constructing Regular Polygons and Sides and Angles of a Polygon. The learning modules served as the students' learning aids for the Constructing Regular Polygons and Sides and Angles of Polygon lessons. Its contents were based on the Curriculum Guide K-12 in Mathematics. Here are the screenshots of parts of the learning modules:

Pre-assessments

The pre-assessment part of the learning module in the digitized teaching-learning package included five (5) item questions aligned to the topics of the two learning modules. Figure 3 shows the screenshots of the pre-assessment part of the two-learning modules.

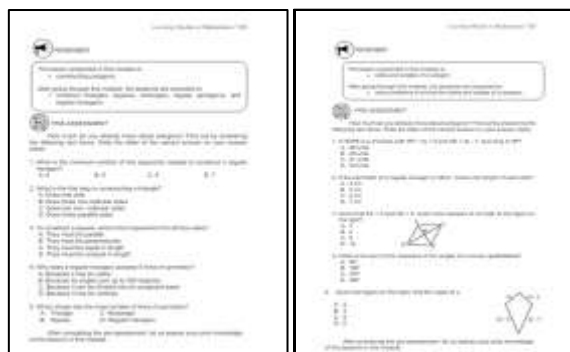


Figure 3: Screenshots of the Learning Modules Pre-Assessments

The pre-assessment part of the learning module in the digitized teaching-learning package aimed to measure the schemata of the learners and their understanding related to the topics of constructing regular polygons and sides and angles of polygons.

Learning Objectives

The learning objectives were statements that students needed to achieve by the end of the lesson. The objectives were composed across three cognitive, psychomotor, and affective domains. Figure 4 shows the screenshots of the learning objectives.

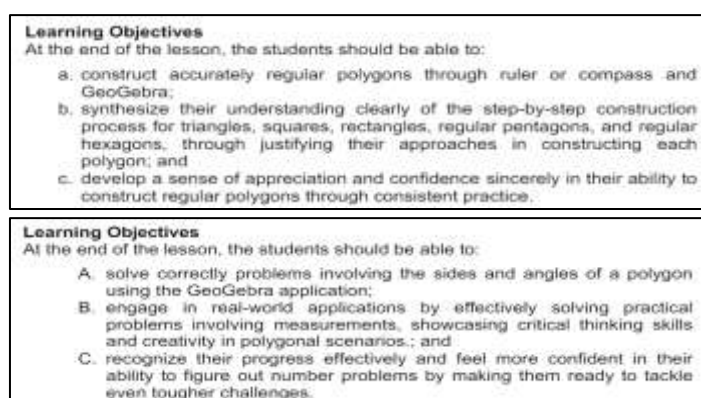


Figure 4: Screenshots of the Learning Modules Learning Objectives

They guided the students in achieving their goals for a specific topic and evaluating their progress at the end of the lesson, determining whether they could attain the different skills.

Lessons

The lesson sections of the two learning modules in the digitized teaching-learning package contained instructions with a step-by-step process for constructing regular polygons and solving the sides and angles of a polygon. Figure 5 shows screenshots of the lessons from the two learning modules.

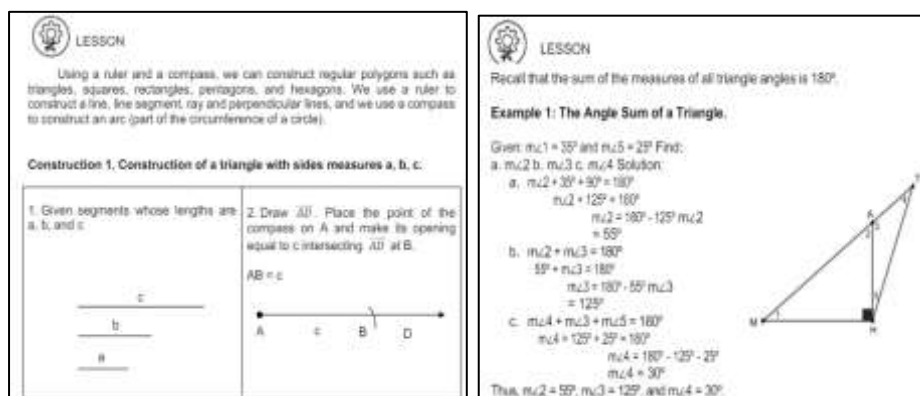


Figure 5: Screenshots of the Learning Modules Lessons

The lesson-proper sections gave an overview of what the teacher would discuss and what new knowledge learners would acquire during the discussion. This module's contents and learning activities were designed to provide motivating and worthwhile learning experiences for learners and the teacher.

Checkpoints

The digitized teaching-learning package's checkpoint part of the learning module contained tasks that required step-by-step solutions. Figure 6 shows the screenshots of the checkpoint part of the two learning modules.

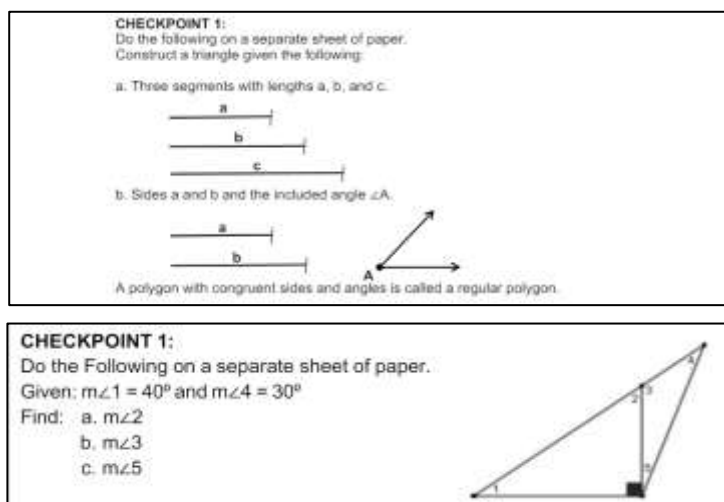


Figure 6: Screenshots of the Learning Modules Checkpoints

The checkpoints part of the learning module helped the students assess their learning and monitor their progress in constructing regular polygons and solving problems involving the sides and angles of polygons.

Applications

The application was an activity part of the learning module in the digitized teaching-learning package that contained detailed instructions, including figures for visual representation of the given problems. Figure 7 shows the screenshots of the application part of the learning module based on the topics of the two learning modules.

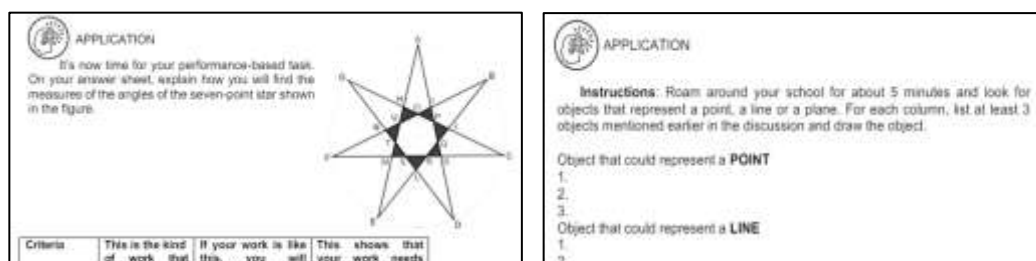
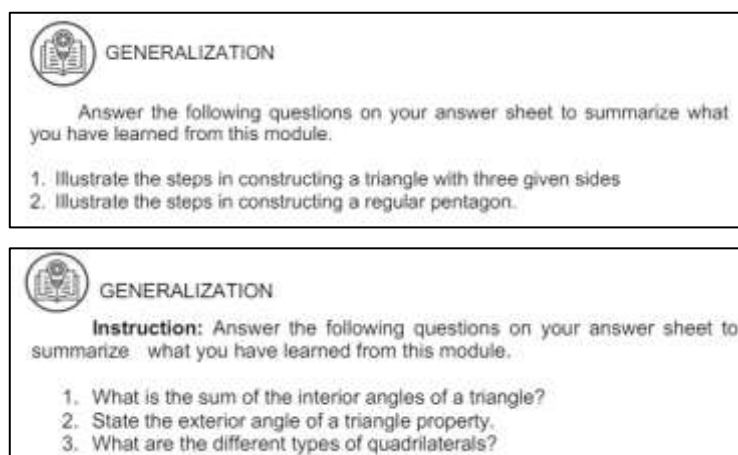


Figure 7: Screenshots of the Learning Modules Applications

The application part of the learning module was designed to provide motivating and worthwhile learning experiences for the learners. Through these application activities, students could relate their knowledge of constructing regular polygons and solving problems involving the sides and angles of polygons to real-life contexts.

Generalizations

The generalizations part of the learning module in the digitized teaching-learning package contained guided questions that students needed to summarize what they had learned from the discussion in constructing regular polygons and the sides and angles of polygons. It included instructions. Figure 8 shows screenshots of the generalizations of the two learning modules.

**Figure 8:** Screenshots of the Learning Modules Generalizations

The generalization part of each learning module provided an abstraction about the lesson of constructing regular polygons and sides and angles of polygons. It was a part of the learning modules where the students shared their insights or takeaways based on their discussions.

Assignments

The assignments section of the two learning modules in the digitized teaching-learning package included QR codes that students scanned to access problems in each topic, used the GeoGebra application, and submitted their answers through Google Forms. Figure 9 shows the screenshots of the assignment part of the two learning modules.

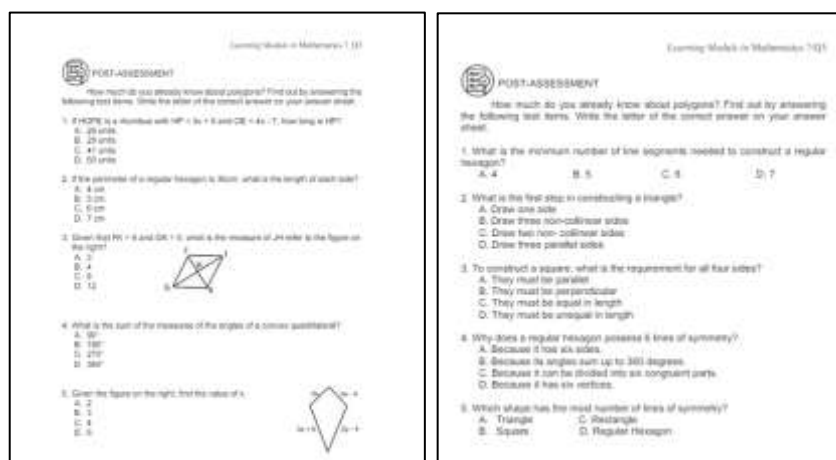


Figure 9: Screenshots of the Learning Modules Assignments

The assignment sections of the learning module provided additional activities for remediation, helping students master the lessons on constructing regular polygons and solving problems involving sides and angles of polygons.

Post-assessments

The post-assessments part of the two learning modules in the digitized teaching-learning package consisted of the same questions as the pre-assessment, with five (5) items aligned to constructing regular polygons and the sides and angles of a polygon. Figure 10 shows the screenshots of the post-assessment part of the two learning modules.

**Figure 10:** Screenshots of the Learning Modules Post-Assessments

The post-assessments were prepared to determine the learners' understanding, assessing whether they had gained knowledge and achieved the expected learning outcomes by the end of the lessons on constructing regular polygons and solving the sides and angles of polygons.

Teacher's Guides

The teacher's guides in the digitized teaching-learning package offered comprehensive support to educators in effectively implementing the teaching-learning materials. The teacher's guides also supplied answers and step-by-step explanations for the exercises and activities in the two learning modules. Figure 11 shows the two teacher's guide cover pages containing the title, grade level, quarter, the topic's name based on the learning competencies, a designed picture representing different types of polygons, the title of the researcher's study, and the names of the researchers.

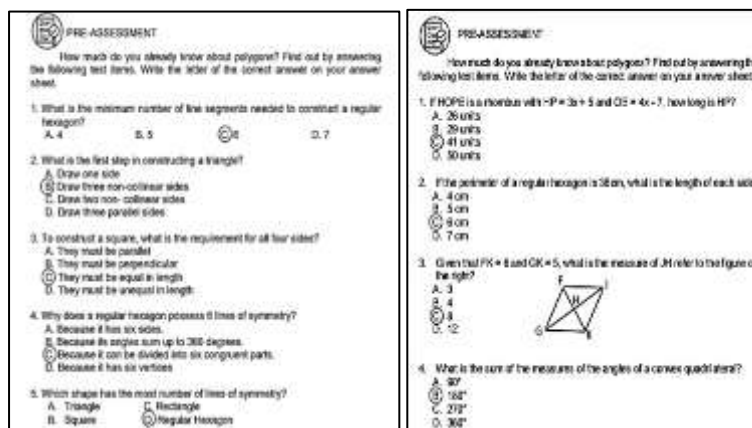


Figure 11: Screenshots of the Teacher's Guides Cover Pages

The teacher's guide contained parts corresponding to the learning modules, including the best answers for the pre-assessment, checkpoint, application, generalizations, assignments, and post-assessment areas. Its contents were based on the Curriculum Guide K-12 in Mathematics. Here are the screenshots of parts of the teacher's guides:

Pre-assessments

The pre-assessment part of the teacher's guide in the digitized teaching-learning package included five (5) item questions with correct answers aligned with the topics of the two learning modules. Figure 12 shows the screenshots of the pre-assessment part of the two teacher's guides containing the encircled correct answer for each item.

**Figure 12:** Screenshots of the Teacher's Guides Pre-assessments

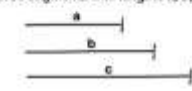
The pre-assessment part of the teacher's guide tested the students' prior knowledge, skills, and understanding related to constructing regular polygons and solving sides and angles of a polygon. It guided the teacher to tailor their strategies to help students learn effectively.

Checkpoints

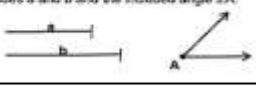
The checkpoint part of the teacher's guide in the digitized teaching-learning package contained tasks with step-by-step and detailed solutions for each item, including figures for visual representation of the given statement problem. Figure 13 shows the screenshots of the checkpoint part of the two teacher's guides based on the topics of the two learning modules.

CHECKPOINT 1:
Do the following on a separate sheet of paper.
Construct a triangle given the following:

a. Three segments with lengths a, b, and c.



b. Sides a and b and the included angle $\angle A$.



CHECKPOINT 1:
Do the following on a separate sheet of paper.
Given: $m\angle 1 = 40^\circ$ and $m\angle 4 = 30^\circ$

Find: a. $m\angle 2 =$
b. $m\angle 3 =$
c. $m\angle 5 =$

Solution:

a. $m\angle 2 + 40^\circ + 90^\circ = 180^\circ$
 $m\angle 2 + 130^\circ = 180^\circ$
 $m\angle 2 + 130^\circ - 130^\circ = 180^\circ - 130^\circ$
 $m\angle 2 = 50^\circ$

b. $m\angle 2 + m\angle 3 = 180^\circ$
 $50^\circ + m\angle 3 = 180^\circ$
 $50^\circ + m\angle 3 - 50^\circ = 180^\circ - 50^\circ$
 $m\angle 3 = 130^\circ$

c. $m\angle 4 + m\angle 3 + m\angle 5 = 180^\circ$
 $30^\circ + 130^\circ + m\angle 5 = 180^\circ$
 $160^\circ + m\angle 5 = 180^\circ - 160^\circ$
 $m\angle 5 = 20^\circ$



Figure 13: Screenshots of the Teacher's Guides Checkpoints

The checkpoints part of the teacher's guide helped teachers assess student learning and monitor progress in constructing regular polygons and solving sides and angles of polygons. It was organized comprehensively to help learners understand and grasp the information and concepts quickly and effectively.

Applications

The Application was an activity part of the teacher's guide in the digitized teaching-learning package that contained tasks with complete instructions and detailed answers, including figures for visual representation of the given problems. Figure 14 shows the screenshots of the application part of the two teacher's guides based on the topics of the two learning modules.

APPLICATION

Instructions: Roam around your school for about 5 minutes and look for objects that represent a point, a line or a plane. For each column, list at least 3 objects mentioned earlier in the discussion and draw the object.

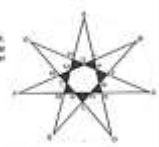
Object that could represent a **POINT** (answer may vary on the objects of the students):

- 1.
- 2.
- 3.

Teacher's Guide to Mathematics 7/8

APPLICATION

It's time for your performance-based task. On your answer sheet, explain how you will find the measure of the angles of the star-shaped star shown in the figure.



Criteria	This is the kind of work that exceeds expectations.	If your work is that good, you will definitely get a passing mark.	This shows that your work is excellent, improved and more effort.
Content (40%)	The information presented is correct, accurate, up-to-date, and easy to read.	The information presented is correct and accurate.	The information presented is adequate and many parts are inconsistent.
Clarity (20%)	The answers are easy to follow and easy to read.	The answers are easy to follow but contain unnecessary details.	The answers are disorganized and confusing.
Completeness (20%)	All questions are answered, and all questions are answered.	Almost all questions are answered.	Some questions are not answered, and some questions are answered.

Solutions:
 Since the measure of each interior angle of the heptagon, this measure is equal to each of the measures of $\angle A$, $\angle B$, $\angle C$, $\angle D$, $\angle E$, $\angle F$, and $\angle G$. Since vertical angles are congruent, an interior angle of the heptagon is $2 \times (180^\circ - 7 \times 180^\circ) = 126.86^\circ$. Hence, $m\angle D = m\angle F = m\angle C = m\angle E = m\angle B = m\angle A = m\angle G = 126.86^\circ$.

Figure 14: Screenshots of the Teacher's Guides Applications

The application part of the teacher's guide was designed to provide motivating and worthwhile learning experiences for both learners and teachers. Through these application activities, they could relate their knowledge of constructing regular polygons and solving sides and angles of polygons to real-life contexts.

Generalizations

The generalizations section of the teacher's guide in the digitized teaching-learning package contained guided questions to summarize what students had learned from a discussion on constructing regular polygons and sides and angles of polygons. It included instructions and the best step-by-step answers, including figures for visual representation of possible student answers. Figure 15 shows the screenshots of the generalizations section of the two teacher's guides based on the topics of the two learning modules.

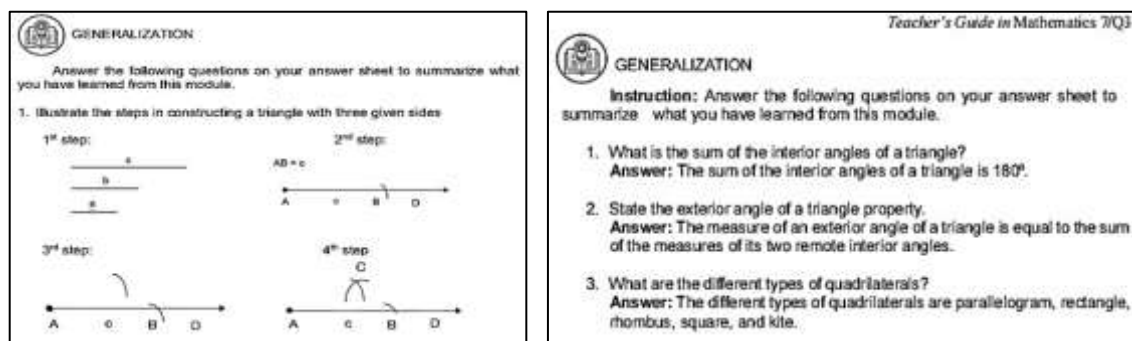


Figure 15: Screenshots of the Teacher's Guides Generalizations

The Generalizations part of each teacher's guide provided an abstraction about the lessons of constructing regular polygons and solving the sides and angles of polygons. It was a part of the teacher's guides and learning modules where teachers could hear the insights or takeaways of the students based on their discussions.

Assignments

The Assignments section of the teacher's guide in the digitized teaching-learning package contained instructions on how students were to answer and pass their assignments. It included QR codes that students scanned to access problems in each topic, used the GeoGebra application, and submitted their answers on Google Forms. Figure 16 shows the screenshots of the assignments section of the two teacher's guides based on the topics of the two learning modules.

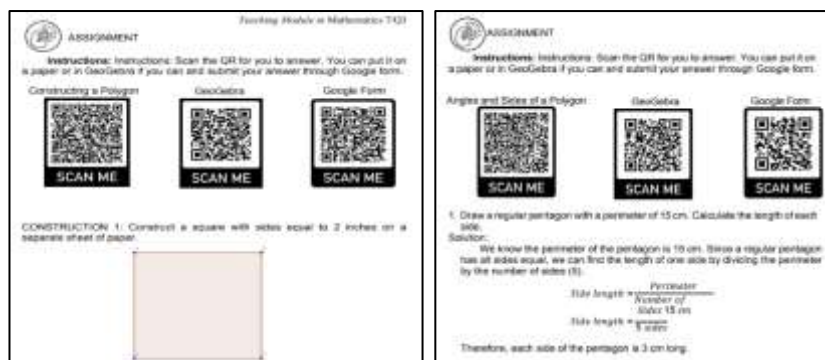


Figure 16: Screenshots of the Teacher's Guides Assignments

These sections of the teacher's guide provided additional activities for remediation, helping students master the lessons on constructing regular polygons and solving problems involving the sides and angles of polygons.

Post-assessments

The post-assessments section of the teacher's guide in the digitized teaching-learning package was the same as the pre-assessment, consisting of five (5) item questions related to constructing regular polygons and solving sides and angles of a polygon. Figure 17 shows the screenshots of the post-assessments section of the two teacher's guides with encircled correct answers.

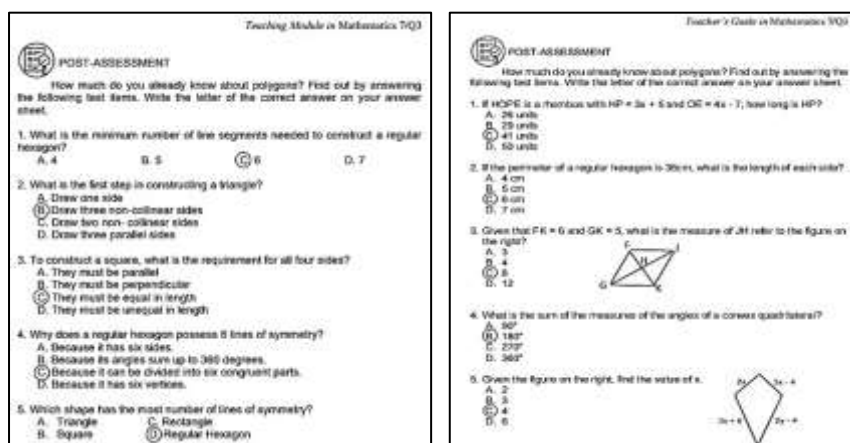


Figure 17: Screenshots of the Teacher's Guides Post-assessments

The post-assessments were prepared to determine the learners' understanding, assessing whether they had gained knowledge and achieved the expected learning outcomes by the end of the lessons on constructing regular polygons and solving sides and angles of a polygon.

GeoGebra Application

The digitized teaching-learning package included the GeoGebra application utilized in each lesson, constructing regular polygons and solving the sides and angles of a polygon. The teacher used the GeoGebra application during the teaching-learning process to demonstrate the steps in constructing specific polygons, utilizing the application's accessible and usable elements. Additionally, in the teaching-learning process of the sides and angles of a polygon, the teacher utilized the GeoGebra application to show the students the figures for the outcomes of their answers. The teacher used the GeoGebra application to help students understand the practical application of their lessons. Figure 18 shows the image of the GeoGebra during implementation.

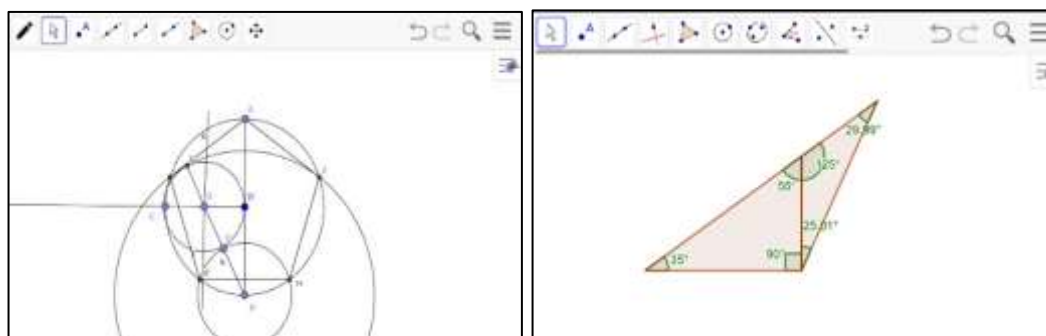


Figure 18: Images of the GeoGebra

Additionally, the GeoGebra application was used to deliver the assignment. The students could access it through a QR code or link presented in the PowerPoint presentation and the students' learning modules. Moreover, figures 19 and 20 show the images of the assignment in the GeoGebra application.

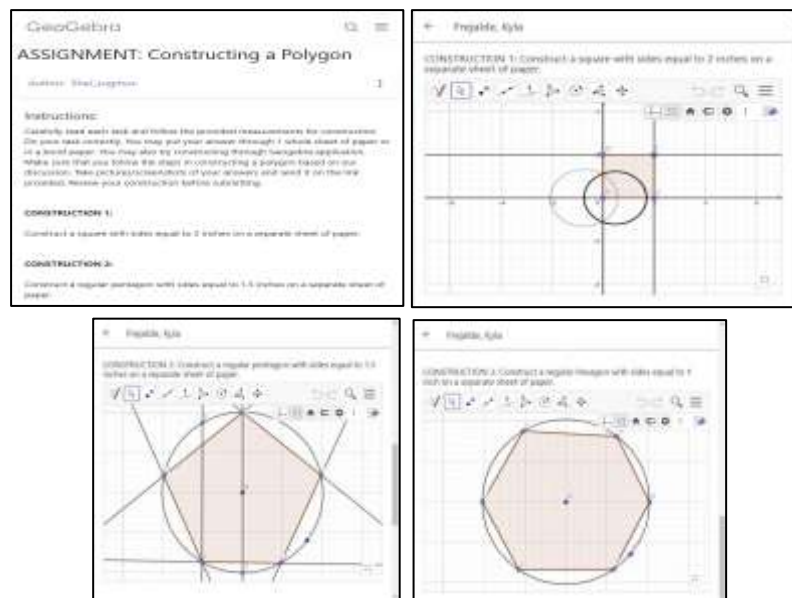


Figure 19: Images of the Assignments for Constructing Polygons in GeoGebra

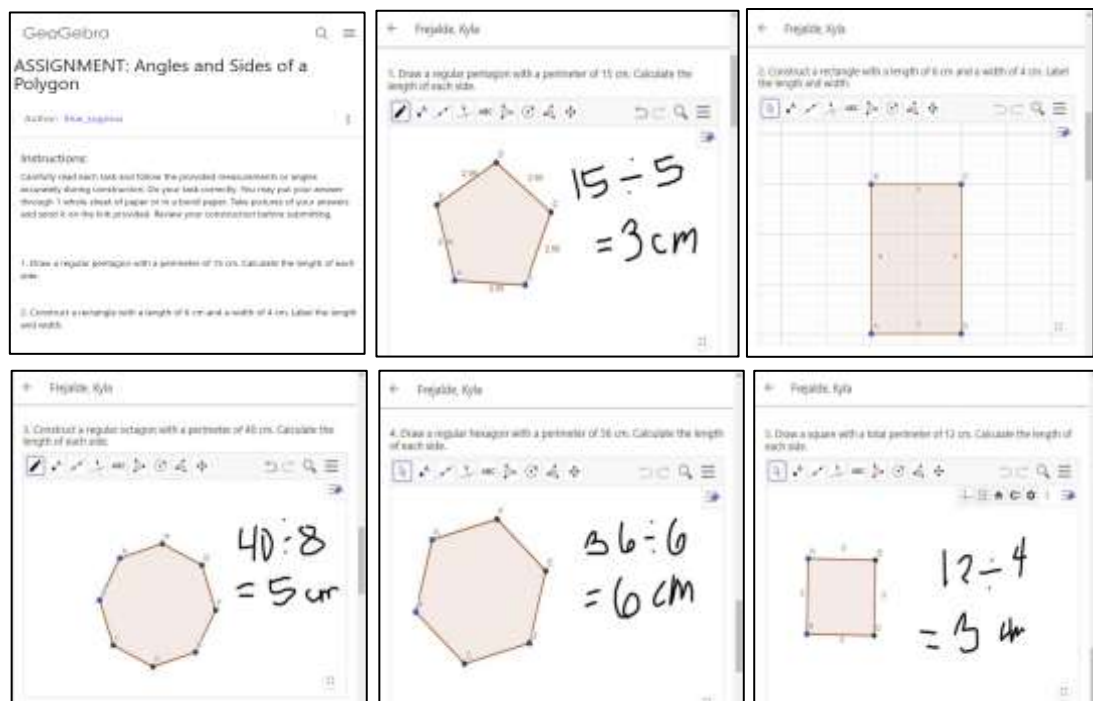


Figure 20: Images of the Assignments for Angles and Sides of Polygons in GeoGebra

Overall, the GeoGebra application made the lessons well-presented and enhanced students' understanding of various concepts. The application encouraged exploration and discovery among students through its integration into the learning process. With this application, instructions were delivered effectively, utilizing digital technology in teaching-learning, which was relevant in today's education context.

PowerPoint Presentations

The PowerPoint presentations included in the digitized teaching-learning package served as visual materials to support classroom discussion. These presentations involved engaging visuals, diagrams, and step-by-step explanations, making complex concepts more accessible and

comprehensible to students and teachers. Figure 21 shows the PowerPoint presentation utilized by the teacher in class.

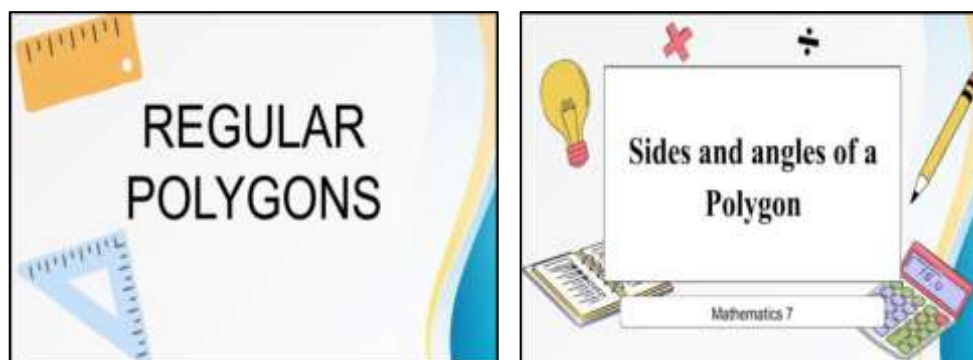


Figure 21: The PowerPoint Presentations

PowerPoint presentation serves as the students' learning aid for their learning and understanding of the lesson in constructing regular polygons and solving sides and angles of a polygon. The researchers utilized Canva to create the presentation.

2. Psychometric Properties of the Developed Digitized Teaching-Learning Package

Table 1: Results of the Evaluation of the Developed Digitized Teaching-Learning Package in Terms of Content Quality

I. Content Quality Criteria	Mean	SD	Verbal Description
1. The content is scientifically adequate and accurate.	4.87	0.16	Excellent Quality
2. Emphasize active learning.	4.80	0.17	Excellent Quality
3. The contents of each activity are relevant to the objectives.	4.93	0.12	Excellent Quality
4. It is well organized.	4.93	0.12	Excellent Quality
5. It evaluates student learning as stated in the objectives.	4.90	0.17	Excellent Quality
6. It allows the development of multiple intelligences.	4.80	0.20	Excellent Quality
7. Topics are supported by illustrations and tasks suited to students.	4.93	0.12	Excellent Quality
8. It is aligned with the curriculum.	5.00	0	Excellent Quality
9. The contents are free to ethnicity, gender, and other stereotypes	4.93	0.12	Excellent Quality
Overall result	4.90	0.13	Excellent Quality

Mean Interpretation: 1.00-1.50 Very Poor Quality | 1.51-2.50 Poor Quality | 2.51-3.50 Good Quality | 3.51-4.50 Very Good Quality | 4.51-5.00 Excellent Quality

The six (6) highest means were for statements number 3, 4, 5, 7, 8, and 9, with a mean of 4.93 and a standard deviation of 0.10, found to be excellent quality. The lowest mean scores were for statements 2 and 6, each with a mean score of 4.8 and a standard deviation of 0.19, indicating that the digitized teaching-learning package should emphasize active learning and allow the development of multiple intelligences. Overall, the digitized teaching-learning package had excellent quality in terms of content, with an overall mean of 4.90 and an overall standard deviation of 0.13.

Table 2: Results of the Evaluation of the Developed Digitized Teaching-Learning Package in Terms of Instructional Quality

II. Instructional Quality Criteria	Mean	SD	Verbal Description
1. It provides feedback on the accuracy of the student's answer.	4.87	0.15	Excellent Quality
2. It is of high educational value	4.77	0.15	Excellent Quality
3. It is a good supplement to the curriculum.	4.83	0.15	Excellent Quality
4. It addresses the needs and concerns of the students	4.77	0.15	Excellent Quality
5. The manual facilitates collaborative and interactive learning.	4.83	0.06	Excellent Quality
6. It integrates student's previous experience.	4.80	0.10	Excellent Quality
7. The manual introduction helps answer follow-up questions.	4.93	0.12	Excellent Quality
8. It reflects current trends in physics instruction and experiments.	4.87	0.15	Excellent Quality
9. The graphics and colors used are appropriate for instructional objectives.	4.77	0.25	Excellent Quality
Overall result	4.83	0.14	Excellent Quality

Mean Interpretation: 1.00-1.50 Very Poor Quality | 1.51-2.50 Poor Quality | 2.51-3.50 Good Quality | 3.51-4.50 Very Good Quality | 4.51-5.00 Excellent Quality

The overall mean in the instructional quality of the digitized teaching-learning package was 4.83, with a standard deviation of 0.14, indicating that it had excellent quality in terms of instructions. Statements numbers 1, 7, and 8 utilized the highest mean of 4.89 and standard deviation of 0.14, suggesting that the digitized teaching-learning package provided feedback on the accuracy of the student's answers, the manual introduction helped answer follow-up questions, and it reflected current trends in physics instruction and experiments. On the other hand, statements 2, 4, and 9 utilized the lowest mean, indicating that the digitized teaching-learning package should have high educational value, address the needs and concerns of the students, and that the graphics and colors used should be appropriate for instructional objectives. Furthermore, the evaluation results indicated that the digitized teaching-learning package had excellent instructional quality, with an overall mean of 4.83 and a standard deviation of 0.18.

Table 3: Results of the Evaluation of the Developed Digitized Teaching-Learning Package in Terms of Technical Quality

III. Technical Quality Criteria	Mean	SD	Verbal Description
1. The manual is easy to understand.	4.70	0.20	Excellent Quality
2. The manual allows learners to control the pace of learning.	4.87	0.15	Excellent Quality
3. The graphics are excellent	4.93	0.12	Excellent Quality
4. The layout and design are attractive	4.77	0.06	Excellent Quality
5. Intend users can easily and independently use the manual.	4.73	0.06	Excellent Quality
6. The language used is clear, concise, and motivating.	4.93	0.12	Excellent Quality
7. The manual is aesthetically pleasing.	4.76	0.06	Excellent Quality

III. Technical Quality Criteria	Mean	SD	Verbal Description
8. The symbols used are well- define	4.86	0.06	Excellent Quality
9. Topics are presented in a logical and sequential order.	4.96	0.06	Excellent Quality
Overall result	4.83	0.10	Excellent Quality

Mean Interpretation: 1.00-1.50 Very Poor Quality | 1.51-2.50 Poor Quality | 2.51-3.50 Good Quality | 3.51-4.50 Very Good Quality | 4.51-5.00 Excellent Quality

The overall mean in the technical quality for the digitized teaching-learning package was 4.83, with a standard deviation of 0.10, which was found to be excellent quality. Statement 9 utilized the highest mean of 4.96, with a standard deviation of 0.06. Statements 1 and 5 utilized the lowest mean of 4.71, indicating that the manual was easy to understand and intended users could quickly and independently use it. The evaluators agreed that the technical quality of the digitized teaching-learning package was excellent, with an overall mean of 4.83 and an overall standard deviation of 0.10.

Table 4: Summary Results on the Evaluation of the Developed Digitized Teaching-Learning Package

Criteria	Overall Mean Score	Overall SD Score	Verbal Description
Content Quality	4.90	0.13	Excellent Quality
Instructional Quality	4.83	0.14	Excellent Quality
Technical Quality	4.83	0.10	Excellent Quality
Overall Result	4.85	0.12	Excellent Quality

Mean Interpretation: 1.00-1.50 Very Poor Quality | 1.51-2.50 Poor Quality | 2.51-3.50 Good Quality | 3.51-4.50 Very Good Quality | 4.51-5.00 Excellent Quality

As a result, the overall mean of the three categories in terms of quality was 4.85 and an overall standard deviation of 0.12, indicating that the digitized teaching-learning package in Geometry for Mathematics 7 had excellent quality.

3. Effectiveness of Digitized Teaching-Learning Package

Table 5: Pretest and Posttest Scores of Students with Digitized Teaching-Learning Package and without Digitized Teaching-Learning Package in the School

Group	Pretest	Posttest
With the digitized teaching-learning package	Mean	21.19
	N	32
	Std. Deviation	2.07
Without a digitized teaching-learning package	Mean	12.44
	N	30
	Std. Deviation	3.69

In the school, for the group of students with the digitized teaching-learning package, the pretest mean score was 8 (SD = 2.11), indicating a low level of initial mathematical proficiency (Mean = 8, SD = 2.11). Following the intervention, the posttest mean score significantly increased to 21.19 (SD = 2.07), demonstrating a substantial improvement in mathematical performance (Mean = 21.19, SD = 2.07). Moreover, for the group of students in the school without the digitized teaching-learning package, the pretest mean score was 6.81 (SD = 2.48), indicating a low level of mathematics performance (Mean = 6.81, SD = 2.48). After the

intervention, the posttest mean score increased to 12.44 (SD = 3.69), indicating a modest improvement in mathematical performance (Mean = 12.44, SD = 3.69). The pretest mean score for students with the digitized teaching-learning package was 12.93, while the pretest mean score for students without the digitized teaching-learning package was 11.95. This indicated that the school's control group (without a digitized teaching-learning package) and the experimental group (with a digitized teaching-learning package) were considered to be statistically equal in terms of performance prior to the intervention.

Based on the results, the pretest scores of the participants from the experimental group and control group in the school were independent of their sex and age. Moreover, the students who utilized the digitized teaching-learning package performed higher than those without it based on their mean scores. Thus, there was a difference in the mean scores of students who utilized the digitized teaching-learning package and those who did not. Students taught with the digitized teaching-learning package had higher mathematical beliefs than those taught without it (Brown & Smith, 2018). The digitized teaching-learning package increased students' performance, especially in Geometry, as revealed in their scores and participation in the activities with the digitized teaching-learning package. According to Johnson (2021), active students with the digitized teaching-learning package cultivated creative thinking and reduced ambiguity and vagueness in mathematics.

4. Significant Difference in the Performance of Students in Terms of Teaching

t-Test Results for Pretest Scores

Table 6: Independent Samples t-test Results for Pretest Scores of Students with Digitized Teaching-Learning Package and without Digitized Teaching-Learning Package of School

Group	Mean	N	SD	t	df	p-value	Interpretation
With the digitized teaching-learning package	8.00	32	2.11	1.25	60	.216	No Significant Difference
Without a digitized teaching-learning package	7.27	30	2.48				

For school, the mean pretest score for students with the digitized teaching-learning package was 8.00 (SD = 2.11), while for students without the digitized teaching-learning package, it was 7.27 (SD = 2.48). The pretest was about Geometry, one of the most significant aspects of mathematics, especially in teaching and learning Math. It emphasized the central point based on current conference proceedings (Jablonski & Ludwig, 2023). The t-test revealed no significant difference in pretest scores between the two groups ($t = 1.25$, $p = 0.216$).

5. *t-Test Results for Pretest and Posttest Scores*

Table 7: Dependent Samples t-test Results for Pretest and post-test scores of Students with Digitized Teaching-Learning Package of School

	Mean	N	SD	t	df	p-value	Interpretation
Pretest	8	32	2.11	-29.16	31	.001	Significant Difference
Posttest	21.19	32	2.07				

The result indicated a significant difference between the pretest and posttest scores of the students with the digitized teaching-learning package. It showcased the study of Ogunyomi (2021), which shows the positive effect of Information and Communication Technology (ICT) on teaching and learning mathematics. Utilizing technologies could form and create interaction and learning towards students' performance in mathematics. The mean pretest score for students

with the digitized teaching-learning package was 8 (SD = 2.11), while for their posttest score, it was 21.19 (SD = 2.07). The t-test revealed a significant difference in students' pretest and post-test scores with the digitized teaching-learning package ($t = -29.16$, $p = 0.001$). These findings suggest that statistical evidence supports a significant improvement in scores after the intervention.

6. *t*-Test Results for Posttest Scores of Students

Table 8: Independent Samples t-test Results for post-test scores of Students with Digitized Teaching-Learning Package and without Teaching-Learning Package of School

Group	Mean	N	SD	t	df	p-value	Interpretation
With the digitized teaching-learning package	21.19	32	2.07	10.34	60	0.001	Significant Difference
Without a digitized teaching-learning package	13.27	30	3.69				

In the School, the mean posttest score for students with a digitized teaching-learning package was 21.19 (SD = 2.07), while for students without a digitized teaching-learning package, it was 13.27 (SD = 3.69). The t-test revealed a significant difference in post-test scores between the two groups ($t = 10.34$, $p = 0.001$).

It presented how GeoGebra software boosted the students to better comprehend mathematical concepts and how GeoGebra developed their performance, understanding, analytical, logical, and abstract thinking. It showcased that GeoGebra was adequate, but the success depended on how the teacher used it to deliver the lesson (Uwurukundo et al., 2020). The results revealed several significant findings that contribute to the researchers' understanding of the impact of a digitized teaching-learning package on student mathematics performance. In general, the results from the independent samples t-tests signify that there was a significant difference in the posttest scores between students with the digitized teaching-learning package and students without the digitized teaching-learning package in the school. In summary, students who utilized the digitized teaching-learning package showed prominently higher posttest scores compared to those students who did not utilize the digitized teaching-learning package.

D. Conclusion

This study demonstrated that a digitized teaching-learning package provided valuable learning experiences that significantly enhanced students' mathematical skills and knowledge. The package, which included detailed lesson plans, learning modules, teacher's guides, PowerPoint presentations, the GeoGebra application, and assessment tools, was evaluated to have excellent psychometric properties in content, instructional, and technical quality. The findings revealed a significant difference in post-test scores between students who utilized the digitized teaching-learning package and those who did not. However, no significant difference was observed in their pretest scores.

Specifically, students who utilized the digitized teaching-learning package showed a more significant improvement in their post-test scores than those who did not. These results confirm the effectiveness of the intervention in improving students' mathematical performance and highlight the potential of digital teaching-learning packages as innovative solutions to support mathematics education. This study offers valuable insights for improving and enhancing

digitized teaching-learning packages, benefiting learners and teachers in pursuing excellence in mathematics education.

Acknowledgment

The researchers extend heartfelt gratitude to everyone who contributed to this study journey. We sincerely appreciate our professors' invaluable knowledge, guidance, and encouragement, which were instrumental in completing this study. We are equally thankful to the cooperative teachers whose active participation significantly enhanced our research. Most importantly, we are profoundly grateful to our families for their unwavering support and inspiration, enabling us to overcome challenges and achieve this milestone. To all who played a role in realizing this study, we sincerely thank you for your collective efforts and meaningful contributions.

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