

Development and Validation of Polygon Puzzlers: An Adaptive Learning Webpage Intervention to Solve Problems Involving Sides and Angles of a Polygon

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DOI: 10.47760/cognizance.2025.v05i01.001

Abstract: Geometry is a fundamental branch of mathematics essential for developing students' spatial reasoning, problem-solving abilities, and critical thinking skills. This study aimed to develop an adaptive learning webpage entitled "Polygon Puzzlers" to assist Grade 7 students with the least learned competencies in Mathematics, specifically in "solving problems involving sides and angles of a polygon" (M7GE-IIIg-1). The study employed a developmental descriptive research design. A panel of three (3) expert validators was selected using a sampling technique. To gather the necessary data, the evaluators used a four-point rating scale and a standardized Experts Evaluation Checklist provided by the Department of Education (DepEd). Descriptive statistics, including frequency count, percentage, and mean, were computed using Microsoft Excel to analyze the data. The validators rated the learning material as "passed" for meeting the standards set by the DepEd in terms of content quality, instructional quality, technical quality, and other criteria. They also recommended the material for possible use in public schools, provided that the corrections and revisions suggested in their report were addressed. Based on these findings, the developed and validated adaptive learning webpage offers personalized learning experiences tailored to students' individual needs and learning pace. It promotes active engagement with the content, reinforcing key concepts while fostering critical thinking and problem-solving skills.

Keywords: adaptive learning webpage, polygon puzzlers, development, validation, sides and angles

I. INTRODUCTION

A. Background of the Study

Geometry is a fundamental branch of mathematics essential for developing students' spatial reasoning, problem-solving abilities, and critical thinking skills. Mastery of geometric concepts such as angles, shapes, symmetry, and spatial relationships not only enhances mathematical proficiency but also provides a foundational framework for understanding and applying principles in diverse academic disciplines. A study by [6] demonstrated that comprehensive instruction in geometry significantly improves students' spatial reasoning skills, critical for success in STEM fields.

However, research suggests that many students struggle with geometry, and Grade 7 is a crucial stage for developing these skills. From a Filipina researcher [5], it was highlighted that a significant proportion of high school students in Mambusao exhibited low performance in geometry. Specifically, students with low performance in geometry struggled with mastering mathematical concepts and faced challenges in problem-solving tasks related to geometry. Additionally, a secondary school teacher from Lucsoon National High School noted that solving problems involving the sides and angles of a polygon (M7GE-IIIg-1) is a least-mastered competency. [10] identified these competencies as some of the least mastered in General Mathematics among senior high school students, indicating significant challenges in this area.

These studies underscore the need for targeted intervention programs to improve students' understanding and performance in geometric problem-solving.

In connection with this, the researchers aim to develop an adaptive learning webpage that will aid in their learning among secondary students.

An adaptive learning webpage customizes educational content based on each user's needs and performance, offering personalized experiences through a web interface that adjusts instructional materials in real time. This approach collects data on students' progress and provides tailored feedback, exercises, and resources, significantly enhancing their learning journey. Research indicates that such adaptive learning technologies promote student engagement and knowledge retention by providing personalized pathways, effective feedback, and supplemental resources [19], [1]. Additionally, a study by [14] highlights that adaptive e-learning environments improve the quality of the learning experience by catering to students' diverse learning styles and needs, ultimately enhancing their development and performance [2].

The webpage will provide interactive and engaging content aimed at enhancing students' understanding of these concepts. Collaboration with educators and experts will ensure that the application aligns with curriculum standards and enhances the learning experience.

The development of an adaptive learning webpage intervention to solve problems involving sides and angles of a polygon has the potential to address the identified gap in learning outcomes among Grade 7 students. By providing an interactive and engaging platform, this intervention can enhance students' understanding of these geometric concepts and contribute to improved environmental education.

B. Objectives of the Study

This study aimed to develop and validate Polygon Puzzlers, an Adaptive Learning Webpage Intervention designed to assist in solving problems related to the sides and angles of polygons. Specifically, the study sought to describe the development process of the adaptive learning webpage and evaluate its validity in terms of content quality, instructional quality, technical quality, and other relevant findings. Additionally, the study aimed to gather recommendations and suggestions from experts regarding the intervention's validity and, based on their feedback, produce a revised and validated version of the Adaptive Learning Webpage Intervention.

C. Frameworks of the Study

This study is anchored on two main theories, Cognitive Load Theory by John Sweller and Constructivism by Jean Piaget. Cognitive Load Theory (CLT) supports the significance of adaptive learning in enhancing students'

knowledge. CLT emphasizes managing cognitive load to optimize learning outcomes, and adaptive learning webpage align with this by personalizing instructional content, pacing, and complexity based on individual learners' needs and cognitive capacities. Adaptive learning systems tailor content to match each student's prior knowledge and skill level, thereby reducing intrinsic cognitive load by presenting information in manageable chunks. These systems also dynamically adjust the presentation of materials to eliminate unnecessary distractions and complexities, reducing extraneous cognitive load. By applying CLT principles, adaptive learning webpage create learning environments that manage cognitive load effectively, leading to improved comprehension, problem-solving skills, and retention of knowledge.

Meanwhile, a perspective from Constructivism Theory supports and emphasizes the significance of learners actively developing their own knowledge through experiences and interactions. In adaptive learning webpage settings, this theory proposes that student can enhance their learning by providing immediate feedback and scaffolding, allowing them to reflect on their progress and adjust their learning strategies accordingly. By promoting active engagement, self-directed learning, and metacognitive awareness, the adaptive learning webpage enhances the construction of knowledge and skills in line with constructivist principles.

This study used the ADDIE model which is the acronym that stands for Analysis, Design, Development, Implementation, and Evaluation. This model provides a step-by-step process for creating effective educational courses and materials.

In the Analysis phase, the researchers determined the least-mastered competency as the basis for the development of the Adaptive Learning Webpage. They collected this data from a Grade-7 Math teacher at Lucsoon National High School. It was in this phase that the researchers collated the appropriate learning content for the digital interactive learning material. The researchers also determined the project's timeframe and its cost.

Meanwhile, in the Design phase, the researchers outlined the design of the adaptive learning webpage in terms of content quality, instructional quality, technical quality, and other findings. They also designed the appropriate levels of activities that aligned with Bloom's Taxonomy, ensuring the achievement of learning competency while engaging the students at the same time.

Moreover, in the Development phase, the researchers met with a programmer to discuss the planned outline, and to create a draft of the webpage. After this, the researchers consulted the first draft to their research adviser for preliminary evaluations.

Furthermore, in the implementation phase, the researchers will facilitate the provision of the adaptive learning webpage to the expert-validators. This is done with the intention of enabling a thorough and detailed analysis of the material.

Finally, in the Evaluation phase, the panel of experts with their extensive knowledge and experience will give their comprehensive evaluation, their assessments will provide critical and objective insights into the content quality, instructional quality, technical quality, and other findings that will guide the researchers for further improvements. The researchers then, will determine the validity of the adaptive learning webpage based on expert validation. The product of the evaluation phase is the developed and validated adaptive learning webpage, which is revised with the expert-validators' comments and suggestions in consideration.

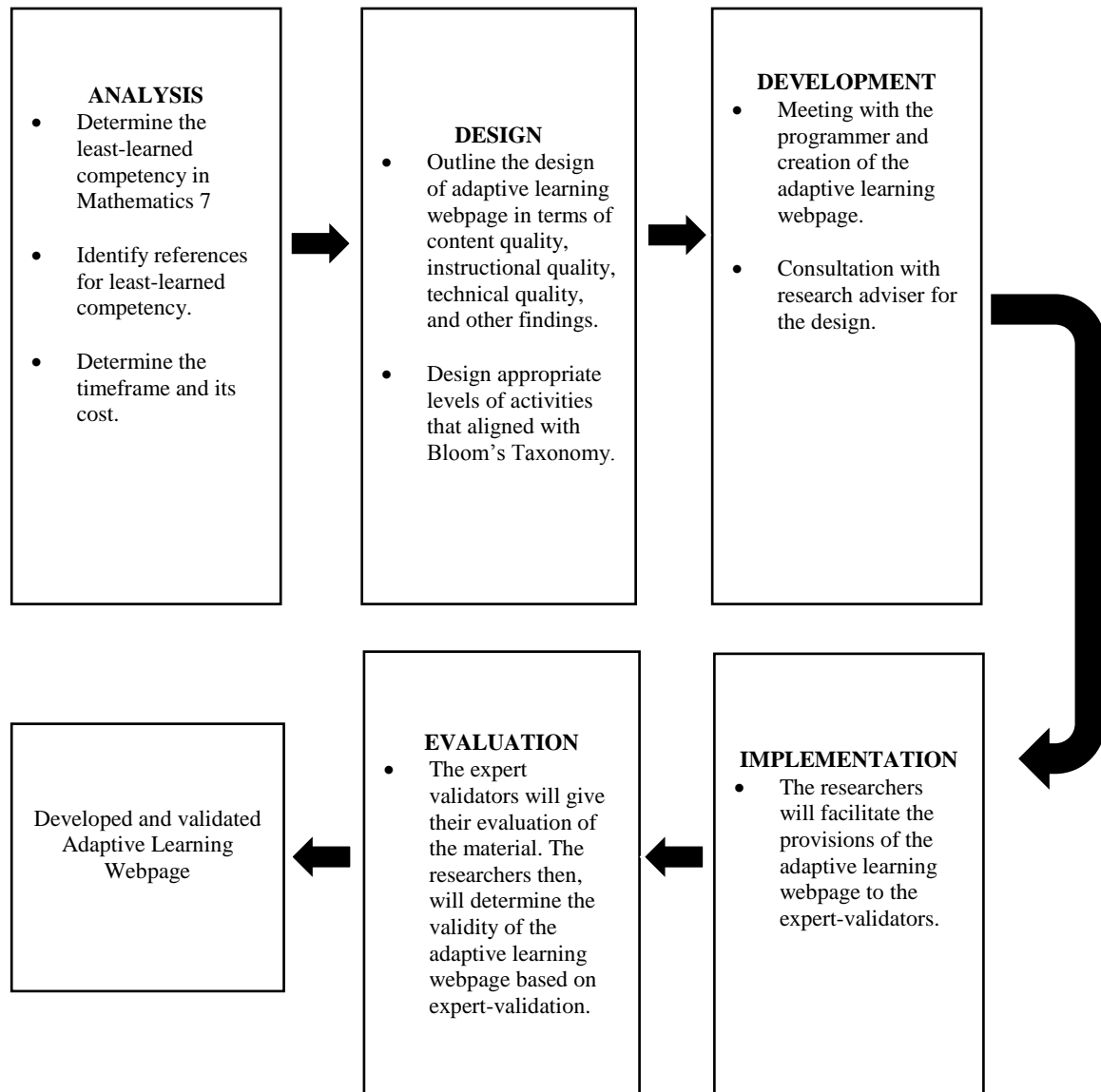


Fig. 1 Product development chart of the adaptive learning webpage entitled “Polygon Puzzlers”, using the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model.

D. Review of Literature

The ability to solve problems involving sides and angles of polygons is an essential skill in mathematics education. In the context of Grade 7 Mathematics, students encounter various learning competencies that are challenging to master.

Solving problems related to the sides and angles of polygons requires a solid understanding of geometric principles such as angles, shapes, and spatial relationships. These skills not only contribute to mathematical proficiency but also enhance critical thinking and problem-solving abilities [6]. Mastery of these concepts forms the basis for more advanced mathematical and scientific disciplines.

Several studies underscore significant challenges in students' geometry skills, particularly in polygon problem-solving. [15] found that students exhibit low achievement in mathematical problem-solving abilities, attributing this to unfamiliarity with problem-solving tasks, weak recall of previous knowledge, and inadequate problem-solving frameworks. They recommend implementing tailored learning strategies to enhance these skills. Similarly, [4] noted middle school students' struggles in identifying and applying polygon properties, emphasizing the need for customized instructional approaches. [18] highlighted the shortcomings of traditional classroom methods in addressing students' difficulties in grasping geometric concepts, urging the adoption of innovative teaching strategies.

Studies have identified specific competencies within Grade 7 mathematics, such as those involving polygons, that pose significant challenges to students [10]. These competencies are often among the least mastered, indicating a need for effective instructional interventions that can improve understanding and retention.

Studies have shown that adaptive learning technologies can lead to significant improvements in student performance. [11] found that students using adaptive learning platforms showed greater gains in mathematics achievement compared to those using traditional instructional methods. This improvement is attributed to the personalized nature of adaptive learning, which addresses individual student needs more effectively.

The integration of technology in education has been shown to enhance learning outcomes across various subjects. According to [12], technology-enhanced learning environments provide opportunities for interactive and personalized learning experiences that traditional classrooms cannot offer. This integration is particularly beneficial for subjects like geometry, where visual and interactive elements can aid understanding.

Several studies have examined the effectiveness of e-learning in mathematics education. [3] found that e-learning platforms that incorporate adaptive learning technologies can significantly improve student understanding and retention of mathematical concepts. These platforms offer flexible learning opportunities, allowing students to learn at their own pace and revisit challenging concepts as needed.

Adaptive learning technologies have emerged as effective tools in addressing the diverse learning needs of students. It has shown significant benefits in enhancing students' academic performance, particularly in mathematics education. [8] found that secondary school students using adaptive media techniques outperformed those using traditional methods, indicating the effectiveness of personalized learning pathways. [16] demonstrated the efficacy of adaptive learning tools in online teaching, showing improved learner engagement and content mastery through personalized learning experiences [16]. [7] focused on personalized geometry instruction using the adaptive web-based learning environment IXL, showing positive effects on high school students' geometry problem-solving skills. This aligns with findings from [13] and [9], who also highlighted the benefits of adaptive web-based learning environments in improving students' mathematical skills [7], [13], [9].

[17] emphasized the developmental benefits of adaptive learning in elementary and middle school mathematics, underscoring its role in catering to diverse learning needs. The results indicated that students who engaged in the adaptive learning webpage showed significant improvement in their ability to solve mathematical problems. The findings suggest that adaptive technologies can play an effective role in improving students' critical thinking and solving problem.

II. METHODOLOGY

A. Research Design and Sampling

The study was under a developmental research method under descriptive research design. It uses descriptive design as it aims to describe the characteristics of the secondary students along with problem-solving skills enhancement for the development and validation of the Adaptive Learning Webpage entitled "Polygon Puzzlers".

The research involves a panel of expert-validators comprising three teachers. The researchers utilized purposive sampling to select evaluators for the developed material. These validators were chosen based on the following criteria: (1) He/She holds a Bachelor of Secondary Education degree majoring in Mathematics, (2) He/She possesses a Master's or Doctorate degree in Mathematics Education or a related field, and (3) He/She

has rendered at least five years of teaching service, in Mathematics. These validators assessed the acceptability of the adaptive learning webpage in terms of its content quality, instructional quality, technical quality, and other findings that they identified.

B. Data Collection Procedure

The researchers utilized a standardized Experts' Evaluation Checklist provided by the Department of Education (DepEd), which was adapted from Division Memorandum No. 441 s. 2019, which provides guidelines for assessing and evaluating localized materials, particularly for non-print. This evaluation tool uses a four-point grading scale to assess the quality of content, instructions, technicalities, and others.

The data collection activities of the present study are described as follows:

Phase 1 – Planning/Analysis Phase.

The researchers asked a Mathematics teacher at Lucsoon National High for a copy of the least-mastered competencies in Grade 7 Mathematics. Among the five presented least-mastered competencies, the researchers chose the competency, “solving problems involving sides and angles of a polygon” (M7GE-IIIg-1). After determining the least-mastered competency, the researchers checked the Teacher’s Guide to determine the learning content to be included in the adaptive learning webpage. They also referred to Student Learning Material provided by the Department of Education, and online resources as additional sources of information. Things considered were the timeframe, programmer, and the estimated cost of the adaptive learning webpage.

Phase 2 – Design/Development Phase

Stage 1. Creating the outline. After determining the least-mastered competency and gathering the learning content to be included, the researchers outlined the adaptive learning webpage with the following parts:

1. Home Page - presents a professional and formal design for educational purposes. It includes a comprehensive background, an overview of the site, and clearly defined goals and objectives.
2. About Us - this highlights the author's expertise, qualifications, and educational background, establishing their credibility.
3. Module Overview – this section serves as an introductory guide to the educational content offered on Polygon Puzzlers.
 - Module 1 (Fundamentals of Polygons) - focuses on the fundamental concepts of polygons, with an emphasis on triangles. It covers the different types of triangles, including equilateral, isosceles, and scalene triangles.
 - Module 2 (Understanding Quadrilaterals) – this shows the various types of parallelograms. This module explains the properties and characteristics of parallelograms such as rectangles, rhombuses, and squares.
 - Module 3 (Calculating the Perimeter of Various Parallelograms) – this builds on the knowledge from the previous modules, focusing on calculating the perimeter of various parallelograms, including kites, trapezoids, and other less common shapes.
4. Video Presentation – this is a video discussion borrowed from Wow Math YouTube Channel for students to have an option for assessing their learnings.
5. Polygon Puzzlers Assessments – this shows the different levels of activities based on Bloom’s Taxonomy.

Bloom’s Taxonomy

Quiz Title

Understanding	Polygon Fundamentals
Remembering	Mastering Sides and Angles
Applying	Angle Acumen
Analyzing	Geometry Genius
Evaluating	Shape Sleuths
Creating	Polygon Architect

- a) Pass Feedback - If a student passes an assessment.
- b) Fail Feedback - If a student does not pass an assessment.
6. Teacher Section – this section provides detailed information about the teachers and instructors associated with Polygon Puzzlers.
7. Student Reviews – this section features feedback from students who have used Polygon Puzzlers, such as their learning experiences.
8. Blog – this offers a wealth of additional information and resources from the author.

- Contact Section – this provides users with a direct line of communication with the author. It includes an email form where users can send messages, ask questions, and provide feedback.

The researchers structured the adaptive learning webpage entitled “Polygon Puzzlers” based on content quality, instructional quality, technical quality, and other findings. They employed different activities and included strategies that were tailored to the learning needs of the students.

Stage 2. Crafting the draft. The researchers sought and met with the programmer to start the development of the adaptive learning webpage entitled “Polygon Puzzlers”. To obtain an empirical basis for the validity of the designed video, the researchers presented and consulted the first draft of the adaptive learning webpage to their research adviser to pre-assess the material for some corrections. They also sought his approval of the adaptive learning webpage for expert validation.

Phase 3 – Implementation Phase.

Following the approval of the first draft, the researchers facilitated the delivery of the adaptive learning webpage to the expert-validators, intending to conduct a comprehensive and detailed examination of the material. The researcher presented the adaptive learning webpage to three (3) panel validators who rated the material using a standardized checklist provided by the Department of Education (DepEd). The developed adaptive learning webpage was subjected to a four-point rating scale based on the following: 1) content quality; (2) instructional quality; (3) technical quality; and (4) other findings. The researchers retrieved the checklists that had been distributed to the expert-validators.

Phase 4 – Evaluation Phase

The checklists distributed were obtained by the researchers in order to seek suggestions from expert-validators, and to identify both strengths and weaknesses of the designed adaptive learning webpage, thereby improving the implementation of solving problems involving sides and angles of a polygon. Subsequently, the validators' comments and recommendations were carefully addressed when developing the adaptive learning webpage. The resulting material constituted a revised version of the adaptive learning webpage, which incorporated the expert validators' comments and suggestions.

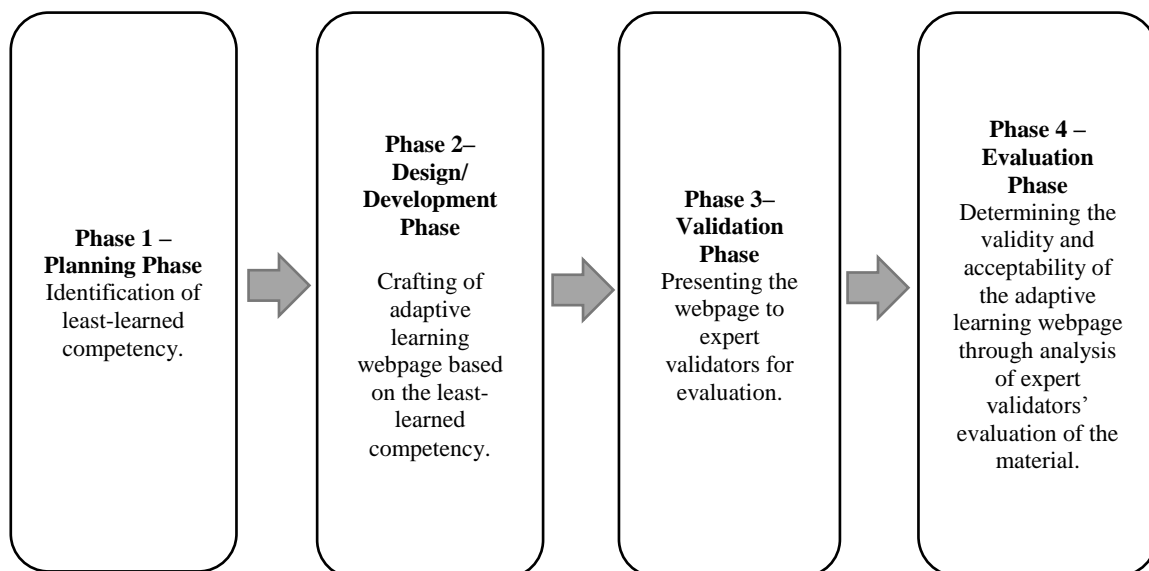


Fig. 2 Data Collection Activities of the Study

C. Data Analysis

The researchers employed descriptive statistics, including frequency distribution, means, and range using Microsoft Excel to assess the validity of the developed adaptive learning webpage entitled "Polygon Puzzlers". Once the data was gathered and analyzed from the Evaluation Rating Sheet for Non-Print Materials, the values were interpreted and deliberated upon. To validate the evaluation results, the researchers computed the inter-rater agreement among expert validators. They utilized the Percentage Agreement as a measure to ascertain the consensus among raters regarding the acceptability of the adaptive learning webpage. Percentage Agreement is a straightforward method for determining inter-rater reliability, calculated by the proportion of items on which evaluators concur. Typically, a Percentage Agreement of at least 75% is deemed necessary in most fields for a test to be deemed reliable [20].

III. RESULTS AND DISCUSSIONS

The Adaptive Learning Webpage was developed and validated to help the students cope with one of their least-mastered competencies in Mathematics 7. Specifically, the Adaptive Learning Webpage was designed to help the students understand and solve problems involving sides and angles of a polygon in a wider and deeper aspect. Additionally, the material ensures the retention of the students to be effective when it comes to acquiring the discussed topic given that it has taken into account the visual and audio learners.

The researchers made use of a variety of transitions and graphics to capture the interest of the students and facilitate learning. In addition, the researchers made sure that the learning content was best suited for Mathematics 7 learners. Lastly, the material included an assessment and answer key to allow the students to reflect on their learning. The developed Adaptive Learning is presented for illustrative purposes.

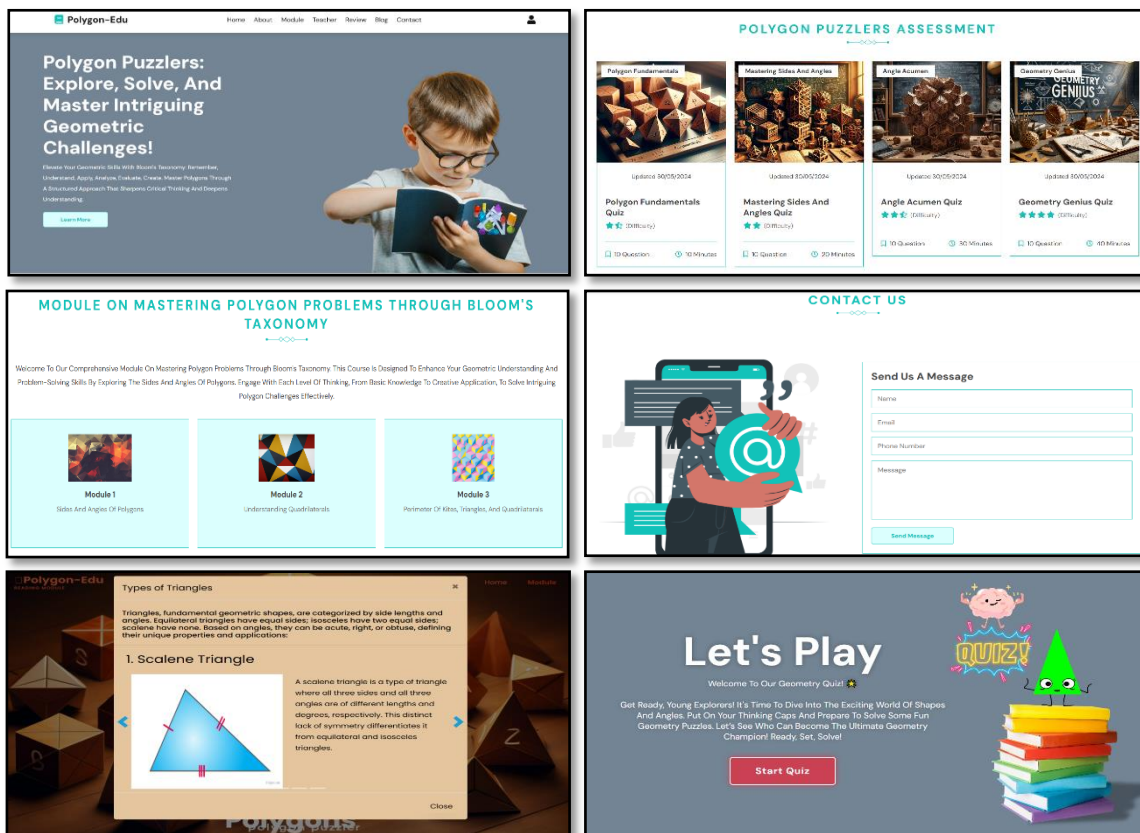


Fig. 3 Screenshots of the Adaptive Learning Webpage Draft

A. Evaluation of the Adaptive Learning Webpage Based on Experts' Judgments

The Adaptive Learning Webpage was evaluated by expert-validators based on four factors such as content quality, instructional quality, technical quality, and other findings. The evaluation tool was a four-point Likert

scale in which validators rated from 1 to 4, with 1 as the lowest and 4 as the highest. The results of the evaluation will determine the acceptability of the Adaptive Learning Webpage based on the points system indicated in the evaluation tool.

TABLE I
VALIDATORS' RESPONSES ON THE FOUR FACTORS

Aspect of Non-Print Materials	VS 4	S/NA 3	Poor 2	Not Satisfactory 1	Mean	Interpretation
Factor A. Content Quality						
Content is consistent with topics/skills found in the DepEd Learning Competencies for the subject ad grade/year level it was intended.	3	0	0	0	4.00	Very Satisfactory
Concepts developed contribute to enrichment, reinforcement, or mastery of the identified learning objectives.	3	0	0	0	4.00	Very Satisfactory
Content is accurate.	3	0	0	0	4.00	Very Satisfactory
Content is up-to date.	3	0	0	0	4.00	Very Satisfactory
Content is logically developed and organized.	3	0	0	0	4.00	Very Satisfactory
Content is free from cultural, gender, racial, or ethnic bias.	3	0	0	0	4.00	Very Satisfactory
Content stimulates and promotes critical thinking.	3	0	0	0	4.00	Very Satisfactory
Content is relevant to real-life situations.	3	0	0	0	4.00	Very Satisfactory
Language (including vocabulary) is appropriate to the target user level.	3	0	0	0	4.00	Very Satisfactory
Content promotes positive values that support formative growth.	3	0	0	0	4.00	Very Satisfactory
				Overall	4.00	Very Satisfactory
Factor B. Instructional Quality						
Purpose of the material is well defined.	3	0	0	0	4.00	Very Satisfactory
Material achieves its defined purpose	3	0	0	0	4.00	Very Satisfactory
Learning objectives are clearly stated and measurable.	3	0	0	0	4.00	Very Satisfactory
Level of difficulty is appropriate for the intended target user.	3	0	0	0	4.00	Very Satisfactory
Graphics /colors /sounds are used for appropriate instructional reasons.	2	1	0	0	3.67	Very Satisfactory
Material is enjoyable, stimulating, challenging, and engaging.	2	1	0	0	3.67	Very Satisfactory
Material effectively stimulates creativity of target user.	2	1	0	0	3.67	Very Satisfactory
Feedback on target user's responses is effectively employed.	3	0	0	0	4.00	Very Satisfactory
Target user can control the rate and sequence of presentation and review.	3	0	0	0	4.00	Very Satisfactory

Instruction is integrated with target user's previous.	3	0	0	0	4.00	Very Satisfactory
Overall					3.901	Very Satisfactory
Factor C. Technical Quality						
Audio enhances understanding of the concept.	3	0	0	0	4.00	Very Satisfactory
Speech and narration (correct pacing, intonation, and pronunciation) is clear and can be easily understood.	3	0	0	0	4.00	Very Satisfactory
There is complete synchronization of audio with the visuals, if any.	3	0	0	0	4.00	Very Satisfactory
Music and sound effects are appropriate and effective for instructional purposes.	3	0	0	0	4.00	Very Satisfactory
Screen displays (text) are uncluttered, easy to read, and aesthetically pleasing.	3	0	0	0	4.00	Very Satisfactory
Visual presentations (non - text) are clear and easy to interpret	3	0	0	0	4.00	Very Satisfactory
Visuals sustain interest and do not distract user's attention.	3	0	0	0	4.00	Very Satisfactory
Visuals provide accurate representation of the concept discussed.	3	0	0	0	4.00	Very Satisfactory
The user support materials (if any) are effective.	3	0	0	0	4.00	Very Satisfactory
The design allows the target user to navigate freely through the material.	3	0	0	0	4.00	Very Satisfactory
The material can easily and independently be used.	3	0	0	0	4.00	Very Satisfactory
<i>Technical Evaluation: Complete Section G. Interoperability: Technical format Checklist for conformance If not already completed prior to this review.</i>						
The material will run using minimum system requirements.	3	0	0	0	4.00	Very Satisfactory
The program is free from technical problems	3	0	0	0	4.00	Very Satisfactory
Overall					4.00	Very Satisfactory
Factor D. Other Findings						
<i>Note down observations about the information contained in the material, where the following errors are found:</i>	NP	PMF	PMR	DE		
	4	3	2	1		
Conceptual errors.	3	0	0	0	4.00	Very Satisfactory
Factual errors.	3	0	0	0	4.00	Very Satisfactory
Grammatical and / or typographical errors.	3	0	0	0	4.00	Very Satisfactory
Other errors (i.e., computational errors, obsolete information, errors in the visuals, etc.).	3	0	0	0	4.00	Very Satisfactory
Overall					4.00	Very Satisfactory

VS – Very Satisfactory; S – Satisfactory; NA – Not Applicable; NP – Not Present; PMF – Present but very minor & must be fixed; PMR – Present & requires major re-development; DE – Do not evaluate further

Table I presents the validator's detailed responses on the four factors – (a) Content Quality, (b) Instructional Quality, (c) Technical Quality, and (d) Other Findings. The evaluators gave "Very Satisfactory" ratings for the

following factors: content quality (M=4.00), instructional quality (M=3.901), technical quality (M=4.00), and other findings (M=4.00).

TABLE II
OVERALL VALIDATORS' RESPONSES ON THE ADAPTIVE LEARNING WEBPAGE

Factors	Mean	Interpretation
Factor A: Content Quality	4.00	Very Satisfactory
Factor B: Instructional Quality	3.901	Very Satisfactory
Factor C: Technical Quality	4.00	Very Satisfactory
Factor D: Other Findings	4.00	Very Satisfactory
Overall	3.92	Very Satisfactory

Table II presents the overall ratings of the validators on the four factors – (a) Content Quality, (b) Instructional Quality, (c) Technical Quality, and (d) Other Findings. As a results, the developed Adaptive Learning Webpage received an overall average rating of 3.92, which is "Very Satisfactory" in terms of its general acceptability.

In particular, the validators find that the material is very satisfactory because it is appropriate for the student's developmental level, free of prejudices and biases based on ideology, culture, religion, race, or gender, and it encourages the development of desirable values and traits such as scientific attitude and reasoning, desire for excellence, and critical and creative thinking; possess the potential to arouse the interest of target reader. When it comes to how the content helps the grade or year level for which it is meant and the subject area's specific objectives are achieved, the validators did agree that it is very satisfactory.

In addition, when it comes to the content quality of the material; it is accurate and up to date. The content also is logically developed and organized and is free from cultural, gender, racial, or ethnic bias. Moreover, the content stimulates and promotes critical thinking and the language is appropriate to the target.

Moreover, the instructional quality of the material was assessed and proven to be very satisfactory. In light of this, the level of difficulty is appropriate for the intended students. Also, the material is enjoyable, stimulating, challenging, and engaging.

Furthermore, the material's technical quality is deemed very satisfactory by the validators. The emphasis on words enhances understanding of the concept and the synchronization of audio together with the visuals was on point. Additionally, the assessors regard the material's presentation and arrangement as very satisfying because it is interesting, has a logical and seamless flow of ideas, and uses a language level appropriate for the intended audience.

The material is also found to be very satisfactory by the examiners in terms of other findings, as there are no conceptual, factual, grammatical, and/or typographical errors.

TABLE III
VALIDATORS' OVERALL RATINGS

Factors	Validator 1		Validator 2		Validator 3		Average	Overall Remarks
	Score	Remarks	Score	Remarks	Score	Remarks		
Factor 1: Content Quality (Resource must score at least 30 points out of a maximum 40 points to pass this criterion.)	40	Passed	40	Passed	40	Passed	40	Passed
Factor 2: Instructional Quality (Resource must score at least 30 points out of a maximum 40 points to pass this criterion.)	37	Passed	40	Passed	40	Passed	39	Passed

**Factor 3:
Technical Quality**

(Resource must score at least 39 points out of a maximum 52 points to pass this criterion.)

52	Passed	52	Passed	52	Passed	52	Passed
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Factor 4: Other Findings

(Resource must score at least 16 points out of a maximum 16 points to pass this criterion.)

16	Passed	16	Passed	16	Passed	16	Passed
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As shown in Table III, the evaluation ratings of the adaptive learning webpage met the required passing scores for all factors. In Factor 1 (content quality), Factor 3 (technical quality), and Factor 4 (other findings), learning materials attained perfect scores of 40 points, 52 points, and 16 points, respectively. Meanwhile, in Factor 2 (instructional quality), the learning materials achieved an average score of 39 points out of 40 points, which was higher than the required score of 30 points. The overall remarks of the expert validators suggested that the instructional material has satisfied the standards set by the Department of Education (DepEd) in terms of Content Quality, Instructional Quality, Technical Quality, and Other Findings. The validators also recommended the approval of the instructional material for possible use in public schools provided that the corrections/revisions included in their report are made.

TABLE IV
INTER-RATER AGREEMENT OF VALIDATORS

Aspect of Non-Print Materials	VS 4	S/NA 3	Poor 2	Not Satisfactory 1	Total
Factor A. Content Quality					
Content is consistent with topics/skills found in the DepEd Learning Competencies for the subject ad grade/year level it was intended.	100%	0	0	0	100%
Concepts developed contribute to enrichment, reinforcement, or mastery of the identified learning objectives.	100%	0	0	0	100%
Content is accurate.	100%	0	0	0	100%
Content is up-to date.	100%	0	0	0	100%
Content is logically developed and organized.	100%	0	0	0	100%
Content is free from cultural, gender, racial, or ethnic bias.	100%	0	0	0	100%
Content stimulates and promotes critical thinking.	100%	0	0	0	100%
Content is relevant to real-life situations.	100%	0	0	0	100%
Language (including vocabulary) is appropriate to the target user level.	100%	0	0	0	100%

Content promotes positive values that support formative growth.	100%	0	0	0	100%
Overall	100%	0	0	0	100%
Factor B. Instructional Quality					
Purpose of the material is well defined.	100%	0	0	0	100%
Material achieves its defined purpose	100%	0	0	0	100%
Learning objectives are clearly stated and measurable.	100%	0	0	0	100%
Level of difficulty is appropriate for the intended target user.	100%	0	0	0	100%
Graphics /colors /sounds are used for appropriate instructional reasons.	66.7%	33.3%	0	0	100%
Material is enjoyable, stimulating, challenging, and engaging.	66.7%	33.3%	0	0	100%
Material effectively stimulates creativity of target user.	66.7%	33.3%	0	0	100%
Feedback on target user's responses is effectively employed.	100%	0	0	0	100%
Target user can control the rate and sequence of presentation and review.	100%	0	0	0	100%
Instruction is integrated with target user's previous.	100%	0	0	0	100%
Overall	90%	10%	0	0	100%
Factor C. Technical Quality					
Audio enhances understanding of the concept.	100%	0	0	0	100%
Speech and narration (correct pacing, intonation, and pronunciation) is clear and can be easily understood.	100%	0	0	0	100%
There is complete synchronization of audio with the visuals, if any.	100%	0	0	0	100%
Music and sound effects are appropriate and effective for instructional purposes.	100%	0	0	0	100%
Screen displays (text) are uncluttered, easy to read, and aesthetically pleasing.	100%	0	0	0	100%
Visual presentations (non - text) are clear and easy to interpret	100%	0	0	0	100%
Visuals sustain interest and do not distract user's attention.	100%	0	0	0	100%
Visuals provide accurate representation of the concept discussed.	100%	0	0	0	100%
The user support materials (if any) are effective.	100%	0	0	0	100%
The design allows the target user to navigate freely through the material.	100%	0	0	0	100%
The material can easily and independently be used.	100%	0	0	0	100%
The material will run using minimum system requirements.	100%	0	0	0	100%
The program is free from technical problems	100%	0	0	0	100%
Overall	100%	0	0	0	100%

Factor D. Other Findings <i>Note down observations about the information contained in the material, where the following errors are found:</i>	NP 4	PMF 3	PMR 2	DE 1	
Conceptual errors.	100%	0	0	0	100%
Factual errors.	100%	0	0	0	100%
Grammatical and / or typographical errors.	100%	0	0	0	100%
Other errors (i.e., computational errors, obsolete information, errors in the visuals, etc.).	100%	0	0	0	100%
Overall	100%	0	0	0	100%

To confirm the ratings of the expert-validators, inter-rater agreement was calculated across the different factors of the adaptive learning webpage. The use of inter-rater agreement measures the extent to which validators agree on the absolute level of performance. Based on the table 4, the majority of the ratings were in the “Very Satisfactory” category, with only a few in “Satisfactory,” this suggests that the validators were largely consistent in their high ratings.

TABLE V
SUMMARY OF THE INTER-AGREEMENT OF VALIDATORS

Factors	VS	S/NA	Poor	Not satisfactory	Total
Factor 1. Content Quality	100%	0	0	0	100%
Factor 2. Instructional Quality	90.001%	9.999%	0	0	100%
Factor 3. Technical Quality	100%	0	0	0	100%
Factor 4. Other Findings	100%	0	0	0	100%
Overall	97.50%	2.50%	0	0	100%

Based on Table V, it showed that 100% of the ratings in factor 1 were “Very Satisfactorily.” In factor 2, 90.001% of the ratings were “Very Satisfactorily,” and 9.999% were “Satisfactorily.” Meanwhile, in factor 3, 100% of the ratings were “Very Satisfactorily”. Finally, in factor 4, the material obtained 100% of the ratings “Very Satisfactorily”. The overall ratings of the evaluators for the four factors revealed that 97.50% were “Very Satisfactorily,” and 2.50% were “Satisfactorily.” Generally, an inter-rater agreement of at least 75% is required in most fields for a test to be considered reliable [20]. The data showed that the inter-rater agreement value is 97.50% which is within the acceptable range, suggesting that the validators are agreeing with one another.

The validators rated the learning material as “passed” for satisfying the standards set by the DepEd in terms of content quality, instructional quality, technical quality, and other findings. They also recommended the material for possible use in public schools provided that the corrections/revisions included in their report are made. Meanwhile, the majority of the ratings of the 3 expert-validators were consistent in the category of “Very Satisfactorily” and with only a few in the category of “Satisfactorily” for the four factors. The high inter-rater agreement confirmed the general acceptability of the developed Adaptive Learning Webpage.

B. Recommendations and Suggestions of the Validators for the Improvement of the Adaptive Learning Webpage

Validator 1 (V1) suggests that the webpage would benefit from a background picture featuring high school students. This would make the site more relatable and engaging for the target audience.

Validator 2 (V2) recommends maintaining a consistent color scheme throughout the webpage. They suggest using a theme color that reflects the overall tone and purpose of Polygon Puzzlers. This would create a more cohesive and visually appealing experience.

Validator 2 (V2) also recommends adding a clear statement of the webpage's objectives or purpose directly on the Home Page. This would help users understand immediately what Polygon Puzzlers is about and how it can benefit them.

C. Revision of the Adaptive Learning Webpage after the Validation Process

The researchers take into account the recommendations and suggestions of the validators. The final output was checked by the research adviser for approval for showing. For illustrative purposes, the revised adaptive learning webpage is presented below.

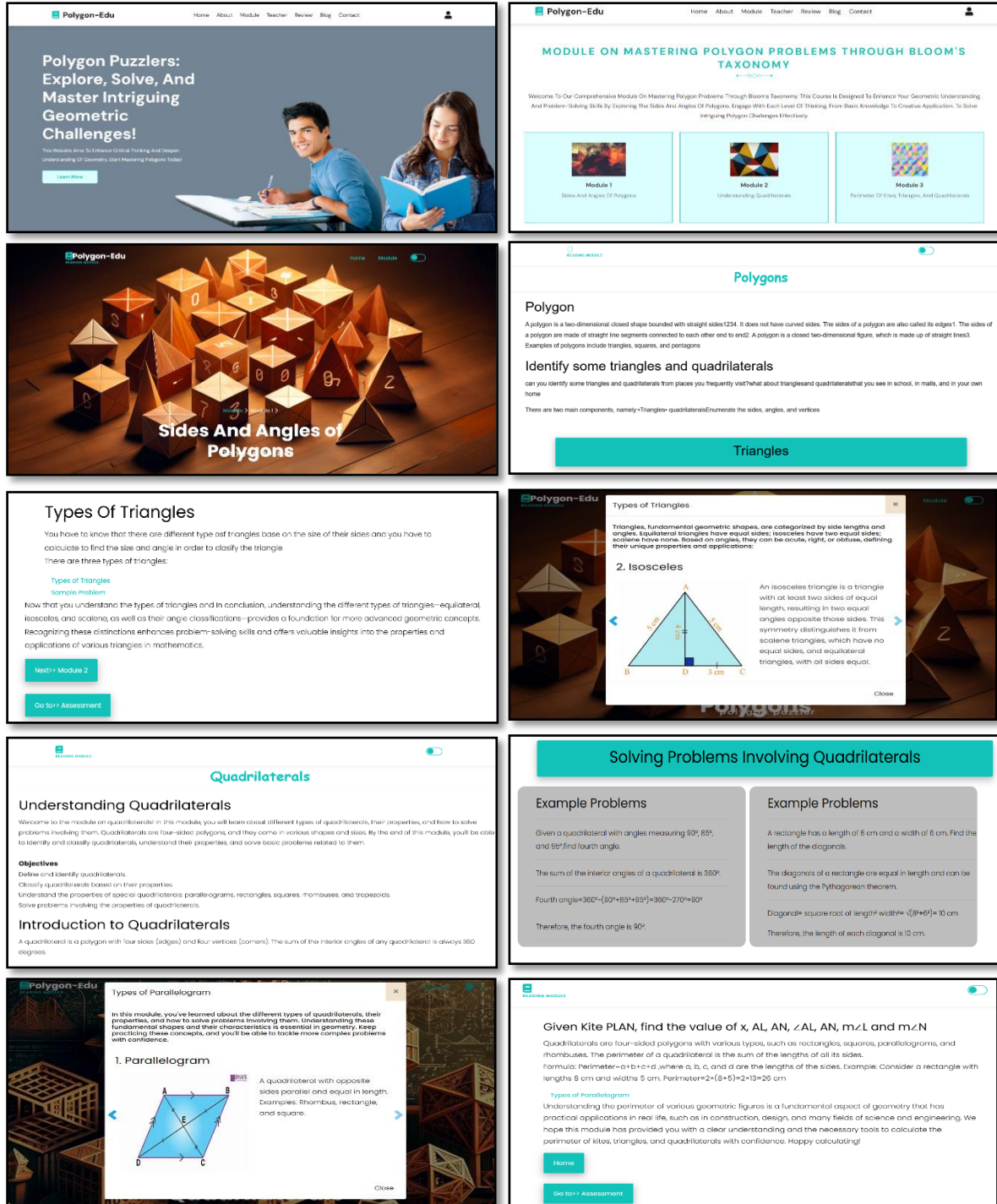


Fig. 4 Screenshots of the Final Output of the Adaptive Learning Webpage

IV. CONCLUSIONS AND RECOMMENDATIONS

The study aimed to develop and validate an Adaptive Learning Webpage for Grade 7 students following the K-12 curriculum. Based on the results of the experts' evaluation, the developed Adaptive Learning Webpage was rated "Very Satisfactorily" in terms of content quality, instructional quality, technical quality, and other findings. The learning material has passed the standards set by the Department of Education (DepEd) for the four factors. The experts also recommended the approval of the material for use in public schools. Moreover, the researchers ensured that the revised learning material possessed all the qualities that the expert validators deemed significant to not be lacking in the material. The errors in colors, background images, and stating the webpage's objective were meticulously examined and addressed in accordance with the suggestions and recommendations of our experienced validators.

In line with the mandate of the Department of Education (DepEd) to ensure that no student is left behind, the researchers recommend several actions for future studies. First, the Adaptive Learning Webpage should be utilized to address the least-mastered competency in Mathematics 7. Additionally, this study can serve as a foundation for future research if further exploration is needed in addressing this particular competency. Finally, the education sector is encouraged to prioritize the use of non-print materials, such as the developed adaptive learning webpage, as supplementary learning tools. These materials have been identified as effective in providing a more comprehensive, accessible, and engaging learning environment.

ACKNOWLEDGEMENT

The researchers extend their heartfelt gratitude to the many individuals who have contributed to the successful completion of this study. They are profoundly thankful to the Almighty God for His divine guidance, blessings, and strength throughout this journey. Special appreciation is given to Dr. Maribelle N. Zipagan, Dean of the School of Teacher Education, for granting permission to conduct this study, and to Dr. Joan J. Sinagpulo, their research instructor, and Mr. Jefry E. Aransado, their research adviser, for their invaluable guidance and constructive feedback. Gratitude is also expressed to their panelists and expert validators for their insights in refining the adaptive learning webpage, and to Mr. Darius Mark S. Caparro for his expertise and dedication in developing the polygon puzzlers. The researchers are deeply indebted to their beloved parents for their unwavering love and support, and they acknowledge with thanks the assistance of many others whose contributions, though unnamed, are sincerely appreciated.

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