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Development and Evaluation of a GeoGebra-Assisted Instructional Tool in Teaching the Key Concepts of Circles for Grade 10 Mathematics

Genevieve Coraine G. Fajagutana[1], Skezeer John B. Paz[2]

[1]Teacher 1, Mathematics Department, Koronadal National Comprehensive High School, Philippines
[2]Professor, Natural Sciences and Mathematics Department, Notre Dame of Marbel University, Philippines

Abstract
This study developed and evaluated a GeoGebra-assisted instructional tool in teaching key concepts of circles to Grade 10 students. The development of the instructional tool followed the ADDIE model and was assessed by evaluators based on its instructional, content, and technical quality. The evaluations indicated that the tool is of excellent quality. A quasi-experimental approach was then employed to measure the tool's effectiveness in improving the performance of students. The study involved two heterogeneous Grade 10 sections from Koronadal National Comprehensive High School (KNCHS). Effectiveness was determined by comparing the pretest and posttest scores of control and experimental groups using an Independent t-Test. The results revealed that the GeoGebra-assisted instructional tool significantly improved students' understanding of key concepts of circle. Based on these findings, it is recommended that other mathematics teachers adopt this tool to enhance student learning. Additionally, further exploration of GeoGebra's features is encouraged.

Keywords: GeoGebra, Instructional Tool, Circles, Geometry

Introduction

Mathematics is a fundamental part of every human logic and reasoning. According to Sawchuk (2018), the goal of math should extend beyond preparing students for college or work; it should enhance their abilities to understand and critique the world. Looking into the actual condition of Mathematics in the Philippines, Igarashi and Suryadarma (2023) found that the foundational math skills of Filipino students consistently declined between 2003 and 2019. In the 2018 Program for International Student Assessment (PISA), less than 20% of students demonstrated the minimum proficiency level (Level 2), while over 50% showed very low proficiency (below Level 1) in mathematics. By 2022, the Philippines scored second lowest in mathematics among the 79 participating countries. To address this issue, Luz (2022) recommended that the educational system introduce self-correcting mechanisms and streamline processes for better outcomes.

Meanwhile, Strutchens, Harris, and Martin (2001) observed that students learn geometry, particularly circle theorems, through memorization rather than exploration and discovery, which may stem from students' weak foundation in geometry. This observation is reflected through the list of least learned competencies in mathematics at Koronadal National Comprehensive High School (KNCHS) for the school year 2021-2022, where learning competencies related to the key concepts on circles were tagged as least learned. This trend continued in the following year, as the 2023 Diagnostic Test conducted by the City Schools Division of Koronadal City revealed that only 61.4% of competencies related to circles were mastered by students. Given that lessons on theorems are foundational to geometry, addressing this issue must be a top priority.

Chand (2017) stated in his research journal, "A Constructivism Approach Towards Integration of ICT for Collaborative Learning," that ICT-integrated tools provide opportunities for a constructivist approach to collaborative learning. These tools offer learning opportunities where students can formulate and test their ideas, draw conclusions and inferences, and convey their knowledge in a collaborative learning environment. On the other hand, Linde (2021) mentioned in her lesson, "Teaching Math: Methods and Strategies," that another effective method in teaching math is by using visuals. According to her, this can be as simple as showing the lesson on a document camera or as sophisticated as using a video or other technology tools.

Meanwhile, The National Council of Teachers of Mathematics (NCTM, 2000) highlighted the need for technology integration in teaching and learning mathematics. Moreover, according to Bhatti (2019), in his experimental study on CAI and the conventional method of retention in mathematics, computer-assisted instruction (CAI) helped improve retention in mathematics, developed students' self-confidence, and reduced their math phobia.

One computer software that aids in teaching and learning mathematics and excels at providing visuals is GeoGebra. GeoGebra is a mathematics software that offers the opportunity to create interactive online learning environments, enabling students to explore mathematical concepts in various ways (Dasari & Tamam, 2020). Em and Roman (2020), in their study "The Effectiveness of GeoGebra in Teaching Grade 10 Mathematics," mentioned that using the GeoGebra software can improve students' performance in mathematics. This is because students need to investigate and use their creativity to solve some of the more challenging theorems. However, to achieve this, students first need a clear visual of the concepts before they can start developing creative thoughts through meaningful learning. GeoGebra can aid in providing students with good visual representations while allowing them to explore the concepts creatively.

Given the above reasons, the researchers have identified the need to develop and evaluate a GeoGebra-assisted instructional tool for teaching key concepts of circles. This study can help teachers impart knowledge and skills in geometry with the aid of the activities in the instructional tool. It can also serve as a foundation for teachers, providing suggestions for incorporating GeoGebra into the teaching of mathematical concepts. This will enable students to learn and practice geometry concepts while gaining a clear understanding through manipulatives provided by GeoGebra. Additionally, this study can serve as a basis for school officials to promote training in using GeoGebra and other mathematics software.

Statements of the Problem

The study aimed to develop and evaluate a GeoGebra-assisted instructional tool for teaching key concepts of circles. Specifically, the study addressed the following objectives:

1. Develop a GeoGebra-assisted instructional tool focused on key concepts of circles.
2. Evaluate the developed instructional tool in terms of:
   a. Instructional Quality
   b. Content Quality

c. Technical Quality

3. Determine the effectiveness of the developed instructional tool in improving students' performance in key concepts of circles.

Method

This section outlines the research design, locale, respondents, research instruments, and data analysis methods used in the study.

Research Design

The researcher employed a development and evaluation approach using the ADDIE learning model as the framework for creating the GeoGebra-assisted instructional tool. The ADDIE model, which stands for Analysis, Design, Development, Implementation, and Evaluation, offered a systematic and structured process to ensure the instructional tool met educational standards and effectively facilitated learning. Additionally, a quasi-experimental design was utilized in the implementation phase. This design allowed the researcher to compare the learning outcomes of students who used the instructional tool with those who did not. The quasi-experimental design provided valuable insights into the tool's impact on student learning and its potential for broader application in mathematics education.

Locale of the Study

The validation and pilot testing of the 50-item multiple-choice test and the evaluation of the GeoGebra-assisted instructional tool were conducted at Koronadal National Comprehensive High School (KNCHS) Senior High School (SHS) Department. KNCHS, a public high school situated in Koronadal City, South Cotabato, was established in 1947, originally known as Koronadal Junior High School. In 1970, it was converted into a national comprehensive school, which marked the beginning of significant improvements. Currently, the school boasts two annexes: the Saravia Annex, established in 2006, and the Bacongco Annex, established in 2005.

For the current school year, KNCHS employs a total of 290 personnel, of which 53 are Mathematics Teachers. According to the Learner's Information System (LIS) for the school year 2023-2024, KNCHS has an enrollment of 7,542 junior high school students, including 2,174 Grade 10 students. The Grade 10 student body is divided into 54 sections, each comprising 40-45 students. The GeoGebra-assisted instructional tool was specifically implemented with this Grade 10 cohort to enhance their learning experience.

Respondents of the Study

Three mathematics teachers from the KNCHS Mathematics Department validated the 50-item multiple-choice test. All validators were master teachers within the department. One Grade 11 section from the KNCHS SHS Department was selected for the pilot testing of the test, with a total of 40 students participating. Additionally, four master teachers, one year-level chairman, and three ICT experts from KNCHS evaluated the GeoGebra-assisted instructional tool in terms of its instructional, content, and technical quality.

The subjects of the study were Grade 10 students from KNCHS. Among the fifty-four Grade 10 sections, two heterogeneous sections were selected for the implementation of the GeoGebra-assisted instructional tool. One section served as the control group, while the other section served as the experimental group.

Research Instruments

Several instruments were utilized in the study: the evaluation form for the GeoGebra-assisted instructional tool, the 50-item multiple-choice pretest/posttest, and the validation tool for the test. The evaluation form, a five-point scale, assessed three domains: instructional quality, content quality, and technical quality.

To develop the 50-item multiple-choice test, a table of specifications was created. Mathematics master teachers validated the test using the validation tool before pilot testing. After pilot testing, item analysis and reliability tests were conducted using Cronbach’s Alpha. Based on the results, the test was revised, retaining 32 items but ultimately reducing it to a 30-item pretest and posttest to align with the number of items per competency. These tests aimed to measure the effectiveness of the GeoGebra-assisted instructional tool in enhancing students’ learning.

The pretest was administered after selecting the study sections. Following the pretest, the GeoGebra-assisted instructional tool was implemented. The posttest was administered two weeks after the start of the implementation, covering all the relevant topics.

Data Analysis

Cronbach’s Alpha was employed to evaluate the reliability of the 50-item multiple-choice test, utilizing the Kuder Richardson Formula 20 to check the consistency of the data gathered during the pilot testing. The analysis revealed a Cronbach’s Alpha of 0.696, indicating that the test is reliable and internally consistent. Following this reliability check, the test underwent item analysis to assess the quality of each item and identify those needing revision. The analysis showed that 28% of the test items should be rejected, 8% revised, and 64% retained. Consequently, the test was revised and reduced to a 30-item pretest and posttest. SPSS software was used for organizing, evaluating, and interpreting the data.

For evaluating the GeoGebra-assisted instructional tool, Aiken’s V was used to test the validity of the evaluators' responses. The result showed an overall validity coefficient of 0.97, indicating that all responses provided by the evaluators are valid. The means of each domain in the evaluation form were calculated and interpreted based on Table 1.

Table 1: Range, Score, and Verbal Interpretation for the Evaluation of the GeoGebra-Assisted Instructional Tool

Range	Score	Interpretation
1.00 – 1.50	1	Very Poor Quality
1.51 – 2.50	2	Poor Quality
2.51 – 3.50	3	Good Quality
3.51 – 4.50	4	Very Good Quality
4.51 – 5.00	5	Excellent Quality

Moreover, the Interrater Reliability test was also conducted to check the agreement between the evaluators' responses. The result showed an Interrater Reliability Agreement of 0.89, indicating a strong agreement among the evaluators.

To assess the effectiveness of the GeoGebra-assisted instructional tool, data from the pretest and posttest were collected. The F-test for Variances was used to determine the appropriate type of t-test to apply. The F-test results revealed that the two groups have equal variances, justifying the use of an Independent t-

Test to analyze whether there is a significant difference between the scores of the control and experimental groups at a 5% level of significance.

Results

This section presents the results of the data gathered during the research process.

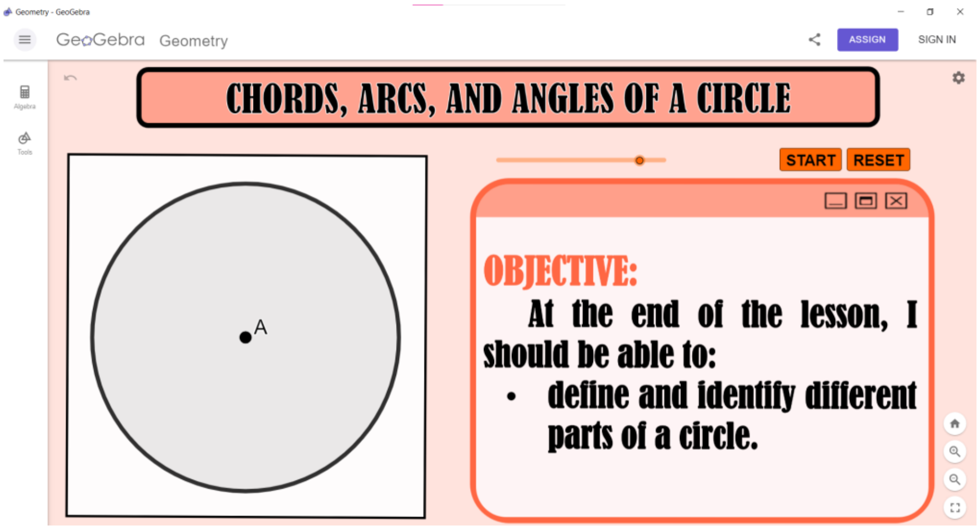
Developed GeoGebra-Assisted Instructional Tool

The initial step involved reviewing relevant documents to inform the decision on the research topic. It was determined that the focus would be on Key Concepts in Circles. This decision was based on data from the list of KNCHS Mathematics Least Learned Competencies for SY 2021-2022 and the 2023 diagnostic test conducted by the City Schools Division of Koronadal City. The results indicated that students had a low mastery of learning competencies related to key concepts in circles, identifying them as among the least learned areas. Consequently, an intervention was deemed necessary.

Subsequently, an instructional tool on key concepts in circles, assisted by the software GeoGebra, was developed. The instructional tool was designed as a comprehensive lesson package containing lesson objectives, discussions, and activities. All lessons were based on four least-learned competencies related to key concepts in circles, with each competency divided into several lessons, resulting in a total of eight lessons. The instructional activities included in each lesson were carefully determined based on the specific content and objectives, and various activities were employed to enhance understanding.

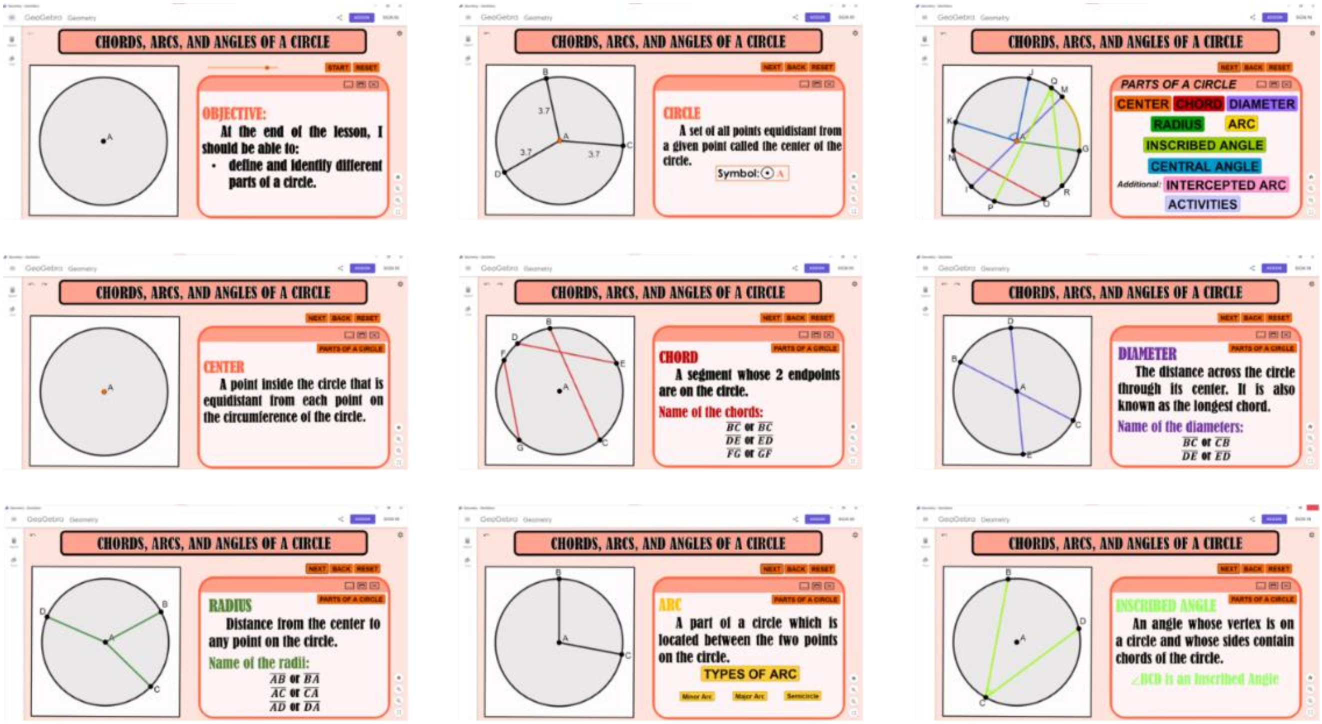
Each lesson begins with a homepage. Figure 1 presents the homepage of Lesson 1, which includes the title of the lesson and the learning objectives.

Figure 1: Homepage of Lesson 1



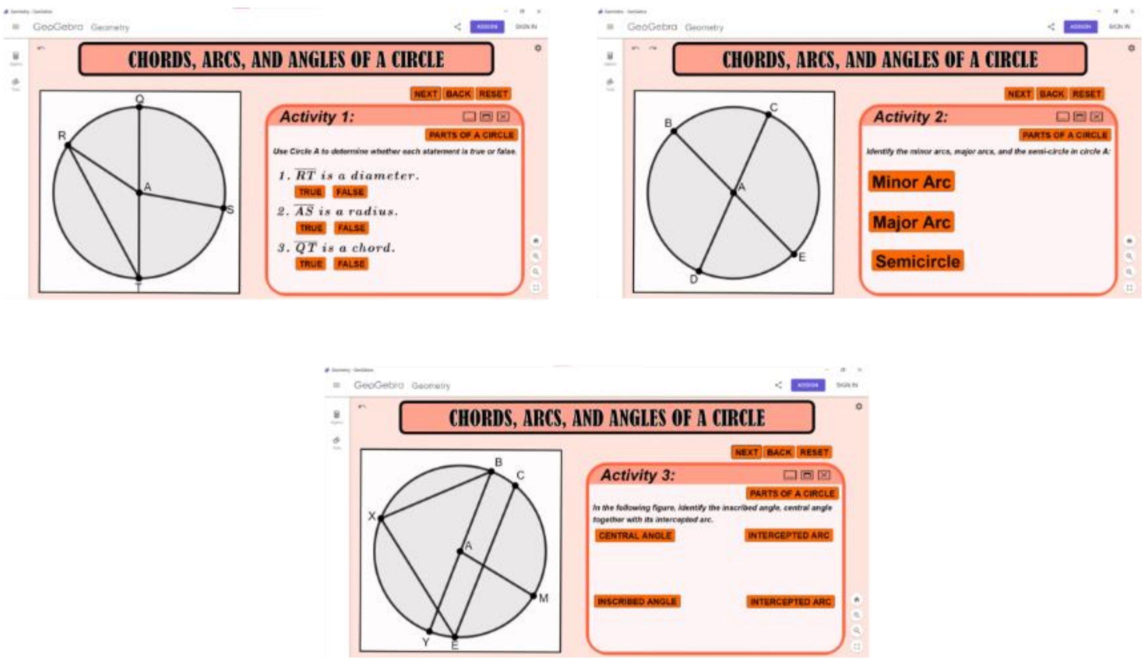
Following the homepage, a discussion of concepts is provided, utilizing hyperlinks for organized content. Figure 2 shows the discussion of concepts for Lesson 1.

Figure 2: Discussion of Concepts in Lesson 1



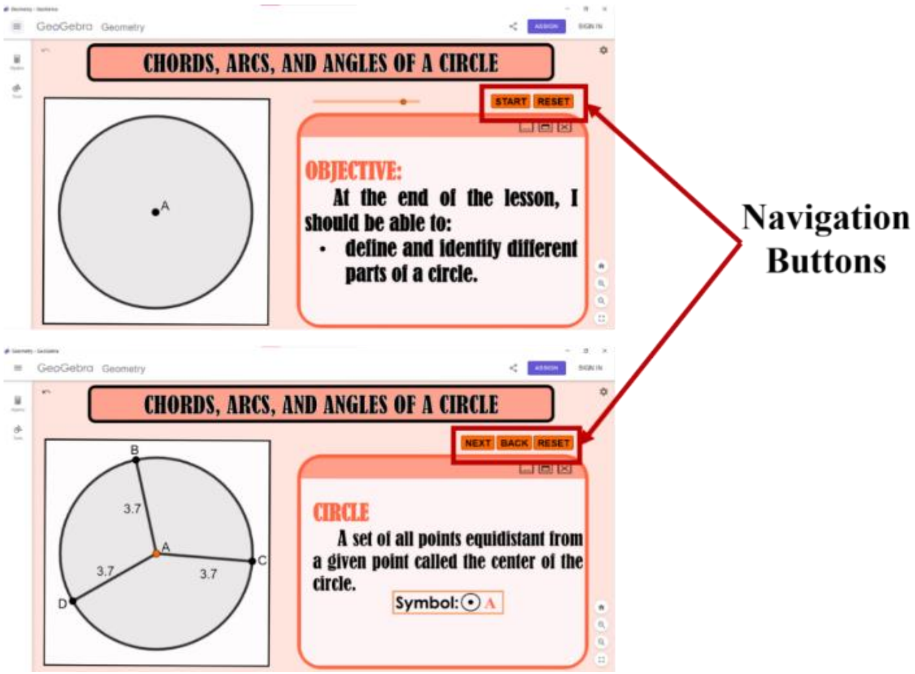
Activities follow the concepts, allowing students to easily input or choose their answers. Figure 3 illustrates the activities for Lesson 1.

Figure 3: Activities in Lesson 1



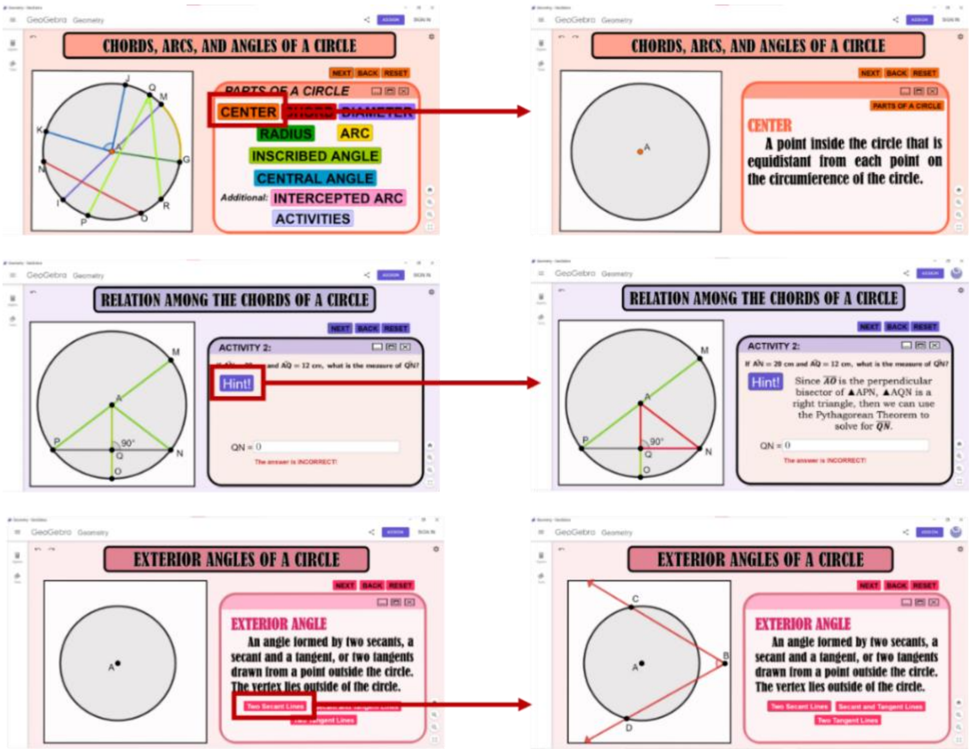
The instructional tool is designed similar to a PowerPoint presentation, consisting of several slides with navigation buttons. Figure 4 displays the navigation buttons, which enable users to proceed to the next slide, go back, or reset the slides to the homepage.

Figure 4: Navigation Buttons



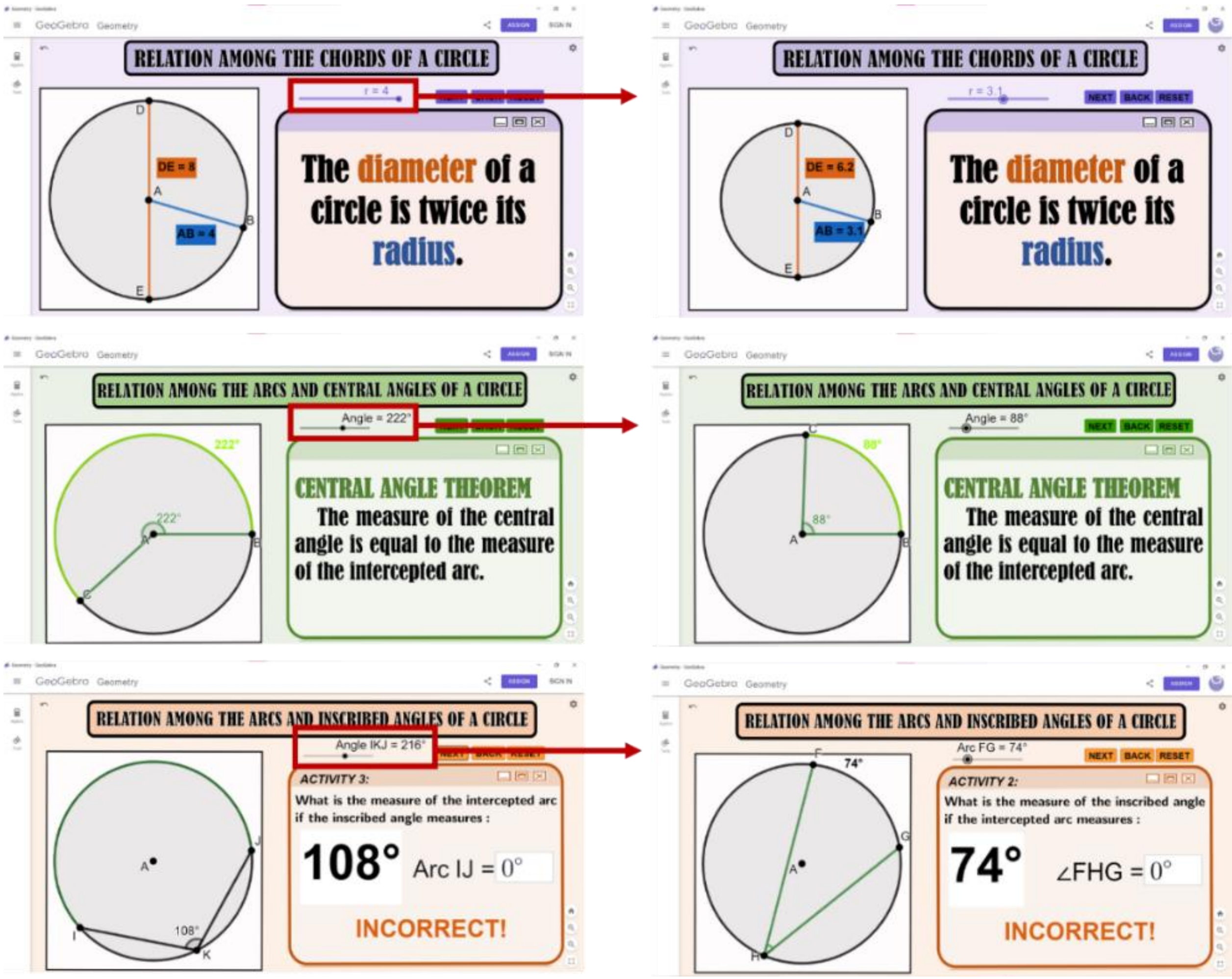
In addition to navigation buttons, hyperlinks were also embedded in the instructional tool using the button tool and scripting feature of the software for a clear and organized discussion. Figure 5 provides an example of these hyperlinks, allowing users to click and be directed to a more in-depth discussion of the concept. These hyperlinks may offer additional information or present a diagram related to a particular concept.

Figure 5: Hyperlink Buttons



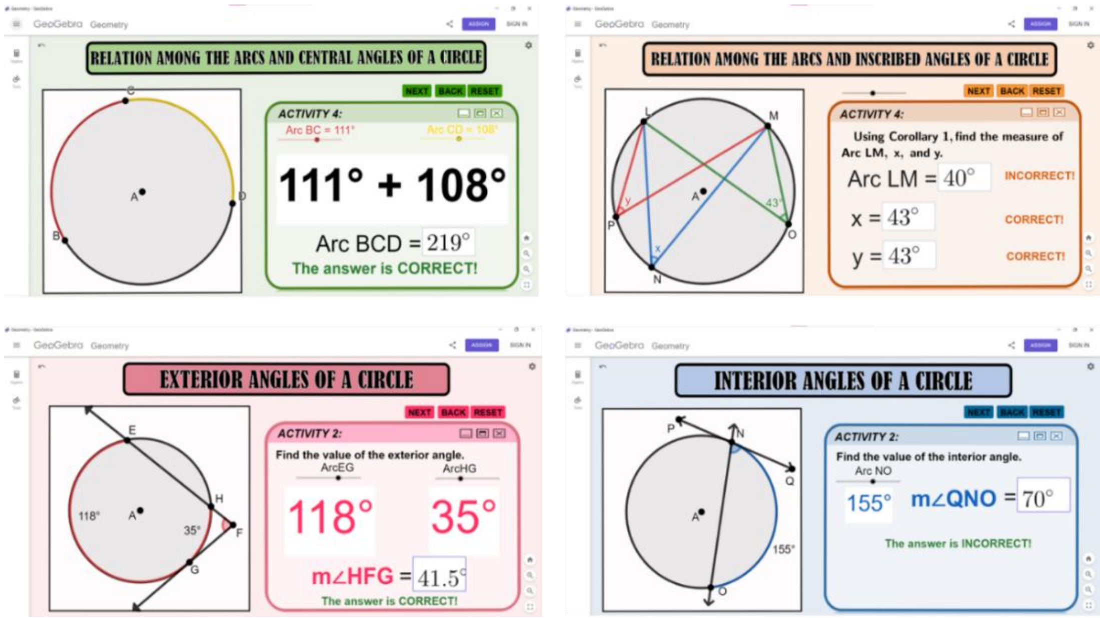
The diagrams in the discussion part of the instructional tool are designed to be manipulated by the user for an interactive learning experience. One of the main measurement tools in GeoGebra is the slider, which enables users to move the cursor over a parameter to dynamically change a value. Figure 6 shows the slider in the instructional tool and its functions. Sliders are often used to create animations, and in developing the instructional tool, the slider was used to manipulate diagrams and values of angles and arcs.

Figure 6: Slider Tool



The activities following the lesson discussions are designed with automated feedback through the input box and text tool. Figure 7 illustrates the automated feedback in the instructional tool. Users can input their answers in the input box, and the text tool automatically provides feedback indicating whether the answer is "correct" or "incorrect." Each text tool is programmed to give direct feedback based on the answers provided.

Figure 7: Automated Feedback



Evaluation of the GeoGebra-Assisted Instructional Tool

The evaluation of the GeoGebra-assisted instructional tool was done by evaluating the instructional tool in terms of its instructional, content, and technical quality and determining its effectiveness through a pretest and posttest. Table 2 presents the evaluation results of the GeoGebra-assisted instructional tool in terms of Instructional Quality. It shows that domains 9 and 10 have the highest mean of 5.00. The Instructional Quality has an overall mean of 4.80.

Table 2 Evaluation of the GeoGebra-Assisted Instructional Tool in Terms of Instructional Quality

A. INSTRUCTIONAL QUALITY	Mean	Interpretation
1. Objectives are well-formulated giving clear direction and establishing a sense of expectancy among students.	4.88	Excellent Quality
2. Prior knowledge of students is properly assessed to bridge the gap between what they already know and what they have to know.	4.63	Excellent Quality
3. Various motivational and cognitive strategies are properly embedded in every lesson to keep students on track.	4.75	Excellent Quality
4. Activities in the instructional tool are very relevant to the main objectives of the lesson and must be realistic considering the resources available (e.g time, materials, equipment, etc.)	4.88	Excellent Quality
5. The instructional tool provides provision for individual differences by supporting diverse learners with different learning styles, preferences, interests, and experiences.	4.75	Excellent Quality
6. Assessment tools included in the instructional tool ensure the development of higher-order thinking skills such as critical and creative thinking.	4.75	Excellent Quality
7. The instructional tool provides a good feedback mechanism so learners can regularly receive formative feedback on learning.	4.63	Excellent Quality

8. The instructional tool discusses basic applications prior to complex situations.	4.75	Excellent Quality
9. The instructional tool encourages reflection and self-evaluation.	5.00	Excellent Quality
10. The instructional tool allows the student to accomplish the activities at their own pace.	5.00	Excellent Quality
OVERALL	**4.80**	**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

Table 3 presents the evaluation results of the GeoGebra-assisted instructional tool in terms of Content Quality. The table shows that domains 1,2,3,4,5 and 9 have the highest mean of 5.00. The Content Quality has an overall mean of 4.93.

Table 3: Evaluation of the GeoGebra-Assisted Instructional Tool in Terms of Content Quality

B. CONTENT QUALITY	**Mean**	**Interpretation**
1. The knowledge and concepts are based on the MELC of Grade 10 Mathematics.	5.00	Excellent Quality
2. The concepts are within the curriculum expectancies of Grade 10 Mathematics.	5.00	Excellent Quality
3. The activities in the instructional tool are aligned with the learning objectives.	5.00	Excellent Quality
4. The knowledge and ideas being presented in every activity are accurate, recent, and free from errors using terminologies	5.00	Excellent Quality
5. The content is presented clearly using language that is understandable and suited to the level of the target learners.	5.00	Excellent Quality
6. The activities given in the instructional tool are sufficient to determine the student's mastery level.	4.75	Excellent Quality
7. The activities given in the instructional tool are systematically and sequentially arranged.	4.88	Excellent Quality
8. The activities in the instructional tool are varied and suited to the objectives of the lesson.	4.88	Excellent Quality
9. The activities in the instructional tool are relevant, interesting, and self-motivating.	5.00	Excellent Quality
10. The activities in the instructional tool are sufficient in quantity and varying levels of difficulty.	4.75	Excellent Quality
OVERALL	**4.93**	**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

Table 4 presents the evaluation results of the GeoGebra-assisted instructional tool in terms of Technical Quality. The table shows that domains 5,6,7,8,9 and 10 have the highest mean of 5.00. The Technical Quality has an overall mean of 4.94.

Table 4: Evaluation of the GeoGebra-Assisted Instructional Tool in Terms of Technical Quality

C. TECHNICAL QUALITY	Mean	Interpretation
1. Textual information is presented clearly with an appropriate choice of font size and style including other formatting features that could enhance the appearance of the texts (e.g. italics, boldface, underline, etc.)	4.75	Excellent Quality
2. The instructional tool warrants the appropriate use of illustrations.	4.88	Excellent Quality
3. The graphics and other media elements utilized (audio, video, animation etc.) are motivating and very relevant to the topics presented.	4.88	Excellent Quality
4. Proper spacing is observed in between texts, sentences, and paragraphs including margin and indention to avoid congested page	4.88	Excellent Quality
5. Main topics, subtopics, specific discussions, and other important parts of the instructional tool are properly labeled for easy recognition.	5.00	Excellent Quality
6. Use of the instructional tool does not require equipment or applications beyond what is typically available to the students (e.g. operating systems, browsers, application software)	5.00	Excellent Quality
7. The instructional tool is properly organized and packed in such a way that all the parts complement one another and each part contains clear directions for students to follow.	5.00	Excellent Quality
8. The instructional tool can be embedded or fully integrated into a Learning Management System for wide dissemination and accessibility.	5.00	Excellent Quality
9. The instructional tool has a user-friendly interface and navigational tools that even novice users can easily follow.	5.00	Excellent Quality
10. The instructional tool can be accessed by students either through the internet (online) or offline by providing electronic copies.	5.00	Excellent Quality
OVERALL	**4.94**	**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

Table 5 presents the summary of the evaluation results of the GeoGebra-assisted instructional tool. The overall mean of evaluation results from the three criteria is 4.89.

Table 5: Summary of the Evaluation Results of the GeoGebra-assisted instructional tool

CRITERIA	Mean	Interpretation
A. Instructional Quality	4.80	Excellent Quality
B. Content Quality	4.93	Excellent Quality
C. Technical Quality	4.94	Excellent Quality
OVERALL	**4.89**	**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

Effectiveness of the GeoGebra-Assisted Instructional Tool in Improving Learning

An Independent t-test was conducted to compare the pretest and posttest scores of the control and experimental groups. The results of this analysis are presented in Table 6.

Table 6: Analysis of the Significant Difference Between the Pretest Scores of the Control and Experimental Group

Group	Mean	SD	t – computed	p-Value	Interpretation
Control Group	7.97	2.623	-0.221	0.826	There is no significant difference
Experimental Group	7.82	2.865			

The analysis revealed no significant difference between the pretest scores of the control group (M=7.97, SD=2.623) and the experimental group (M=7.82, SD=2.865); t(66) = -0.221, p = 0.826. This indicates that both groups had similar levels of understanding of the subject matter prior to the implementation of the instructional tool.

On the other hand, Table 7 shows the analysis of the significant difference between the pretest and posttest scores of the experimental group.

Table 7: Analysis of the Significant Difference Between the Pretest and Posttest Scores of the Experimental Group

Test	Mean	SD	t – computed	p-Value	Interpretation
Pretest	7.82	2.865	-9.897	0.000	There is a significant difference
Posttest	15.56	3.544			

The Independent t-test comparing the pretest (M=7.82, SD=2.865) and posttest scores (M=15.56, SD=3.544) of the experimental group revealed a significant difference; t(66) = -9.897, p = 0.000. This significant increase in scores indicates that the GeoGebra-assisted instructional tool had a positive impact on the students' understanding of key concepts in circles.

Moreover, Table 8 presents the analysis of the significant difference between the posttest scores of the control and experimental groups.

Table 8: Analysis of the Significant Difference Between the Posttest Scores of the Control and Experimental Group

Group	Mean	SD	t – computed	p-Value	Interpretation
Control Group	12.26	3.926	3.632	0.001	There is a significant difference
Experimental Group	15.56	3.544			

The Independent t-test revealed a significant difference between the posttest scores of the control group (M=12.26, SD=3.962) and the experimental group (M=15.56, SD=3.544); t(66) = 3.632, p = 0.001. This finding suggests that students who were taught using the GeoGebra-assisted instructional tool outperformed those who received traditional instruction.

Discussion

The development and evaluation of the GeoGebra-assisted instructional tool for teaching key concepts of circles revealed significant improvements in student understanding and engagement. The tool was evaluated across three domains: instructional quality, content quality, and technical quality, all of which received a rating of excellent quality with an overall rating of 4.89. This aligns with Octaria's (2022) study, which found that GeoGebra-assisted e-modules encourage independent study, active learning, and increased student interest.

The evaluators strongly agreed that the GeoGebra-assisted instructional tool allows students to accomplish activities at their own pace while stimulating self-evaluation and reflection. This aligns with Hearn and McMillan's (2008) findings that students are more motivated and perform better when they assess their learning, reflect on their progress, and generate new learning ideas. The high overall mean score of 4.80 in instructional quality suggests that the instructional tool is relevant, realistic, and provides clear guidance, supporting diverse learning needs and promoting reflective practices. Moreover, the content of the instructional tool is aligned with the Most Essential Learning Competencies (MELC) and meets the Grade 10 Mathematics curriculum expectations, making it both current and appropriate for the student's level. According to Val (2016), educational content should be within the students' learning capacity and experience. The evaluators noted that the activities are relevant, interesting, self-motivating, and well-aligned with the competencies and learning objectives, which is essential for effective learning as emphasized by Shin (2018). They recommended incorporating more activities to provide a more comprehensive assessment of learning. The overall mean score of 4.93 for content quality, indicates that the content is scientifically accurate, well-organized, and effective in stimulating critical thinking and active learning. Moreover, the evaluators also strongly agreed that the instructional tool is user-friendly, with clear labeling, logical organization, and no need for additional equipment beyond what students typically have. Kapadia (2023) supports the notion that well-arranged and systematically presented content reduces misunderstandings and frustrations, allowing students to focus on metacognitive processes and enhancing their learning experience. The instructional tool can be fully integrated into a Learning Management System, accessible both online and offline, with appropriate font size, style, and spacing. The overall mean score of 4.94 for technical quality reflects the tool's user-friendly design and motivational qualities.

On one hand, both groups performed poorly on the pretest, which aligns with Mbuguan, Kiruino, and Pell's (2012) findings that persistent low performance in mathematics is often due to factors such as understaffing, inadequate resources, lack of motivation, and poor attitudes among teachers and students. However, the experimental group's performance improved significantly after using the GeoGebra-assisted instructional tool. This improvement is supported by Azucena et al. (2022), who state that GeoGebra boosts confidence, enhances learning, and helps remediate students' least mastered skills. Moreover, the experimental group outperformed the control group, demonstrating that the GeoGebra-assisted instructional tool significantly enhanced students' performance in key concepts of circles. Leong and Shadaan (2013) emphasize GeoGebra's effectiveness in teaching and understanding mathematics, particularly in fostering cooperative and collaborative learning in geometry.

Conclusions

Based on the findings, it can be concluded that the GeoGebra-assisted instructional tool is of excellent quality. It allows students to accomplish activities at their own pace and encourages self-evaluation and reflection. The content of the instructional tool is based on the MELC provided by the DepEd, and all activities are aligned with it. The content and activities are recent, relevant, interesting, and suitable for the learners' level. The instructional tool has a user-friendly interface, with properly labeled components for easy recognition. It does not require equipment or applications beyond what is typically available to students and is well-organized so that all parts complement one another and contain clear directions for students to follow. Based on the results of the pretest and posttest, the GeoGebra-assisted instructional tool significantly improved students' performance in key concepts of circles.

Recommendations

Based on the findings and conclusion of the study, the GeoGebra-assisted instructional tool is recommended for use by other mathematics teachers due to its proven effectiveness in improving student learning. School heads may also consider conducting seminars or Learning Action Cell (LAC) sessions on GeoGebra. This approach can introduce GeoGebra to a broader audience, particularly mathematics teachers and professionals in the field. Additionally, other features of the software beyond its basic tools can be explored. GeoGebra has the potential to be used in various branches of mathematics, supporting a wide range of topics.

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