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DEVELOPMENT OF PROBLEM-BASED LEARNING-BASED MATHEMATICS WITH THE ASSISTANCE OF GEOGEBRA APPLICATIONS TO IMPROVE STUDENTS' MATHEMATICAL CONCEPTS UNDERSTANDING ABILITY

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Abstract

This research is a development research (R & D) that aims to improve students' ability to understand mathematical concepts with learning media assisted by problem-based learning geogebra applications. The benefit of this research is that students can foster their learning interest in learning mathematics with the help of geogebra application technology so that students can be active in learning and think logically and broadly. This research uses a development research method with a "Four-D Model" or 4-D model which includes four stages of development, namely: define, design, develop and disseminate. a process to develop and validate a product (Sugiyono, 2019: 394). Meanwhile, according to Sariyani, the results of learning media development explained geogebra-assisted learning materials, lesson implementation plans (RPP), teacher books (BG), student books (BS), group worksheets (LKK), concept comprehension ability test instruments, and mathematical disposition questionnaires. Out of 38 students, 5 students were incomplete with a completeness rate of 20% and 33 students were incomplete with a completeness rate of 80%. For students who are more motivated, have a deeper understanding, and have better math skills. Development instrument reaction form sheets, learning program drafts, and student works Student questionnaires and knowledge tests of mathematical concepts are also given on stage. Once the production and assessment of teaching materials and mathematical instruments is complete, validators will proceed to validate previously discontinued instruction, math, and instrumentation use evaluation sheets. Student answer questionnaires and worksheets using learning media such as GeoGebra were used to assess students' understanding of mathematical topics at intervals 2.5–M–3.5 with valid categories.

Keywords: *Geogebra, Problem Based Learning , Understand Mathematical Concepts*

Abstrak

Penelitian ini merupakan penelitian pengembangan (R&D) yang bertujuan untuk meningkatkan kemampuan pemahaman konsep matematis siswa dengan media pembelajaran berbantuan aplikasi geogebra berbasis *problem based learning*. Manfaat penelitian ini adalah agar siswa dapat menumbuhkan minat belajar mereka dalam pembelajaran matematika dengan bantuan teknologi aplikasi *geogebra* agar siswa dapat aktif dalam pembelajaran dan berfikir logis serta luas. Penelitian ini menggunakan metode penelitian pengembangan dengan "Four-D Model" atau model 4-D yang meliputi empat tahap pengembangan yaitu: *define* (pendefinisian), *design* (perancangan), *develop* (pengembangan) dan *disseminate* (penyebaran). suatu proses untuk mengembangkan dan memvalidasi suatu produk (Sugiyono, 2019). Sedangkan menurut Sariyani, Hasil Pengembangan Media Pembelajaran Dijelaskan materi pembelajaran berbantuan geogebra, rencana pelaksanaan pembelajaran (RPP), buku guru (BG), buku siswa (BS), lembar kerja kelompok (LKK), instrumen tes kemampuan pemahaman konsep, dan



angket disposisi matematis. Bahwa dari 38 siswa, 5 siswa tidak tuntas dengan tingkat ketuntasan 20% dan 33 siswa tidak tuntas dengan tingkat ketuntasan 80%. Untuk siswa yang lebih termotivasi, memiliki pemahaman yang lebih dalam, dan memiliki kemampuan matematika yang lebih baik. Lembar formulir reaksi instrumen pengembangan, draf program pembelajaran, dan karya siswa Kuesioner siswa dan tes pengetahuan konsep matematika juga diberikan di atas panggung. Setelah produksi dan penilaian bahan ajar dan instrumen matematika selesai, validator akan melanjutkan untuk memvalidasi lembar evaluasi penggunaan instruksi, matematika, dan instrumentasi yang sebelumnya dihentikan. Angket jawaban siswa dan lembar kerja menggunakan media pembelajaran seperti GeoGebra digunakan untuk menilai pemahaman siswa terhadap topik matematika pada interval 2,5–M–3,5 dengan kategori valid.

Kata Kunci: Geogebra, *Problem Based Learning*, Pemahaman Konsep Matematis

INTRODUCTION

Education is an option that aims to influence and help children with the aim of improving their knowledge, physical fitness, and morale to gradually guide children towards their highest ideals (Kholik, 2022). A child can live happily and everything he does benefits himself, his faith, society, country, and the world at large. In addition, education is an adult's effort to guide a young person towards maturity while assisting the child in learning how to carry out life obligations responsibly and independently.

Teachers face significant difficulties in this situation because the traditional function of teachers as a source of knowledge has changed. The presence of the teacher in the classroom not only provides knowledge, but also teaches students the attitudes and abilities necessary to develop intelligence superior to machines and use machines wisely. Mathematics is one of the skills needed to succeed in the fourth industrial revolution and advance the understanding of science and technology.

The development of modern technology is based on the universal science of mathematics, which also plays an important role in a number of other areas and promotes the growth of human reason (Agung, 2020). This requires a solid understanding of the concept of learning mathematics. Because meeting the five requirements set by the National Council of Teachers of Mathematics (NCTM) and included in the junior high school (SMP) mathematics curriculum requires the ability to understand concepts. The five requirements address the capacity to reason and demonstrate, communicate, connect, and represent—all essential means of acquiring and applying knowledge (Aldila, 2020). Learning mathematics serves to train brain growth and intelligence. The study of mathematics is necessary to develop problem-solving and analytical skills (Latifah et al., 2021).

In addition, learning mathematics helps one develop methodical, scientific, logical, critical thinking skills as well as increase creativity. So that mathematics is easily understood by students. Good mathematical principles must be understood by students.



If students are able to evoke meaning and encourage activeness in searching for ideas, which can be oral, written, and graphic information, they will be able to understand mathematical concepts (Jeheman, 2019). To answer the difficulties when learning mathematics, conceptual awareness is needed. Conceptual knowledge is needed to develop critical and systematic thinking skills, reasoning skills, as well as objective and open attitudes in facing challenges faced in everyday life in order to adapt to changing times. Understanding mathematical ideas is very important so that children do not have learning problems (Hadiyanti, 2019). Using learning media to teach mathematical ideas to students is one way to improve conceptual understanding.

The level of conceptual understanding does not correspond to the level of conceptual knowledge. Evidence shows that Indonesian children still have relatively poor math scores. Indonesian students' grade VIII average math scores place them 45th out of 50 participating countries of TIMSS (Trends in International Mathematics and Science Study), an international study in mathematics and science conducted to learn more about achievement in mathematics and science in participating countries. Indonesia's position in PISA 2015 (Program Internationale for Student Assessment), a method of assessing students' ability and knowledge in mathematics, science, and language subjects, is 64 out of 180.

This is in accordance with the research of (Diana, 2021) which found that children in one school had poor concept comprehension skills. Many factors, including internal characteristics of students and external factors of teachers, may contribute to students' low understanding of mathematical concepts ariables that are beyond the student, such as tactics or learning procedures (Aminah et al., 2020). Internal factors such as feelings and attitudes towards mathematics are factors that students have. Interactive learning media is used because students' knowledge of mathematical concepts is still low. GeoGebra-based learning materials are interactive learning tools that can be used to improve understanding of concepts.

Students can track their learning progress in GeoGebra Group using a learning management system. GeoGebra-based teaching materials are expected to improve (Agung, 2020). GeoGebra is a tool for creating geometry concepts and can be used as a geometry teaching tool, especially to illustrate or visualize geometry concepts. In addition, GeoGebra can express geometric problems and illustrate geometric objects, making it easier to understand the necessary concepts. Teachers can practice classroom teaching using GeoGebra software.

There are many benefits of using the GeoGebra program, including the following: 1) When compared to the use of a pencil, ruler, or compass, paintings are usually made quickly and accurately. 2)



The use of animation tools and movement manipulation (dragging) in the GeoGebra program can provide students with a clearer visual understanding of mathematical ideas using the Geogebra program to teach mathematics (Nur, 2019). *Journal of Mathematics and Mathematics Education, Delta-Pi*, 5, 1 efforts made by GeoGebra-based learning resources to help students develop conceptual comprehension skills that adhere to reliable, useful, and efficient standards.

The reality on the ground shows that there are still many teachers who have not utilized interactive learning resources. Teachers continue to teach students through printed texts and lectures. The findings of preliminary observations made at MAS Al-Washliyah school in Johor Medan Building make this clear. One of the school teachers was also the subject of an interview. He said the school's resources and infrastructure were insufficient, for example the scarcity of projectors, laptops and computer labs. The person in charge of the computer lab who was also interviewed by the researcher said that the lab was specifically used for ICT classes. Therefore, the teacher uses the teaching methodology of Problem-Based Learning to improve his/her understanding of students' mathematical concepts.

According to Eggen and Kauchak (Halawati, 2019), a problem-based learning model is a collection of instructional methods that use issues as focal points for the development of problem-solving abilities, content, and self-regulation. While this is going on, it is suggested by (Supinah, 2020) that problem-based learning is a learning strategy that starts by offering students problems to solve (Meiliza Aminy, 2021). The Problem-Based Learning Model, often known as problem-based learning, is a teaching method that utilizes real-world issues to teach students about critical thinking and problem-solving techniques as well as fundamental information and ideas about the subject matter (Astrie Pratiwi Damayanti et al., 2021). According to this approach, the duties of the teacher include asking difficulties, asking questions, facilitating debates.

RESEARCH METHODS

This research uses the type of Research Development (Research and Development). The development of learning media that will be carried out in this study refers to the Thiagarajan development model which is also known as the "Four-D Model" or 4-D model which includes four stages of development, namely: *define, design, develop* and *disseminate*. This research develops *problem-based learning* media for mathematics assisted by the geogebra application to improve students' ability to understand mathematical concepts. This research was conducted at MAS Al-Washliyah Johor Building in the second semester of Academic Year 20 22/2023. Subjek in this study was a student of

MAS Al-Washliyah Gedung Johor Medan class X-A as many as 38 students. andan object in this study is the Development of *Problem-Based Learning Mathematics* Learning Media withthe help of Geogebra to Improve the Ability to Understand Mathematical Concepts of Students on Geometric Transformation material. The instruments and tools to collect data in this study are Learning Implementation Plan (RPP), Teacher Book (BG), Student Book (BS), Group Worksheet (LKK), test instrument of ability to understand mathematical concepts and mathematical disposition questionnaire.

Three requirements must be met to assess the quality of a product: validity, prattleness, and effectiveness. Therefore, if the mathematics learning resources developed already meet the criteria then it is considered feasible.. If the learning media is included in the minimal valid category, it is said to be valid. A newly created product can be validated by asking many knowledgeable specialists or experts to evaluate it (Sugiyono, 2019).

Tabel 1. Kriteria Kevalidan Media Pembelajaran

No	V_a atau nilai rerata total	Kriteria Kevalidan
1	$1 \leq V_a < 2$	Tidak valid
2	$2 \leq V_a < 3$	Kurang valid
3	$3 \leq V_a < 4$	Cukup valid
4	$4 \leq V_a < 5$	Valid
5	$V_a = 5$	Sangat valid

There are three methods of assessing the validity of the instrument: (1) evaluation of the validity of construction, which is carried out with the help of expert opinion; (2) evaluation of the validity of the content, carried out by comparing the content of the instrument with the subject matter that has been taught; and (3) evaluate the validity of the instrument externally, which is done by comparing the results of previous tests with empirical facts that actually occur in the field (Sugiyono, 2019).

Practicality refers to the extent to which users (and other experts) perceive an intervention as obvious, usable, and cost-effective under "typical" conditions (Akker, 2018). The following restrictions must be met by practicality criteria: (1) Expert practitioners evaluate the applicability of newly produced ideas, and (2) users of the developed product find it easy to use.

Learning effectiveness indicators can be based on the achievement of learning completeness (if it has a minimum absorption of 65%, while classical completeness is achieved if 85% of students have been completed), the achievement of completeness of learning objectives (at least 75% of the formulated learning objectives can be achieved by at least 65% of students), the time used in learning is efficient or does not exceed ordinary learning, and student response to positive learning (Hasratuddin, 2018).



RESULTS

Learning Media Development Results Explained geogebra-assisted learning materials, Learning Implementation Plans (RPP), teacher books (BG), student books (BS), group worksheets (LKK), concept comprehension ability test instruments, and mathematical disposition questionnaires. the end product of this development research. The following is an explanation of the results of making learning media:

Defficiency

Based on the findings of observations made on learning media at MAS Al-Washliyah Johor Medan school, it is clear that teachers have not used information and communication technology appropriately. Teachers have never applied the use of learning media in line with technological advances. By utilizing the facilities offered by the school, teachers are less proficient in making teaching materials. Learning becomes teacher-oriented in the classroom when only written materials and lectures are used, making students passive. RPP continues to lack models that can engage students, and neither teachers nor students nor their teachers use worksheets to aid the learning process. This is what causes students' mathematical reasoning ability and creativity to be low.

Design.

At this stage, lesson plans, teacher books, student books, group worksheets for each meeting, assessment of understanding of mathematical ideas, and questionnaires on mathematical dispositions are produced as part of the first design of learning media. all result of the design phase. It is hoped that by applying all original designs as a whole using the Geogebra-assisted Problem-Based Learning framework, students of class X-A MAS Al-Washliyah at Johor Medan Building, can develop their creative thinking skills and mathematical skills.

Develop

Expert and expert validity tests are carried out after learning material with the Geogebra-assisted Problem Based Learning paradigm, then field trials are carried out. The goal is to correct errors and shortcomings in the design results, which are then used as a basis for editing and refining the initial learning design.

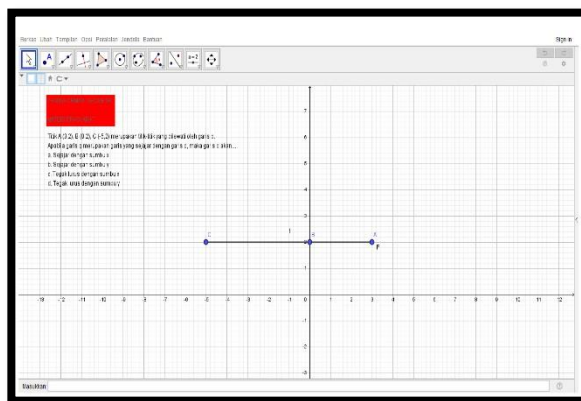
Geometric transformations are one of the difficult subjects for teachers to teach. Therefore, GeoGebra-based mathematics education materials have been created to assist students in understanding the content of GeoGebra Transformation better. After making observations, it was discovered through the study of student characteristics that various student traits, including the student's relatively low

ability to understand mathematics, contributed to learning that was not as successful as it might have been. Even so, many sisters still did not aggressively ask. Some people still find it difficult to understand simple concepts. These qualities of children's character make educational programs unsuccessful. The characteristics of these children cause educational programs to not work, he said. works well.

As mentioned (Nila, 2019), to provide specific learning activities, learners must actively participate in their education. Given this, different or different learning strategies should be used, such as using study materials. At that time, students began to concentrate on lesson plans (RPP), learning outcomes tests, and concept understanding tests on the material including geometric transformations. The first action taken during the learning process is the completion of the Learning Implementation Plan (RPP). is the process of making lesson plans for the application of learning.

There are steps that will be followed during the learning process a) to apply what has been learned. b) basic skills, core skills, learning indicators, learning objectives, learning resources, and methods, learning tools, learning strategies, and learning models; c) stages of activity consisting of opening, middle, and closing activities; and d) evaluation of the Learning Implementation Plan (RPP) which is only carried out through four meetings.

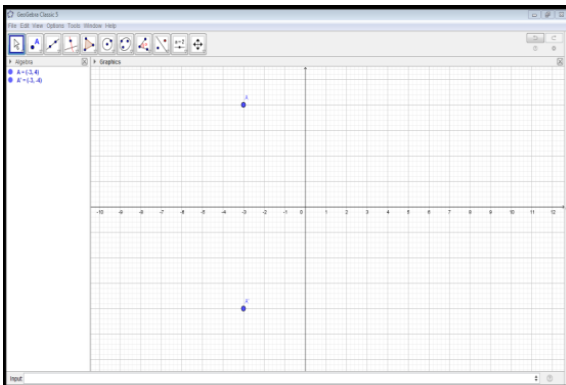
Learning Media or also called media selection and determination is the design of mathematics learning media content, namely the selection and determination of media to meet interesting criteria and can help students in achieving the competencies to be achieved. GeoGebra learning resources for geometric transformations are available for subjects. Geometric transformation is the main subject of learning geometry mathematics in various media. Prerequisite materials will be printed with a statement that the waiter understands by printing the dot and the waiter marking the point.



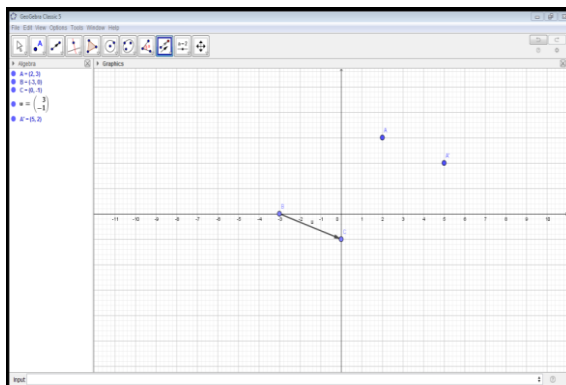
Gambar 1. Materi Prasyarat

Basic Skills and Objectivity of Study. The educational resources in this bag will be used to teach students about reflection, transposition, rotation, and dilation. One content subsection will show Point Transformations, Field Transformations, and Composition Transformations to be used with a specific LKS.

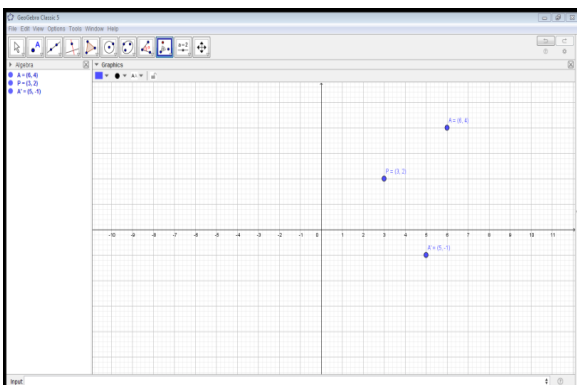
Gambar 2. Refleksi



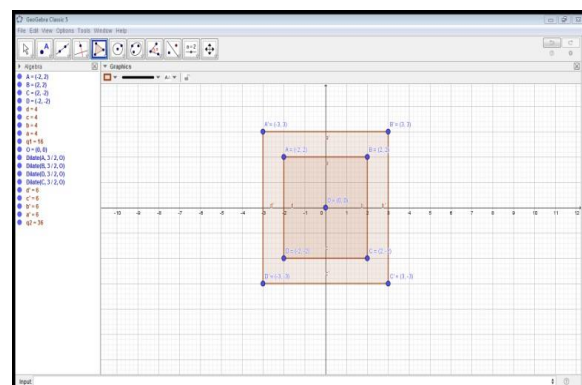
Gambar 3. Translasi



Gambar 4. Rotasi



Gambar 5. Dilatasi



Exercise: Describe the subject the student will be studying. Learning outcomes tests in the form of concept comprehension tests, and concept comprehension tests are assessment tools that can be used by teachers to measure the progress of their students after the learning process is complete. The latest test is an essay test with about seven topics that will be covered using GeoGebra.

Students began to develop mathematics teaching resources in this session using GeoGebra, which is in line with the RPP design. Some aspects appear during the infancy, as seen in Corrections, comments, and suggestions are the result of expert validation and are used as a foundation for improvement and improvement of teaching materials. Validation of mathematics learning media at this stage. The following table shows lesson plans, student questionnaire responses, and math concept comprehension ability test results:

Tabel 1. Deskripsi Hasil Penilaian Ahli Terhadap Bahan Ajar dan Instrumen Tes

Lembar Validasi	Indikator	Penilaian	Hasil Validasi
Media Pembelajaran Bernatuan GeoGebra	Aspek perangkat Lunak	3,43	sedikit revisi
Lembar Kerja Siswa (LKS)	Format Penulisan Media Isi	Aspek3 2,8 3,17	sedikit revisi
Rencana Pelaksanaan Pembelajaran (RPP)	Format Penulisan BahasaIsi	3,3 3 2,8	sedikit revisi
Angket Siswa	Respon Aspek Bahasa Aspek Respon Siswa	Petunjuk Aspek Cakupan 3,5 3 3	sedikit revisi
Tes Pemahaman Matematis	Kemampuan Isi Bahasa Konsep	2,8 3,5	sedikit revisi

Table 1. Work with students on GeoGebra worksheets, with help from lesson plans and student responses to questionnaires (Appendix 3), and evaluate their understanding of mathematical formulas at intervals 2.5–M–3.5 with valid categories added. The results of the tool validation show that the mathematics teaching materials currently used together need to be revised. For them to judge.

The results of the Review and Validation of Mathematics Education Results are presented in the table below for each device:

Tabel 2. Hasil Revisi dari Validator

Perangkat yang divalidasi	Hasil Validasi
Media Pembelajaran Matematika Berbantua GeoGebra	Perbanyak penggunaan tools padamedia.
Lembar Kerja Siswa (LKS)	Perbanyak aktivitas siswa dalam hal interaksi dengan media pembelajaran.
Rencana Pelaksanaan Pembelajaran (RPP)	Perbanyak interaksi antara siswa dengan media pembelajaran yang digunakan.
Angket Respon Siswa	Kolom pertanyaan ganti dengan pernyataan Pilih bahasa yang tepat untuk butir pernyataan pertama
Tes Kemampuan Pemahaman Matematis Siswa	Pilih redaksi yang tepat untuk soal essay Sesuaikan alokasi waktu dengan jumlah dan tingkat kesukaran.

Please be knowledgeable and offer validator evaluation findings for math teaching resources. which sets instructions for GeoGebra based on mathematics Work with students on content, lesson planning, feedback from students of grade X-A MAS Al-Washliyah Gedung Johor Medan, and math comprehension exams. Table 3 at the bottom shows this:

Tabel 3. Rangkuman Hasil Validasi

Sumber	Rata-rata	Kriteria
Media	3,43	Valid
Lembar Kerja Siswa(LKS)	2,99	Valid
Rencana Pelaksanaan Pembelajaran (RPP)	3,03	Valid
Angket Respon Siswa	3,16	Valid
Tes Kemampuan Pemahaman Matematis	3,15	Valid

According to the table above, it can be concluded that mathematics instruction based on GeoGebra, student-to-student correspondence in mathematical instruction, lesson plans, student answers, and validator thresholds for mathematical competence are all suitable for trials.

Utilizing items that have been produced after being formed during the planning stage is an activity at this level. Class X-A students at MAS Al-Washliyah Johor Medan were given the results of



improving mathematics teaching materials based on feedback from validators and supervisors. Trials were conducted to determine how well GeoGebra really works in the context of peer education in mathematics. In addition, during this experiment, talks were conducted about the activities students did during class, the resources the teacher used, and the students' reactions to the Peer Education Media. After all educational activities that require the use of GeoGebra Mathematics Learning Tools have been completed, teachers should give students time to consider their answers to the newly introduced Mathematics Learning Media.

Based on an examination of students' answers to arithmetic educational media used in higher grades, the percentage of students who answered correctly on a percentage basis was 83%, as shown in the graph. This increases the percentage of student responses that favor the practical use of GeoGebra in mathematics education. From the description above, it can be seen that the teaching materials made with the Geogebra-assisted Problem-Based Learning approach have met the expectations of practicality. As a result, both instructors and students can use the resulting learning materials for the Geogebra-assisted Problem-Based Learning paradigm.

Students will actively participate in problem solving using the Problem Based Learning with Geogebra learning media approach. Research which came to the conclusion that learning tools made using PBL meet the requirements for success as evidenced by student mastery of both individual and classical learning reinforces this (Tanjung, 2019). According to research by Sinurat (Suprihady, 2022), learning using multimedia can help students deal with real-world situations, which can improve their mathematical skills, which states that the use of the Geogebra application can increase student learning completeness by 87.87%, meaning that it is done traditionally, supports this (Ramadhani, 2019).

Throughout the educational process, fraternity activities are examined using the findings of data efficiency analysis and fraternity activity analysis. The findings are based on seven factors of your activity: You must make claims and categorize objects according to their qualities. Using appropriate and relevant evidence to describe a proposition in some mathematical form and provide a description of the proposition rather than just an explanation of it. According to the findings of the examination of the level of student activity while attending college lectures, 62.14% of them are in the range of 60 to 80 percent. Student engagement is essential for effective learning. process. On the lamppost is a thorough study. Therefore, it can be concluded that the activities driven by participants during the research procedure can be judged effective.

The percentage of scores obtained from test results is determined by concept knowledge analysis and concept comprehension tests. Both of these processes are carried out in a way that ensures proper responses in draft guideline assessment comprehension tests. Five criteria were developed from the categories that students mentioned in the survey. Consider the category offering me Q as an illustration:

Tabel 4. Kualifikasi Persentase Skor Pemahaman Konsep Siswa

Persentase	Kategori
$70\% < P \leq 100\%$	Sangat Baik
$60\% < P \leq 70\%$	Baik
$50\% < P \leq 60\%$	Cukup
$40\% < P \leq 50\%$	Kurang
$0\% < P \leq 40\%$	Sangat Kurang

Concept Introduction Based on the results of the analysis, Class X-A students are classified as "good" with 7 indicators classified as "good, serious" and 1 indication classified as "good". The table below lists findings from the analysis.

Tabel 5. Deskripsi ketuntasan Hasil Belajar Siswa

Interval	Kategori	Frekuensi	Persentase (%)
00,00-70,00	Tidak Tuntas	5	20
70,00-100,00	Tuntas	33	80

Table 5 shows that out of 38 students, 5 students were incomplete with a completeness rate of 20% and 33 students were incomplete with a completeness rate of 80%. with the type of test results show that the student has mastered the standard of completeness.

DISCUSSION

Learning is an activity that takes up most of the time during the educational process, allowing the learning process to take into account the student's level of understanding. To achieve the goals that have been set, an effective learning process must be carried out. It is necessary to consider several



aspects that might affect how well the learning process goes, such as model selection and learning tactics. Claims that trusted teachers can use the potential of technology. For students who are more motivated, have a deeper understanding, and have better math skills. Computers today have different types of applications.

Computer-aided teaching is excellent for inspiring students to actively participate in their learning and to understand the fundamentals of mathematics. It can also help students master certain arithmetic ideas more quickly.

Design stage, at the planning stage, researchers begin to utilize learning resources, compile instructions (RPP), and analyze test results. Analyze the draft of the shape comprehension exam (Appendix 5) using geometry transformation material in GeoGebra. Media-based mathematics education is developing and is currently at the Development Stage. Prerequisite materials, skills, indications, transformational geometry, and activities are all included in the math learning toolkit. Reflection, translation, translation, and rotation are the four submaterials that make up the geometry transformation material. Development instrument reaction form sheets, learning program drafts, and student works. Student questionnaires and knowledge tests of mathematical concepts are also given on stage.

Once the production and assessment of teaching materials and mathematical instruments is complete, validators will proceed to validate previously discontinued instruction, math, and instrumentation use evaluation sheets. Before the module is cooked, validators provide a score for evaluation and some correction suggestions. Student answer questionnaires and worksheets using learning media such as GeoGebra were used to assess students' understanding of mathematical topics at intervals 2.5–M–3.5 with valid categories. Resources and techniques for teaching mathematics that have been accepted as valid by two validators are now in use.

The practice of mathematics is influenced by the education of media consumers. The number of students who answered the questionnaire of 83% showed how useful mathematics learning media is, which shows that the learning media for mathematics subjects used meet practical standards. Useful mathematics study materials. Apply media. Students and instructors have responded with great excitement to the math learning shown above. The use of technology, said (Rangkuti, 2023), is an ideal approach to improve the quality of education because, as must be realized, science and technology penetrates every area of daily life (Hildani & Safitri, 2021; Latif et al., 2020; Romansyah et al., 2019; Safitri, 2017). When teaching mathematics with the GeoGebra program, a higher standard of knowledge is generated compared to material education that puts students first.



CONCLUSION

After making observations, it was discovered through the study of student characteristics that various student traits, including the student's relatively low ability to understand mathematics, contributed to learning that was not as successful as it might have been. basic skills, core skills, learning indicators, learning objectives, learning resources, and methods, learning tools, learning strategies, and learning models; c) stages of activity consisting of opening, middle, and closing activities; and d) evaluation of the Learning Implementation Plan (RPP) which is only carried out through four meetings.

Learning Media or also called media selection and determination is the design of mathematics learning media content, namely the selection and determination of media to meet interesting criteria and can help students in achieving the competencies to be achieved. Learning outcomes tests in the form of concept comprehension tests, and concept comprehension tests are assessment tools that can be used by teachers to measure the progress of their students after the learning process is complete. Work with students on GeoGebra worksheets, with help from lesson plans and student responses to questionnaires (Appendix 3), and evaluate their understanding of mathematical formulas at intervals 2.5–M–3.5 with valid categories added.

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Apply media Students and instructors have responded with great excitement to the math learning shown above. When teaching mathematics with the GeoGebra program, a higher standard of knowledge is generated compared to material education that puts students first.

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