The Development of Geogebra-Assisted Learning Design on Rank Number Material

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Abstrak

Penelitian ini bertujuan menghasilkan produk desain pembelajaran berbantuan Geogebra yang valid, praktis, dan efektif yang dapat membantu proses pembelajaran peserta didik. Penelitian ini menggunakan prosedur penelitian dan pengembangan ADDIE yang terdiri dari 5 tahapan pengembangan yaitu: (1) Analisis, (2) Perancangan, (3) Pengembangan, (4) Implementasi, dan (5) Evaluasi. Teknik pengumpulan data menggunakan metode wawancara, angket (kuesioner), dokumentasi, dan tes hasil belajar. Hasil penelitian ini adalah sebuah desain pembelajaran berbantuan Geogebra pada materi bilangan berpangkat yang meliputi LKPD dan RPP untuk peserta didik kelas IX SMP Negeri 1 Tompaso Baru. Desain pembelajaran ini mendapatkan kategori "valid" dan layak digunakan berdasarkan hasil validasi oleh ahli media dan ahli materi dengan memperoleh nilai 3,95 pada validasi materi dan 3,84 pada validasi media. Desain pembelajaran ini juga mendapat kategori "sangat praktis" digunakan berdasarkan hasil angket respons peserta didik dengan memperoleh nilai persentase sebesar 92,41%, dan mendapatkan kategori "sangat efektif" digunakan berdasarkan hasil uji coba produk di kelas pada peserta didik kelas IX SMP Negeri 1 Tompaso Baru dengan perolehan nilai persentase 90,48%.

Kata kunci: Kesulitan Siswa, Konsep, Keterampilan, Pemecahan Masalah.

Abstract

This study aims to produce a valid, practical, and effective GeoGebra-assisted learning design product to help students learn. This study uses ADDIE research and development procedures which consist of 5 stages of development, namely: (1) Analysis, (2) Design, (3) Development, (4) Implementation, and (5) Evaluation. The results of this research and development are a GeoGebra-assisted learning design on rank number material, including lesson plans and worksheets for class IX students of SMP Negeri 1 Tompaso Baru. This learning design is the "valid" category on the validation results by material and media experts by obtaining a score of 3,85 in material validation and 3,84 in media validation. This learning design also received the "very practical" category used based on the result of the student response questionnaire by obtaining a percentage value of 92,41%, and the "very effective" category was used based on the result of the trial in class IX students at SMP Negeri 1 Tompaso Baru with the acquisition of a percentage value of 90,48%.

Keywords: Learning Design, GeoGebra, Number Rank,

INTRODUCTION

Along with the changing times in the world of education, which continue to change significantly, the mindset of educators has changed from a common and rigid mindset to a more modern mindset. This affects the progress of education in Indonesia. Everyone needs education (Kelung et al., 2018; Rompas et al., 2023). By taking an education, every individual can learn many things and know many things. According to the National Education System

Law No. 20 of 2003, education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential (Sulistyaningsih et al., 2018). Education aims to create individuals with quality and character so that they have a broad outlook to achieve an expected goal and can adapt appropriately in various environments (Makahenggeng et al., 2018; Tiwow et al., 2022) because education can motivate individuals personally to be better in various aspects of life.

Formal education can be pursued by studying at schools starting from kindergarten, elementary school, middle school, to university. At school, every individual or student can learn many things according to their level (Bernafet et al., 2018; Kalengkongan et al., 2021). There are various subjects offered in schools for students to study, one of which is mathematics.

Mathematics is one of the compulsory subjects in primary and secondary schools and is one of the most critical subjects in education. Therefore, students are expected to be able to master this field of knowledge to support learning achievement (Tiwow et al., 2022). So in the learning process, efforts must be made to master the material for students, one of which is the material for rank numbers. Rank numbers are math material that begins to be studied in junior high school (SMP) for class IX students in odd semesters.

In the learning process in the classroom, teachers are expected to be able to choose suitable methods, strategies, approaches, learning designs, and learning resources. They can involve students in learning activities to achieve learning objectives. Learning resources play an essential role in the learning process. One of the commonly used learning resources is teaching materials (Manambing et al., 2018). The selection and use of appropriate teaching materials for the learning process make it easier for teachers and students to achieve the learning objectives in the curriculum (Domu & Mangelep, 2020). Teaching materials are made based on the needs and characteristics of teaching materials that will be adapted to the needs of students (Domu & Mangelep, 2019). In addition to teaching materials, using learning media is also very helpful in the learning process, both software and hardware. In an increasingly rapid world development, technology is also increasingly sophisticated, so in today's learning process, many use media as learning applications (Runtu et al., 2023). Many learning applications/media have been developed, especially mathematics learning applications/media (Domu & Pesik, 2020). One application or learning media has been developed in GeoGebra. GeoGebra is a dynamic, accessible, and multi-platform mathematics software that combines geometry, algebra, tables, graphs, statistics, and calculus in one easy-to-use package for all levels of education. This software was developed for teaching and learning mathematics in schools by Markus Hohenwarter at Florida Atlantic University.

In the world of education, there must be problems involving teachers or students (students). According to Lesilolo (2018), the main problem faced by educators in the world of education today is not a problem related to how to get students involved in a learning activity. This is because, in fact, every individual, consciously or unconsciously, directly or indirectly, are always involved in the learning process as long as he is awake (in a conscious state) (Boham & Domu, 2021). Educators' real problem is how to help students learn specific information, skills, or concepts that will be useful when they grow up (Londa & Domu, 2020). The most important part of this problem is how to present an appropriate stimulus to students where this stimulus can focus the attention, mentality, and effort of students so that they can master the skills that are important for them to have (Domu et al., 2022).

Based on the description above, what is the urgency of the world of education today is how to present learning (processes and activities) so that it can actively stimulate students to learn to master specific knowledge, skills, or attitudes. To solve the above problems, it is necessary to develop learning designs to find quality (effective, efficient, and practical) processes, activities, or forms of learning to achieve the expected learning objectives (Nangon et al., 2022). In this case, why design or learning design is needed? The use of media in the development of learning designs is also needed to support learning in class so that it is easier for students to understand learning material and make it easier for teachers to explain learning material.

Based on observations made by researchers at SMP Negeri 1 Tompaso Baru, it was found that teachers provide learning resources for students. The learning resources used in learning mathematics are class IX mathematics textbooks. In addition to learning resources, the teacher has also provided learning tools, including the lesson plan. LKPD is still rarely used in learning, and the LKPD presented is still simple, which only contains the title of the material, instructions for use, a summary of the material, and practice questions. In addition to learning resources, researchers also observed how teachers teach in class. It was found that the teacher's teaching method in the classroom was more dominant in the conventional direction or one-way teaching, with the teacher as a facilitator and students receiving the material explained and working on practice questions. In addition to observing the teacher's teaching, the researcher also interviewed students about the learning process in class. It was found that students still needed to improve in understanding the concept of calculation, one of which was the matter of rank numbers. Also, not all students were actively involved in learning activities, such as they were embarrassed to ask the teacher about learning material. This was reinforced by the researcher's interview with one of the teachers regarding the process of learning mathematics in class, that students needed to be more actively involved in learning. However, many still needed more focus on learning, such as telling stories with their peers. In addition, it was also found that students rarely use technology-based learning media, one of which is Geogebra. Based on research by Handayani & Sulisworo (2021), Geogebra is effectively and practically used in learning mathematics and can help students' mathematics learning process. Using Geogebra in learning mathematics, especially material with rank numbers, can help students understand the concepts and calculations of the material taught (Domu et al., 2020).

METHOD

The type of research method used in this study is the research and development method, using the ADDIE research and development model procedure. The ADDIE development model has five stages, namely: 1) Analysis, 2) Design, 3) Development, 4) Implementation, and 5) Evaluation.

The subjects and population in this study were class IX students at SMP Negeri 1 Tompaso Baru, with a sample of 21 students. When research and development are carried out in the odd semester of the 2022/2023 academic year in November - December 2022. The research location is SMP Negeri 1 Tompaso Baru, Tompaso Baru District, South Minahasa Regency.

Data collection techniques were used in this research and development: tests and non-tests. The test is carried out by giving test questions on learning outcomes to students using learning design products. While the non-test is done by way of interviews, giving questionnaires, and documentation. The instruments used were material, media validation questionnaire sheets, student response questionnaire sheets, learning outcomes test questions, and photos as documentation.

Learning design products that have been developed are analyzed, whether valid, practical, or effective, using techniques (1) Validity Data Analysis, (2) Practicality Data Analysis (3) Effectiveness Data Analysis.

RESULT AND DISCUSSION

The development stages the researchers used in this research and development, namely using the ADDIE development model, consists of 5 stages, namely: 1) analysis, 2) design, 3) development, 4) implementation, and 5) evaluation.

Analysis Stage (Analysis)

The results of the analysis that has been carried out state that there are no specific learning media to be applied in the learning process. Hence, the results of interviews conducted by researchers with students state that many students are not interested in learning mathematics and still need to understand the material, especially material exponential numbers which turned out to be wrong in calculating the results of exponential numbers. So

based on the results of the analysis, the researcher chose to develop a GeoGebra-assisted learning design on rank number material.

Design Stage (Design)

The framework and ideas are prepared to make the learning design at the design stage. Design preparation is done so that researchers have an idea of the appearance and content of the learning design that will be made. The instrument's design was used to compile a description of the media validation questionnaire, material validation, and student response questionnaires on media use. In this design tapa, the researcher plans to compile worksheets that contain rank number material, how to use GeoGebra, and practice questions. In addition to LKPD, researchers also compiled lesson plans.

Development Stage (development)

This stage is the stage of making learning designs through learning media. After the product has been made, an evaluation or assessment is carried out by experts (validators) by giving a validation sheet. The purpose of validation is to find out whether the learning design is valid or not, the advantages and disadvantages of the product, as well as inputs and suggestions to improve the learning design being developed. Based on stage I and stage II validation, the results of the validator's validation of the learning design obtained the "valid" category for learning media and learning materials in the second stage of validation. We obtained an average score of 3.95 in material validation and 3.84 in media validation by validators.

The following are the results of material validation and media validation by the validators:

Table 1. Results of Phase II Material Validation

No	Aspect Assessed	Validator Score			Avarege Score
		V_1	V_2	V_3	
1	Relevance of material in LKPD with KD	4	4	4	4
2	Material according to learning objectives	4	4	4	4
3	Accuracy of concept and definitions	3	3	4	3.33
4	The material is presented in a structured/systematic manner on LKPD	4	4	4	4
5	The material is presented based on the ability of students	4	4	4	4
6	Clarity of material presented in LKPD	4	4	4	4
7	Grouped into logical sections	4	4	4	4
8	Confusion of concepts in LKPD	4	4	4	4
9	Conformity of questions with learning materials	4	4	4	4
10	The accuracy and effectiveness of the sentences used	4	4	4	4
11	The sentences in the LKPD do not have double meanings	4	4	4	4
12	Language used according	4	4	4	4
13	The accuracy of using language spelling	4	4	4	4
14	Student involvement in the learning process	4	4	4	4
	Total Scoring Average	3.93	3.93	4	
	Average validator score		3.95		
	Criteria		Valid		

Table 2. Results of Phase II Media Validation

No	Aspect Assessed	Validator Score			Average Score
		V_1	V_2	V_3	
1	LKPD can be used in the form of existing hardware or software	4	4	4	4
2	LKPD easy to use	4	4	3	3.66
3	There are instructions for using LKPD	4	4	3	3.66
4	The instructions in the LKPD are easy to understand	4	4	4	4
5	The letters used in LKPD are attractive and easy to read	4	4	4	4
6	LKPD does not use many fonts	4	4	3	3.66
7	The coloring in the LKPD does not interfere with understanding the material	4	4	4	4
8	The coloring in LKPD makes it easier to understand the material	4	4	3	3.66
9	Placement of consistent layout elements on LKPD	4	3	3	3.33
10	Levels of titles are clear and consistent in LKPD	4	4	4	4
11	The language used in LKPD is in accordance with good and correct language	4	4	4	4
12	*Geogebra* can be accessed on various platforms	4	4	4	4
13	*Geogebra* is easy to use	4	4	4	4
14	There are instructions for using Geogebra	4	4	3	3.66
15	Font type and font size are good in RPP	4	4	4	4
16	The placement of layout elements and writing formats are consistent in RPP	4	4	3	3.66
17	Levels of titles are clear and consistent in RPP	4	4	3	3.66
18	The language used in the RPP is in accordance with good and correct language	4	4	4	4
19	Font type and font size are good in RPP	4	4	4	4
	Average	4	3.95	3.58	
	Average validator assessment		3.84		
	Category		Valid		

Implementation Stage (Implementation)

Based on the data processing results on student response questionnaires by being given practicality questionnaire sheets, the learning design obtained an average score of 3.70 with a percentage of 92.41%, so the learning design obtained the "very practical" assessment criteria used. Effectiveness trials were also carried out in field tests. The effectiveness test is carried out by giving students a test of learning outcomes to see whether the GeoGebra-assisted learning design is effectively used. The effectiveness trial results obtained an average value of 81.42 with a percentage of 90.48%. They received the "very effective" criteria so that the GeoGebra-assisted learning design on rank number material developed is very suitable for use in the learning process.

The following are the results of the student response questionnaire analysis shown in table 3.

Table 3. Student response questionnaire results

No	Student	Score (*max*=36)	Average (*max*=4)
1	ARM	30	3,33
2	CR	33	3,67
3	CP	32	3,56
4	GL	35	3,89
5	GG	33	3,67
6	GR	28	3,11
7	GA	32	3,56
8	JL	36	4,00
9	KG	36	4,00
10	KL	36	4,00
11	KM	35	3,89
12	NU	34	3,78
13	TS	30	3,33
14	VP	35	3,89
15	VR	34	3,78
		Total Score	55,44
		Average	3,70

The percentage of learning design practicality uses the following formula:

$$P = \frac{f}{n} \times 100\%$$
$$P = \frac{3,70}{4} \times 100\% = 92,41\%$$

Based on the results of data analysis, the practicality of learning design results obtained, namely obtaining an average value of 3.70 with a percentage of 92.41%, thus obtaining the criteria of "Very Practical". The results of the analysis of student learning outcomes tests are shown in table 4.

Table 4. Student Test Results

No	Student	Completeness	Criteria test score (KKM = 75)
1	AM	80	Completed
2	ARM	80	Completed
3	CR	80	Completed
4	CP	85	Completed
5	GL	85	Completed
6	GG	80	Completed
7	GR	80	Completed
8	GA	80	Completed
9	JL	90	Completed
10	KG	85	Completed
11	KL	85	Completed
12	KR	70	Uncompleted
13	KS	85	Completed
14	KM	85	Completed
15	MM	75	Completed
16	NU	90	Completed
17	SM	65	Uncompleted
18	TS	85	Completed
19	VP	90	Completed
20	VR	80	Completed
21	TR	80	Completed
	Average	81,42	Completed

Stage Evaluation (Evaluation)

According to the ADDIE research procedure, the evaluation stage is a stage in each of the previous stages of the process, from the analysis stage to the implementation stage.

Based on the results of the development carried out by the researcher by going through the five stages above, the final product is produced, namely a GeoGebra-assisted learning design on rank number material that has been qualified as valid and suitable for use based on the results of validation of material experts and media experts, highly qualified based on the results of student response questionnaires and qualified highly effective based on class trial results. The results of this research and development are a Geogebra-assisted learning design on rank number material, including worksheets and lesson plans for class IX students at SMP Negeri 1 Tompaso Baru. This learning design is valid, effective, and practical based on the evaluation and validation that has been done before. Previous studies also support this research and development, one of which is research by Handayani and Sulisworo (2021) titled "Development of Geogebra-Assisted Mathematics Learning Media on Geogebra Transformation Materials' with the research results proving that Geogebra-assisted learning media is effective and practically used in learning mathematics.

The development stages the researchers used in this research and development, namely using the ADDIE development model, consists of 5 stages, namely: 1) analysis, 2) design, 3) development, 4) implementation, and 5) evaluation. The results of the analysis that has been carried out state that there are no specific learning media to be applied in the learning process. Hence, the results of interviews conducted by researchers state that many students are not interested in learning mathematics and still need to understand the material, especially material exponential numbers, which turned out to be wrong in calculating the results of exponential numbers. So based on the results of the analysis, the researcher chose to develop a GeoGebra-assisted learning design on rank number material.

Furthermore, at the design stage, the framework and ideas are prepared in making the learning design. Design preparation is done so that researchers have an idea of the appearance and content of the learning design that will be made. The instrument's design was used to compile a description of the media validation questionnaire, material validation, and student response questionnaires on media use. In this design tapa, the researcher plans to compile worksheets that contain rank number material, how to use GeoGebra, and practice questions. In addition to LKPD, researchers also compiled lesson plans.

Next is the development stage. This stage is the stage of making learning designs through learning media. After the product has been made, an evaluation or assessment is carried out by experts (validators) by giving a validation sheet. The purpose of validation is to find out whether the learning design is valid or not, the advantages and disadvantages of the product, as well as inputs and suggestions to improve the learning design being developed. Based on stage I and stage II validation, the results of the validator's validation of the learning design obtained the "valid" category for learning media and learning materials in the second stage of validation. We obtained an average score of 3.95 in material validation and 3.84 in media validation by validators.

Next is the implementation stage (trial). Based on the data processing results on student response questionnaires by being given practicality questionnaire sheets, the learning design obtained an average score of 3.70 with a percentage of 92.41%, so the learning design obtained the "very practical" assessment criteria used.

Effectiveness trials were also carried out in field tests. The effectiveness test is carried out by giving students a test of learning outcomes to see whether the GeoGebra-assisted learning design is effectively used. The effectiveness trial results obtained an average value of 81.42 with a percentage of 90.48%. They received the "very effective" criteria so that the GeoGebra-assisted learning design on rank number material developed is very suitable for use in the learning process.

Next is the evaluation stage. According to the ADDIE research procedure, the evaluation stage is a stage in each of the previous stages of the process, from the analysis stage to the implementation stage.

Based on the results of the development carried out by the researcher by going through the five stages above, the final product is produced, namely a GeoGebra-assisted learning design on rank number material that has been qualified as valid and suitable for use based on the results of validation by material experts and media experts, highly qualified and practical.

CONCLUSION

Based on the results of this research and development, it can be concluded that: (1) The development of a Geogebra-assisted learning design on rank number material for students gets a score with "valid" criteria and is suitable for use based on the assessment of material expert validators and media experts, with a value of 3.95 on material and 3.84 on media. (2) The development of a Geogebra-assisted learning design on rank number material for students gets a score with the criteria of "very practical" based on the results of the practicality questionnaire assessment by students, obtaining a percentage value of 92.41%. (3) The development of Geogebra-assisted learning designs on rank number material for students to score with the criteria of "very effective" was used by conducting field tests conducted by class IX students of SMP Negeri 1 Tompaso Baru, with a percentage of 90.48%.

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