



## Development of Mathematics Learning Media Using Geogebra-Assisted Scientific Approach to Improve Students' Creative Thinking Skills Learning Skills and Independence

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Received: 02 Oktober 2024 ; Accepted: 04 November 2024 ; Published: 08 November 2024

DOI: <http://dx.doi.org/10.15575/jp.v8i2.307>

### Abstrak

Tujuan penelitian ini adalah untuk mengetahui kevalidan, kepraktisan, dan keefektifan media pembelajaran menggunakan pendekatan saintifik berbantuan geogebra dalam meningkatkan kemampuan berpikir kreatif dan kemandirian belajar siswa. Metode penelitian ini adalah penelitian dan pengembangan. Model pengembangan penelitian ini adalah model ADDIE. Subjek penelitian ini adalah siswa kelas VIII salah satu SMP Swasta di Medan. Hasil penelitian ini menunjukkan bahwa media pembelajaran menggunakan pendekatan saintifik berbantuan geogebra mendapat rata-rata skor 4,79 pada kategori valid. Kepraktisan media pembelajaran menggunakan pendekatan saintifik berbantuan geogebra dinilai dari rata-rata skor keterlaksanaan pembelajaran diperoleh sebesar 88,33% dengan kategori baik, dan respon positif siswa memperoleh rata-rata skor sebesar 88,38% dengan kategori sangat positif sehingga media yang dikembangkan dapat dikatakan praktis. Sedangkan keefektifan media pembelajaran menggunakan pendekatan saintifik berbantuan geogebra dinilai dari rata-rata skor ketuntasan secara klasikal siswa sebesar 90,63% dengan kategori sangat tinggi, ketercapaian tujuan pembelajaran diperoleh rata-rata skor sebesar 86,81%, dan respon siswa diperoleh rata-rata skor sebesar 88,33% sehingga media yang dikembangkan dapat dikatakan efektif. Skor peningkatan kemampuan penalaran matematis siswa mendapat nilai N-gain sebesar 0,37 pada kategori sedang, dan skor peningkatan kemandirian belajar siswa mendapat nilai N-gain sebesar 0,35 pada kategori sedang, sehingga dapat dikatakan media yang dikembangkan dapat meningkatkan kemampuan berpikir kreatif dan kemandirian belajar siswa.

**Kata Kunci:** Saintifik, Geogebra, Kemampuan Berpikir Kreatif, Kemandirian Belajar Siswa.

### Abstract

*The purpose of this study was to determine the validity, practicality, and effectiveness of learning media using a scientific approach assisted by geogebra in improving students' creative thinking skills and learning independence. The research method is research and development. The development model of this study is the ADDIE model. The subjects of this study were students of grade VIII of a private junior high school in Medan. The results of this study indicate that learning media using a scientific approach assisted by geogebra received an average score of 4.79 in the valid category. The practicality of learning media using a scientific approach assisted by geogebra is assessed from the average score of learning implementation obtained by 88.33% with a good category, and students' positive responses obtained an average score of 88.38% with a very positive category so that the media developed can be said to be practical. Meanwhile, the effectiveness of learning media using the Geogebra-assisted scientific approach is assessed from the average classical student completion score of 90.63% with a very high category, the achievement of learning objectives obtained an average score of 86.81%, and student responses obtained an average score of 88.33% so that the media developed can be said to be effective. The score for increasing students' mathematical reasoning abilities got an N-gain value of 0.37 in the moderate category, and*

the score for increasing students' learning independence got an *N*-gain value of 0.35 in the moderate category, so it can be said that the media developed can improve students' creative thinking skills and learning independence

**Keywords:** *Saintific, Geogebra, Creative Thinking Skills, Student Learning Independence.*

## **A. Introduction**

Learning media helps kids study without becoming bored. In teaching and learning, media aids learning. Enhancing student education using media is one goal. Learning media helps instructors present content and adds value to learning, according to (Al-Khwarizmi, 2018). Using learning material in the classroom helps motivate and stimulate students. Sudjana (2002) argued that learning media may increase student teaching and learning, which should improve learning outcomes. (Arsyad, 2015) defines media as written and audio-visual communication. Learning media may convey issues. Learning media helps students comprehend the topic and solve instructor difficulties. Introducing an issue with learning media will be more fun.

Media helps students grasp arithmetic topics, motivates them to study, and creates a lively classroom environment, according to (Ramadhani, R., Wardani, H., Nurdalilah, N., & Nasution, 2023). Media in mathematics learning may impact students' mathematical abilities, particularly creative thinking, according to (Tunnajach.N.F & Gunawan, 2021). With great learning material, pupils' arithmetic skills may improve. Thus, media growth in learning is crucial. Media can help instructors innovate learning to keep up with technology and the times. Learning media also makes students and instructors more participatory, which improves topic comprehension, creativity, and innovation. Media may also help explore tough arithmetic topics. According to (Angelia, C., Voogt, J., Fluck, A., Webb, M., Cox, M., Malyn-Smith, J., 2016), interactive learning technologies improve students' creative thinking. They can think creatively and solve issues better than the control group utilizing standard learning approaches.

According to field observations, instructors have not adequately deployed Information and Communication Technologies. Teachers still utilize lectures and books to teach. This was seen via interviews with Medan Private Junior High School instructors. He claimed the school's amenities and infrastructure were good, including many lab projectors and laptops. The investigators also interviewed the computer lab manager, who said the facility was exclusively utilized for Information and Communication Technologies. Nobody has utilized it for other disciplines, notably math.

According to an interview with Medan Junior High School mathematics teacher Mr. Eka Saputra, S.Pd, the lack of student interest in math was due to his use of printed books and the lecture method. The instructor also stated he had never used computers or cellphones to lecture. Additionally, the instructor indicated he solely created instructional material using minimal teaching tools. (Diningrum, P. R., Azhar, E., Faradillah, 2018) explain this when instructors don't utilize Information and Communication Technologies appropriately. Most instructors don't utilize learning media. This is because instructors can't utilize technology to communicate better. Teachers just lecture and don't utilize media to help students grasp.

Based on data from the Central Statistics (Hewi, La., Shaleh, 2020) survey on the use and utilization of information and communication technology in education in 2020, as many as 59.33% of students use the internet. This figure grew rapidly from 33.98% in 2016. Internet use at all levels of education has increased. Within two years, elementary school students who access the internet increased to 35.97%. While school facilities are quite adequate. Teachers tend to only use printed books and simple media, making students less enthusiastic about learning. The use of media in the learning process in mathematics can be said to be less than optimal. The limitations of learning media and the weak ability of teachers to create media have resulted in the application of the lecture method increasing. The limited learning technology devices used in the classroom are thought to be one of the causes of the weak quality of education in general, especially in mathematics. The use of media in the learning process in mathematics can be said to be less than optimal. It can be seen in Figure 1. that there are still many teachers who use the lecture method and use simple media in every mathematics learning activity.

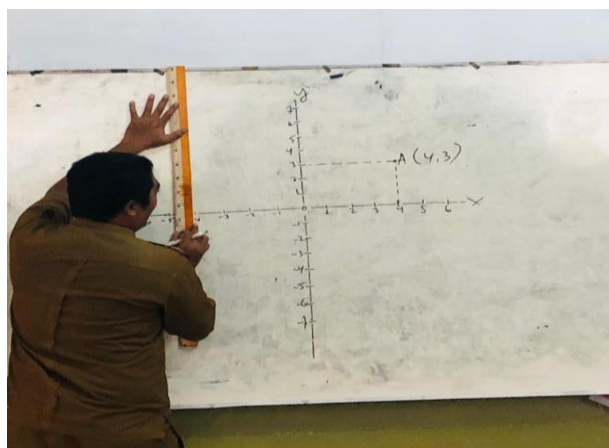


Figure 1. Teacher Using Simple Media

Teaching and learning mathematics is frequently abstract and beyond students' everyday experiences, making it hard for instructors and students to grasp. Teachers haven't utilized media to engage children or spark their curiosity. Math disinterest makes pupils less engaged and productive. This may contribute to poor learning results. Media is crucial to solving student issues. Teachers must create learning tools to simplify instruction (Hendrikson R Panjaitan, 2023). This requires learning media and a learning strategy. Learners may apply the scientific method.

(Rangkuti, 2023) found that this scientific method boosts students' creativity and learning freedom. Compared to conventional techniques, Machin discovered that scientific learning helps students think critically, imaginatively, and independently about new information. The description above shows the necessity for learning media. Geogebra-assisted software may

help produce instructional material. Geogebra can explain flat forms in real life, helping pupils grasp difficulties. Many educators and academics utilize Geogebra in learning. (Musfiqon, 2012) found that the Scientific Learning method using Geogebra media may increase students' mathematics creative thinking abilities in class VIII-H of SMP Negeri 10 Medan in the 2019/2020 academic year. (Siswanto & Ratiningsih, 2020) found that pupils educated using a scientific approach and GeoGebra had much higher creative thinking abilities than those taught conventionally. Given Indonesian students' poor math scores in the Trends in International Mathematics and Science Study (TIMSS), they are far behind other nations. Student creativity affects math learning. A direct learning strategy that ignores emotional and psychomotor skills leads to low student creativity (Maulydia, S. S., Surya, E., & Syahputra, 2017).

All classroom learning, particularly arithmetic, requires creative thinking. Because creative thinking may solve math issues in many ways (Tampubolon, S. W., & Syahputra, 2017). According to Nasution (2017:40), creative thinking is a response to internal variables that help people outside their comfort zone. Creative thinking is everyone's potential. Combining creative thinking with problem-solving might generate fresh ideas. Creative thinking abilities are directly tied to critical thinking, a high-level math talent, which may inspire someone to perceive every situation creatively and solve it creatively, according to Sirait, Sinaga, and (Fardani, Z., Surya, 2021). Students may tackle arithmetic problems better using creative thinking. In the 2013 curriculum, creative thinking skills are needed to master and create technology, so all students from elementary school to college should learn mathematics to develop logical, analytical, systematic, critical, creative, and collaborative skills.

Creativity affects a person's life and society. Individual creativity and new discoveries are intertwined. A creative effort that makes a person happy is a representation of their creativity. Creativity indicates complete functioning. This highlights the necessity of creativity in developing all abilities and skills to reach life potential. Students' question responses show inadequate arithmetic competence. This question was for SMPS Al Ulum Medan students. The following questions tested students' creativity in Figure 2.

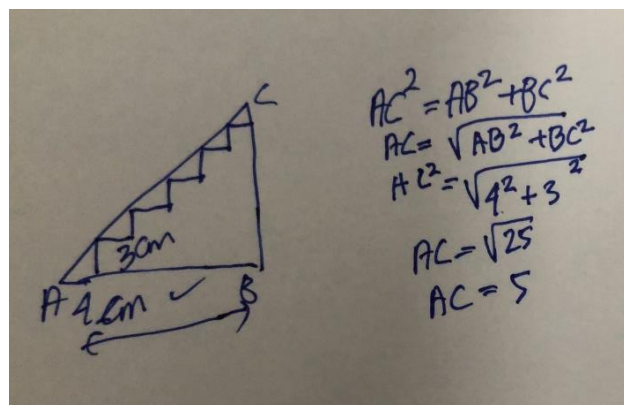


Figure 2 Student Answer Sheet

Based on the students' answers, the data analysis of mathematical creative thinking ability showed that students were still lacking in expressing more than one answer/idea to a mathematical problem, less accustomed to changing their problem-solving methods, and monotonous in using the methods or formulas taught. Still, kids were less used to thinking creatively while addressing issues. Students still struggled to respond with details. Thus, instructional media and relevant learning activities are essential to increase students' creative thinking. (Cahyono, 2017) also found that students taught using learning media had improved creative thinking skills. (Amir, Z., Mulyani, 2019) found that media/teaching aids that illustrate abstract mathematical ideas or principles may make learning enjoyable, entail active student involvement, and increase creative thinking. Another research by (Putra, Y. P., Musril, 2022) found that students' creative thinking abilities with learning media had a minimum completion value and were better than those without. Students need innovative thinking and learning freedom. Learning independence is also crucial to classroom success. "Independent students will be able to deal with obstacles or problems and overcome them" (Yamin, M. dan Ansari, 2008). According to Setiawan (Höffler, T. N., & Leutner, 2017), learning independence is motivated by one's own will, choice, and responsibility for learning. (Sari, 2016) confirmed that learning independence involves learning without outside support. Because students are less interested in the content, instructors must repeat it to get them to comprehend it, which reduces student learning independence.

Applying a scientific approach to maths helps boost students' learning independence. This method stresses student observation, inquiring, attempting, reasoning, and communication. Learning tools like GeoGebra may also help kids see and engage with arithmetic. According to the description above, the researcher will create geogebra-based learning media to promote students' creativity and independence. This instructional resource covers Pythagorean math for Medan Private Junior High School class VIII students. This material should improve kids' creativity and independence.

## **B. Research Method**

The type of research conducted using the Research and Development (R&D) method. Research and Development is one of the research methods applied to produce a product while testing the validity, practicality and effectiveness of the product produced, so that it is suitable for use. This development research aims to produce a new product that already exists and will be developed again. In the research and development that will be carried out, the researcher applies the ADDIE model. This ADDIE model consists of five steps in its application, namely: analysis, design, development, implementation, and evaluation (Sugiyono, 2018). The research was conducted in the even semester of the 2023/2024 academic year on the Pythagorean material. The subjects in this study were students of class VIII of Medan Private

Junior High School Private Middle School. The object of this research is Geogebra-assisted mathematics learning media on the Pythagorean material.

### **C. Result and Discussion**

Data analysis and research results obtained at each stage of development are presented as follows:

#### **Analysis**

Based on the results of initial observations on the availability of learning media at Medan Private Junior High School Middle School, it was found that the lack of use of mathematics learning media in the classroom, especially in Pythagoras learning, indirectly affects the low creative thinking skills and learning independence of students. Pythagoras learning with the help of manual pictures on the board is not enough to help students visualize the learning object, so students have difficulty learning Pythagoras. In terms of the learning media used, teachers have not been able to create interesting learning media that helps students learn Pythagoras. Teachers only use simple media to explain the mathematics learning. From the discussion above, several main problems can be seen in the learning process related to the availability of mathematics learning media. This problem has an impact on the low creative thinking skills and learning independence of students. So, to overcome this problem, it is necessary to develop a mathematics learning media that meets the criteria of valid, practical, and effective. With the hope that after learning using the developed learning media, the creative thinking skills and learning independence of students at Medan Private Junior High School Middle School will increase.

#### **Design**

This level involves designing learning media to create a Pythagorean theorem prototype. Two sets of student worksheets for two sessions. Student Worksheet comprises problems, resources, and directions for pupils to solve using Scientific-based Student Worksheet media and Geogebra. The Student Worksheet cover has happy math students to make it appealing. The Student Worksheet cover will have topics, Student Worksheet titles, material titles, and room for students to list clubs and members. The next page includes a foreword, a brief description of the Student Worksheet, steps of the scientific approach, competencies to be achieved through the Student Worksheet, including core competencies, basic competencies, achievement indicators, learning objectives, and student instructions. The Learning Implementation Plan (RPP) examines teaching and learning stages. The Pythagorean theorem 2 questions and the use of Pythagoras and triple Pythagoras in daily life will be used to create a mathematical creative thinking ability exam. Two higher-order thinking skill questions. Each Pythagoras and triple Pythagoras mathematics creative thinking exam question will include an illustration to help students solve contextual concerns. Using the signs of mathematics creative



thinking abilities, alternative solutions to the exam are gathered into a solution table with question numbers, alternative answers, and scores for each stage. A student learning independence questionnaire's grid includes aspects of learning independence, achievement indicators, statement items, and total scores based on indicators. The learning independence questionnaire will include 15 positive and 15 negative statements with varying numbers.

### Development

The creation of a product in the form of a scientific-based student worksheet assisted by Geogebra is adjusted to the analysis and design stages. The product is designed using the Canva, Microsoft Word and Geogebra applications to produce images, graphics, and writing that are interesting and easy for students to understand. After the product is successfully created, the product is then tested to obtain valid, practical, and effective product criteria. The following is a display of the Student Worksheet that was developed

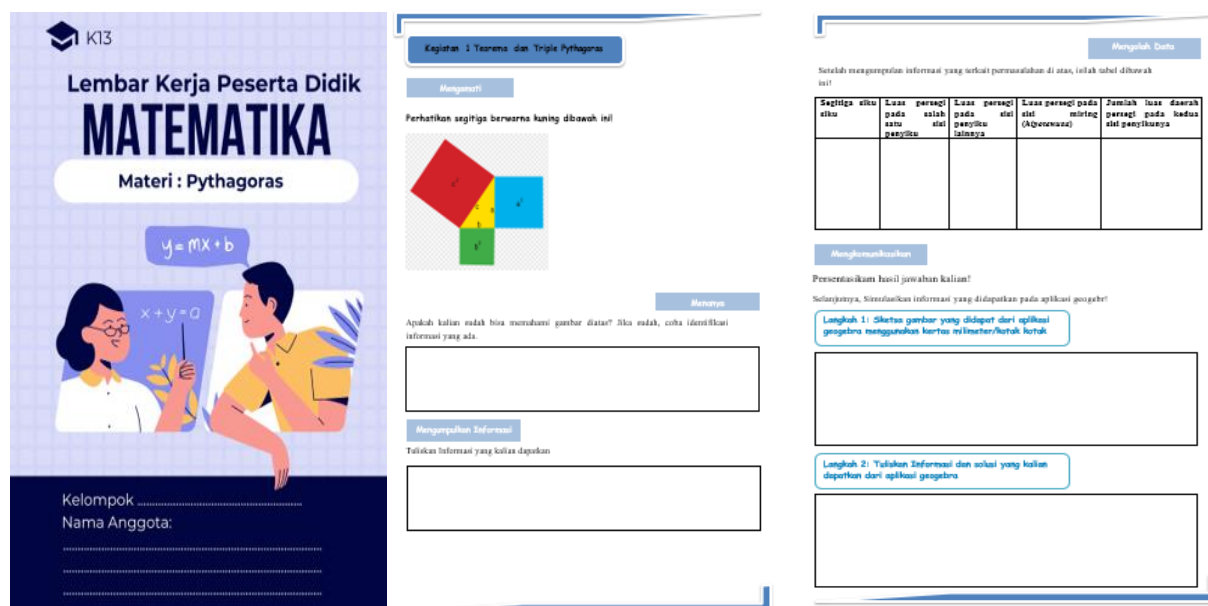


Figure 3 Student Worksheet

After the product is successfully created, the next step is to conduct a product trial to obtain valid, practical, and effective product criteria. The following is the data that has been developed:

Table 1. Validation Results

No	Aspect	Average	Category
1	Learning Tool Plan	4,8	Valid
2	Student Worksheets	4,7	Valid
3	Mathematical Creative Thinking Ability	4,5	Valid
4	Learning Independence	4,5	Valid

Table 1 shows that the RPP, Student Worksheets have a total "valid" average of 4.6. The data in this study were analyzed using descriptive statistical analysis. According to Sheskin (2004), descriptive statistics as an analysis tool for the purpose of describing data without drawing conclusions and making predictions. Common procedures used in descriptive statistics are in the form of tables, graphs, diagrams and calculations on the size of the central and dispersion of data.

**Implementation**

Results of Analysis of Mathematical Creative Thinking Ability Test

In this study, the level of student mastery is reviewed from the ability to think creatively mathematically using a test of mathematical thinking ability. This study used a pretest and posttest to class VIII-5 totaling 32 students to see the increase in mathematical thinking ability. The description of the results of the mathematical thinking ability test is shown in table 2 as follows.

Table 2. Level of Mastery of Mathematical Creative Thinking Skills

No	Interval Nilai	Pretest		Posttest		Category
		Number of students	Percentage	Number of students	Percentage	
1	$90 \leq \text{KBKM} \leq 100$	0	0%	12	37,50%	Very high
2	$80 \leq \text{KBKM} < 90$	16	50%	18	56,25%	High
3	$70 \leq \text{KBKM} < 80$	0	0%	1	3,13%	Enough
4	$60 \leq \text{KBKM} < 70$	10	31,25%	1	3,13%	Low
5	$0 \leq \text{KBKM} < 60$	6	18,75%	0	0%	Sangat Rendah

Based on table 2, it shows that in the pretest of 32 students, there were no students who had mathematical creative thinking skills in the very high category (0%), there were 16 students (50%) who had a level of mastery in the high category, 0 students (0%) had a level of mastery in the sufficient category, 10 students (31.25%) had a level of mastery in the low category, and 6 students (18.75%) had a level of mastery in the very low category. Meanwhile, in the posttest after being given learning using Scientific-based Student Worksheet media assisted by geogebra, the results showed that 12 students (37.50%) had a level of mastery in the very high category, 18 students (56.25%) had a level of mastery in the high category, 1 student (3.13%) had a level of mastery in the sufficient category, and there was 1 student (3.13%) who had a level of mastery in the low category and there were no students (0%) who had a level of mastery in the very low category

Analysis of Student Learning Independence Results

The student learning independence questionnaire was used to see the extent to which the aspects of free responsibility, progressiveness and tenacity, initiative or creativity, self-control, and self-stability of students in understanding the components of media and learning devices developed through the problem-based learning model assisted by geogebra. The student



learning independence questionnaire had positive and negative responses including 15 positive statements and 15 negative statements. Based on the results of the analysis of the student response questionnaire, it shows that the average percentage of positive student responses to the student learning independence questionnaire can be seen in the following table 3:

Table 3. Results of the Student Learning Independence Questionnaire

No	Interval Nilai	Pretest		Posttest		Category
		Number of students	Percentage	Number of students	Percentage	
1	76-100	1	3,13%	6	18,75%	Very Good
2	51-75	14	43,75%	25	78,13%	Good
3	26-50	17	53,13%	1	3,13%	Quite Good
4	0-25	0	0%	0	0,00%	Not Good
Total		32	100%	32	100%	Sangat Rendah

Based on table 3, it shows that before being given treatment, students who obtained the very good category were 1 student (3.13%), students who obtained the very good category were 1 student (3.13%), students who obtained the good category were 14 students (43.75%), for the fairly good category were 17 students (53.13%) and for the less good category were 0 students (0%). While after being given treatment, students who obtained the very good category were 6 students (18.75%), students who obtained the good category were 25 students (78.13%), for the fairly good category were 1 student (3.13%) and the less good category were 0 students (0%).

### Evaluation

Revision of learning goals into accomplishment objectives in learning activities occurs during analysis. Media development will focus on these learning goals. This project aims to promote students' mathematical creativity and learning independence utilizing scientific-based Student Worksheet media and geogebra. This media is structured according to student demands, including content exposure, beginning conditions, and engaging media designs. An assessment was done in the design stage to enhance the media created for the analysis stage, where writing forms and test and questionnaire preparation were deficiencies. The graphic instructions on Student Worksheet questions altered the forms for authoring scientific-based Student Worksheet media using geogebra. This will assist pupils solve math creative thinking and independence issues. After media development, 5 validators—3 lecturers and 2 teachers—tested its validity. The five validators suggested adding captions to media and creative thinking ability tests, expanding the LKPD answer space to let students express themselves, and simplifying the learning independence questionnaire language. The five validators' changes make the product legitimate. Several assessments are done during implementation to ensure the medium is legitimate, practical, and successful. In implementation, time restrictions in the learning process are typically an issue. This occurred during the first meeting in this research

because students were puzzled about the student-centered scientific learning methodology. Most pupils didn't know the geogebra program, therefore some had trouble using it. Students may learn and apply geogebra by extending group discussion references.

### **Discussion**

Validity of developed media comes from: 1) Scientific approach-based media is content-valid. The degree to which the measuring instrument includes all significant characteristics of the topic being assessed is called content validity. Instruments must fully cover the subject or skill being measured. (Surapranata, 2016) stressed content validity to ensure the exam includes all planned material. According to (Arikunto, 2017), a test item has strong content validity if it evaluates particular learning goals that match the topic. 2) Scientifically designed media has construct validity. This signifies that media with a Scientific approach has been developed using creative thinking skills and student learning independence markers. LKPD and RPP complement one other to assess creative thinking and student learning independence using the scientific method. Students may utilize learning media freely to develop their creative thinking and learning independence. (Rohman, 2014) defined validity as the degree to which the design of the generated learning medium is based on content and construct validity. (Aufa, M., Saragih, S., Minarni, 2015) agree that material and media validation findings may determine product development outcomes' validity. (Arsyad, 2015) also said that material that supports learning activities should be chosen. According to (Marselina, Vince, 2019) learning media is high-quality and useful if the validator evaluates its content and construct validity. (Rohman, 2014)) also defined validity as the degree to which the device design is based on content and construct validity. (Akbar, 2018) stated that learning device validation tests yielded good validity.

Experts (validators) found the scientific-based LKPD media supported by geogebra adequate for usage with minimal adjustments. (Akker, J. V. D. Gravemeijer, K. McKenney, S. & Nieveen, 2013) asserts that learning media are practical if the validator says they can be used. According to Nieveen in (Akker, J. V. D. Gravemeijer, K. McKenney, S. & Nieveen, 2013), educators judge a product's practicality by saying it can be utilized and used readily by educators and pupils. (Nurfatanah, Rusmono, 2018) claimed that instructors and students who utilize the product throughout the experiment judge its practicality. The usefulness of learning material is determined by student feedback. Student responses to minimal requirements indicate practicality of learning material.

According to the posttest findings, in effectiveness test I, students' classical problem-solving skills were 68.75% and in effectiveness test II, 100%. Students' problem-solving skills from effectiveness tests I and II meet conventional accomplishment requirements (> 80%). The research above shows that classical learning medium with a scientific approach to creative thinking satisfies efficacy standards. (Kumalasani, M., Yenny, 2022) found that scientifically

designed learning medium satisfied efficacy standards with a classical degree of completeness ranging from 50% to 83.3%.

#### D. Conclusion

Based on the results of the research and discussion in this study, the following conclusions can be put forward. The development of learning media was validated against media experts and material experts. The data from the assessment results by experts were calculated by producing a total average. From the results of the total average, it was categorized according to the level of media validity that had been previously determined. The increase in students' mathematical creative thinking skills who were given treatment using scientific-based LKPD media assisted by Geogebra experienced an increase in the moderate category with an N-gain value of 0.43. The increase in students' learning independence who were given treatment using scientific-based LKPD media assisted by Geogebra experienced an increase in the moderate category with an N-gain value of 0.258 which was in the moderate category.

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