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# Development of Web-Based Mathematics Learning Media to Improve Reasoning Ability and Self-Efficacy of High School Students

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*Abstrak*

*Tujuan penelitian ini untuk mengetahui bagaimana kevalidan, kepraktisan dan keefektifan media pembelajaran matematika berbasis web untuk meningkatkan kemampuan penalaran dan self efficacy peserta didik, 1 dan peningkatan kemampuan penalaran dan self efficacy. Jenis penelitian ini adalah penelitian pengembangan Thiagarajan yaitu model 4-D. Subjek dalam penelitian ini adalah siswa MAN 1 Medan Kelas X-18 sebanyak 30 peserta didik. Hasil penelitian; Media pembelajaran matematika berbasis web yang dikembangkan telah memenuhi kriteria valid dan praktis dari aspek materi, tampilan, interaktivitas, maupun kemudahan penggunaan. Kelayakan tersebut diperoleh berdasarkan hasil validasi oleh ahli materi, ahli media, serta hasil uji coba terbatas dan uji coba luas yang dilakukan terhadap peserta didik. Media pembelajaran ini terbukti efektif dalam meningkatkan kemampuan penalaran matematis peserta didik. Hal tersebut disebabkan oleh peningkatan skor kemampuan penalaran matematis secara signifikan setelah peserta didik menggunakan media pembelajaran yang dikembangkan dibandingkan dengan sebelum penggunaan media. Penggunaan media pembelajaran matematika berbasis web juga memberikan kontribusi positif terhadap peningkatan penalaran dan self efficacy peserta didik. Peserta siswa menunjukkan peningkatan keyakinan terhadap kemampuan dalam memahami dan menyelesaikan permasalahan matematika.*

**Kata Kunci**: *Pengembangan, Kemampuan Penalaran, Self Efficacy*.

Abstract

The purpose of this study was to determine the validity, practicality and effectiveness of web-based mathematics learning media to improve students' reasoning skills and self-efficacy, 1 and improve students' reasoning skills and self-efficacy. This type of research is Thiagarajan's development research, namely the 4-D model. The subjects in this study were 30 students of MAN 1 Medan Class X-18. Research results; The web-based mathematics learning media developed has met the valid and practical criteria in terms of material, appearance, interactivity, and ease of use. This eligibility was obtained based on the results of validation by material experts, media experts, as well as the results of limited trials and extensive trials conducted on students. This learning media has proven effective in improving students' mathematical reasoning skills. This is due to a significant increase in mathematical reasoning ability scores after students used the developed learning media compared to before using the media. The

use of web-based mathematics learning media also makes a positive contribution to improving students' reasoning and self-efficacy. Student participants showed increased confidence in their ability to understand and solve mathematical problems.

***Keywords**: Development, Reasoning Ability, Self Efficacy*

## A. Introduction

The education process requirements include mathematical reasoning as a competence standard; thus, it must be developed. "Math subjects' objectives include the importance of reasoning, so students can reason in patterns and properties, perform mathematical manipulations, and use mathematical statements to conclude, prove, and explain ideas"(Kemendikbud., 2016) "The term reasoning is a process of thinking based on facts and relevant sources to reach logical conclusions" (Purnamasari, 2017).

Students learn to solve arithmetic issues and develop new concepts using mathematical reasoning. (Sumartini, 2018) "Mathematical material and mathematical reasoning are two things that are interrelated because mathematical material is understood through reasoning, and reasoning is trained by learning mathematical material." If reasoning isn't established, arithmetic will become a collection of operations without an idea. (Gaza, 2018) say, "Students' reasoning ability is still relatively low, as seen from the results of the study showing that 75% of students have reasoning ability scores below the KKM." Another research by (Zulkarnain, 2015) found that "the quality of students' reasoning ability is still low because students have not been able to formulate arguments and conclude an answer." From the results of the observations, students did not collect facts, draw conclusions, provide explanations, or justify their answers; therefore, their reasoning skills are still inadequate. Internal and external influences affect pupils' minimal mathematical thinking. Currently, external influences are used to enhance pupils' mathematical thinking (Surya, E., 2013).

For instance, enhancing teacher learning techniques, modifying the curriculum, and providing school facilities. Internal aspects must also be created to enhance pupils' mathematical thinking. Examples include self-efficacy, student attitudes toward teachings, and physical and mental preparation. (Permendikbud RI, 2013) states, "Graduate Competency Standards (SKL) require students to behave with noble, knowledgeable, self-confident, and responsible attitudes in their interactions with the social and natural environment. Self-confidence must be fostered." Students' arithmetic self-efficacy affects their assignment completion. (Nurullita., Surya, Edy. & Syahputra, 2017), "Self-efficacy will affect motivation and achievement." According to (Hamidah., 2018)"individuals who have high self-efficacy consider failure as a lack of effort, while individuals who have low self-efficacy consider failure to come from a lack of ability." (Harianja, W.J & Panjaitan, 2022) said that "Low self-efficacy might result from not knowing one's potential and its barriers. Self-awareness and self-potential

measurement are essential to self-development. Baron (Bandura, 1989) defined self-efficacy as "belief in one's competence to do anything. Self-efficacy boosts pupils' mathematics communication abilities.

Teachers help pupils develop thinking skills and self-efficacy. To (Rahmawati, R., Azizah, 2018), "the role of teachers as educators is that teachers have the task of encouraging, guiding, and providing learning facilities for students to achieve goals." Teachers must develop a strong learning design, including picking an appropriate learning model, to make learning enjoyable. (Suhandi, A., & Robi'ah, 2022) agree, "Independent curriculum encourages instructors to create a student-centred learning approach. According to the study, MAN 1 Medan's math program is still ineffective. The school undertook this study because pupils have varying academic talents and require more creative learning techniques to enhance their math comprehension. Traditional methods of learning at MAN 1 Medan still use PowerPoint (attached). Rapid technology advances may assist instructors in streamlining the learning process. Web-based learning material may help students grasp math topics, develop logical thinking, and gain arithmetic problem-solving confidence. MAN 1 Medan has decent computer labs and internet connection; however, they are underutilized for learning. Low student motivation in arithmetic arises from teacher-centred, non-student-centred learning and uninteresting learning approaches.

A successful learning approach for diverse pupils is cooperative learning. Warsono & (Hariyanto, 2018) found that cooperative learning improves academic performance for gifted, average, and slow learners. This research will use the inquiry group cooperative approach. The inquiry group cooperative learning approach stresses student engagement and action in finding lesson content (knowledge) from textbooks or the internet. (Suhendri, 2018) state, "The cooperative learning model of the investigation group type is one of the learning models that can be applied as an alternative to solving the problems above in an effort to improve students' reasoning and self-efficacy in learning." As per Ibrahim et al., "In the cooperative learning model of investigation group type, students will work together in groups to solve complex problems so that later they will obtain academic information and skills." According to (Arends, 2018) "The cooperative learning model of investigation group type is a learning model that involves students since planning, both in determining the topic and the investigative procedures used."

Website-assisted learning material may help learners. Web-based learning media supports education and literacy using online media, according to (Jansen, A., & Rojas, 2022). Additionally, website-based learning media may increase student thinking, learning activities, and learning outcomes (Khairinal, Suratno, dan Aftiani, 2021). (Ertin, Aini, 2018) found that web-based Protozoa lessons boost student self-efficacy.

Integrating learning modules into websites allows math learning to employ web-based media. Students may access learning resources anytime, anyplace. Web-based learning modules allow students to study more freely and increase educator-student interactions, which may boost learning outcomes (Dermawan, Fahmi, 2020). (Wahyudin, 2016) also shows that e-learning webs may enhance, complement, and replace learning activities in mathematics. Google Sites is an efficient web-based learning tool (Angelia, C., Voogt, J., Fluck, A., Webb, M., Cox, M., Malyn-Smith, J., 2016). Google Sites is easy to use since it doesn't involve programming. Using a drag-and-drop interface, educators may combine text, graphics, videos, and connections to other learning materials in one well-structured web page (Adzkiya, D. S., & Suryaman, 2021). Due to its integration with Google Drive, Docs, and Forms, Google Sites improves collaboration. This makes it easier for teachers and students to collaborate, work on assignments, and engage in online debates and projects.

As a result of the many studies that have been conducted and the benefits that have been discussed, it is possible to draw the conclusion that web-based learning media, particularly those that make use of Google Sites, are an option that promotes learning both inside and outside of the classroom . The use of it not only makes the process of learning more exciting, but it also has the potential to boost students' interest in the content as well as their logic in comprehending it. In accordance with this, research conducted by (Adzkiya, D. S., & Suryaman, 2021) demonstrates that the use of web-based learning media via the utilization of Google Sites may make it simpler for students to comprehend the content that is presented by the instructor while simultaneously enhancing their interest in the process of learning.

Consequently, the use of web-based mathematics learning material in conjunction with the implementation of the investigative group-type learning model may serve as a supplementary component for educators who play the role of facilitators in the learning process that takes place inside the classroom setting (Rahmawati, R., Azizah, 2018). Researchers need to make efforts to develop web-based mathematics learning media with the application of the investigation group type learning model. This model is expected to be able to assist students in improving their reasoning skills and self-efficacy in learning. Based on the background of the problem, researchers need to make these efforts.

## B. Research Method

This type of research is Research and Development, using the Thiagarajan learning device development model, namely the 4-D model (define, design, develop, and disseminate) (Sugiyono, 2018). This research was conducted at MAN 1 Medan class X in the even semester of the 2024/2025 Academic Year. The subjects in this study were MAN 1 Medan Class X-18 students with 30 students. The objects in this study were Mathematics learning media in the

form of teaching materials, learning videos, Student Activity Sheets , Problem Solving Ability Tests (TKPM) and Student self-efficacy questionnaires. The data collection instrument during development research is the product assessment instrument developed by the researcher. The stages of 4-D model development are shown in the following chart:

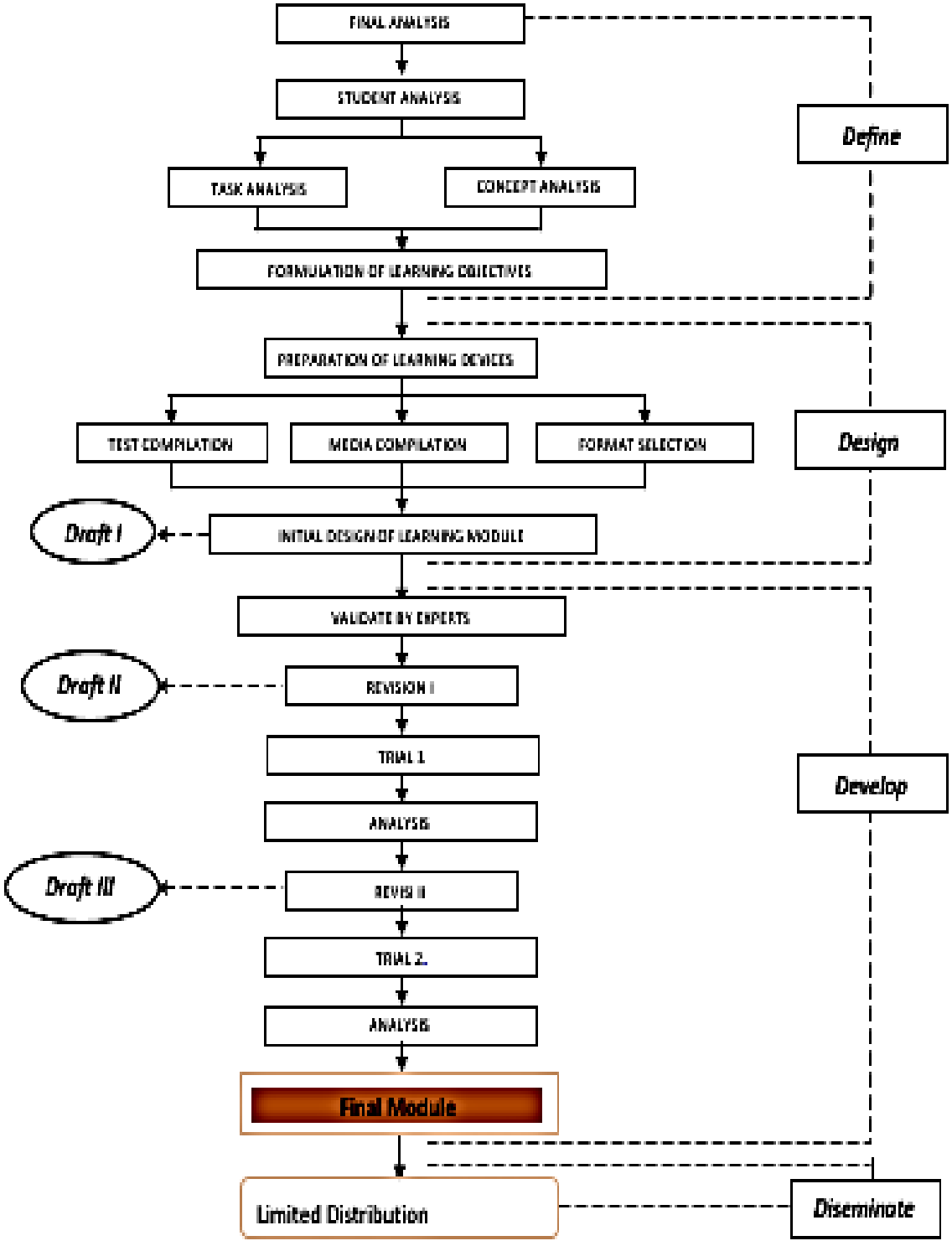


Figure 1. Research Design for 4-D Development Modified by Researcher

***Define***

This stage aims to identify the basic problems faced by students during learning. This analysis is carried out to find out the basic problems needed in development. In this stage, an

analysis of the needs of teachers and students in learning linear equation material is carried out by giving questionnaires to respondents. In the initial stage, the researcher conducted an initial diagnosis through observation with the aim of obtaining an overview of the problems and solutions to be used. The method used at this stage is the observation method. Observation is an activity of observing every activity during the learning process.

***Design***

This stage aims to make initial planning for the product to be developed.

***Develop***

This stage aims to produce a web-based mathematics learning media product, which will be revised and declared feasible to be developed based on input from selected expert lecturers.

***Disseminate***

The dissemination stage is the final stage of the 4D model development research. This stage is carried out to disseminate the products resulting from the development that has been carried out. The distribution of web-based mathematics learning media is carried out on a limited basis, namely to grade 10 teachers.

## C. Result and Discussion

To improve students' reasoning ability and self-efficacy. The development model used in this study is 4 D, with the stages of Define, Design, Develop, Implementation, and Evaluation. Based on the research and development conducted, the following research results were obtained:

***Define***

The stage carried out in the first analysis stage is the initial analysis. The first procedure in implementing this development is to conduct an initial analysis, namely a needs analysis in class 10 MAN 1 Medan, by distributing questionnaires to 2 teachers and 40 students at MAN 1 Medan. The results of the interview showed that 100% of the teachers said that web-based learning media would improve students' reasoning skills and self-efficacy so that the learning process runs more effectively, and 100% of students said that the learning process was very boring and they wanted new learning tools. Student analysis is a stage used by researchers to find out about student characteristics, which are the basis for researchers to compile web-based mathematics learning media that will be developed. Web-based mathematics learning media that are in accordance with student characteristics are expected to improve students' reasoning skills and self-efficacy. MAN 1 Class 10 students are generally 15-16 years old. At this stage, students are able to think logically and rationally and have begun to think abstractly (Ali, 2011). At this stage, students have begun to be able to imagine roles as students. Based on the results of observations carried out by researchers, in general students follow learning activities quite well. Learning that uses student textbooks makes students less active.

***Design***

Design is the second ADDIE development model step. Researchers start designing the learning module now. This design stage involves preparing web-based mathematics learning media tools, selecting designs, and designing the media. The 10th grade mathematics curriculum is used to create web-based math instructional resources. The web-based mathematics learning material will include an introduction, content, and conclusion. The cover, preface, table of contents, core and basic competencies, and usage instructions are at the beginning. The contents section has learning resources. The conclusion includes assessment questions and a bibliography. Web-based mathematics learning media design begins here. Display results of this learning gadget are as follows.

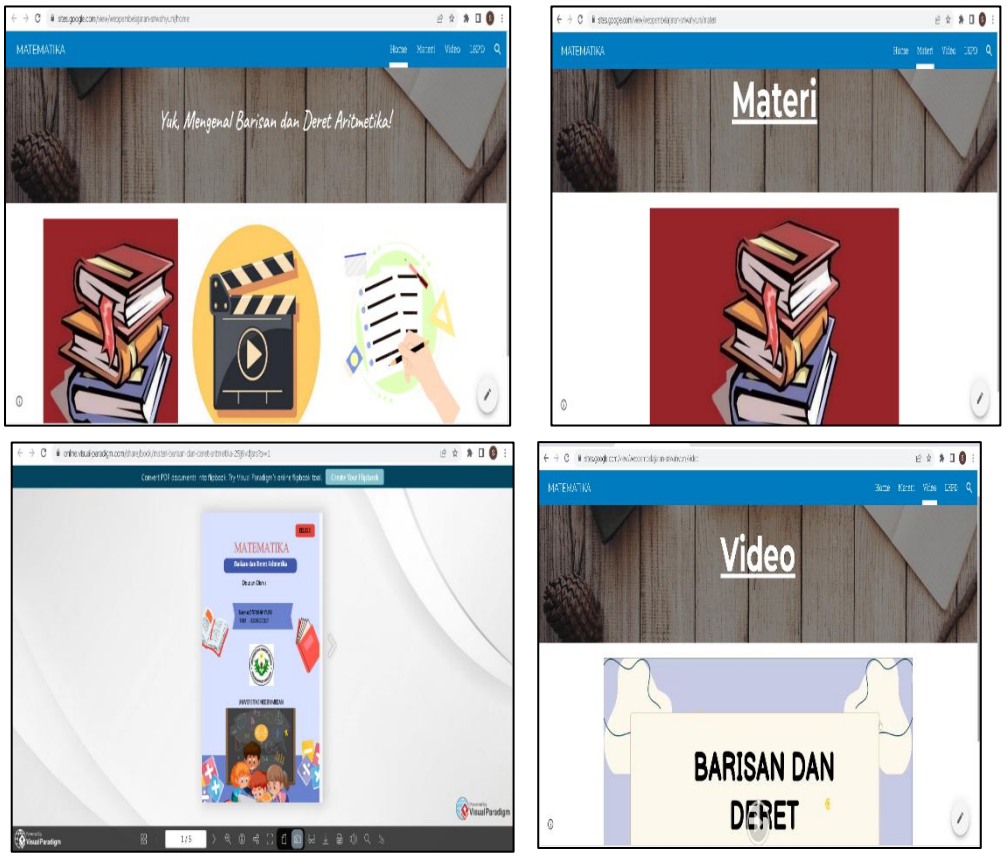


Figure 1 Forms of Learning Media

***Develop***

The development stage is a product that has been validated by material experts, media experts, and learning model experts, then revised the responses from the experts. After that, a questionnaire was given regarding the learning device by students with individual trials, small group trials, and large group trials to obtain input on media products for students of MAN 1

Medan.

The validators who validated the developed learning devices consisted of 5 people, including 3 UNIMED mathematics education lecturers, 2 teachers from MAN 1 Medan High School.

Table 1. Recapitulation of Learning Device Validation Results by Experts

| No | Objects being assessed | Average total validation value | Validation Level |
|---|---|---|---|
| 1. | Web Media Material Expert | 4,37 | Valid |
| 2. | Learning Model | 4,33 | Valid |
| 3. | Learning Media | 4,32 | Valid |

According to the data shown in Table 1, the average overall validity of the learning device falls within the range of three to four. It is possible to assert that the learning device that was produced is "Valid" on the basis of the applicable validity criteria. On the basis of the learning implementation criteria, it is possible to draw the conclusion that the implementation of the learning device at the first meeting has a learning implementation level of 4.5, which is considered to be high criterion, with four or fewer instances of IP being less than five. In this particular Trial, it has a learning implementation level of IO = 4.5, which is considered to be significant. As a result, the learning gadget has satisfied the requirements for empirical practical knowledge.

**The results of students' reasoning ability and self-efficacy on Arithmetic Sequence and Series Material Using Web-based Learning Media**

Based on research that has been conducted at MAN 1 Medan on the results of students' reasoning ability and self-efficacy on arithmetic sequence and series material on students who are taught with learning devices. The value of the results of students' reasoning ability and self-efficacy on arithmetic sequence and series material learned with web-based learning media, from 30 students collected spread from a score of 57 to 89, with Mode (Mo) = 73, Median (Me) = 71, Mean (M) = 71.27 and variant = 67.79.

Frequency distribution of the results of students' reasoning ability and self-efficacy for Arithmetic Series and Series that are taught using web-based learning media can be seen in Table 2.

Table 2. Frequency distribution of the results of students' reasoning ability and self-efficacy using web-based learning media

| No | Class Interval | Frequency |
|---|---|---|
| 1 | 57 – 61 | 3 |
| 2 | 62 – 66 | 6 |
| 3 | 67 – 71 | 6 |
| 4 | 72 – 76 | 9 |
| 5 | 77 – 81 | 2 |

| | | |
|---|---|---|
| 6 | 82 – 86 | 2 |
| 7 | 87 – 91 | 2 |
| | Total | 30 |

**The results of students' reasoning ability and self-efficacy on Arithmetic Sequence and Series Material Using Reading Book Learning Devices**

Based on research that has been conducted at MAN 1 Medan on the results of students' reasoning ability and self-efficacy who are taught using reading book learning devices. The results of students' reasoning ability and self-efficacy on arithmetic sequence and series material learned using reading book learning devices, it was found that the results of students' reasoning ability and self-efficacy from 40 respondents collected were spread from a score of 49 to 71, with Mode (Mo) = 54, Median (Me) = 54, Mean (M) = 56, and variance = 28.85.

The frequency distribution for the results of students' reasoning ability and self-efficacy on arithmetic sequence and series material learned using reading book learning devices can be seen in Table 3.

Table 3 Frequency Distribution of Scores of Reasoning Ability and Self-Efficacy Results of Students on Arithmetic Sequences and Series Material Learned Using Reading Book Learning Tools

| No | Class Interval | Frequency |
|---|---|---|
| 1 | 49 – 53 | 3 |
| 2 | 54 – 58 | 6 |
| 3 | 59 – 63 | 6 |
| 4 | 64 – 68 | 9 |
| 5 | 69 – 73 | 2 |
| 6 | 74 – 78 | 2 |
| 7 | 79 – 91 | 2 |
| | Total | 30 |

**Normality Test**

Data normality check is used to determine whether the sample comes from a normally distributed population. The test is conducted using the Lilliefors Test on two sample groups. A summary of the results of the normality calculation can be seen in Table 4.

Table 4. Summary of Data Normality Calculation Results

| No | Group | dk | $L_{hitung}$ | $L_{tabel}$ |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | The results of students' reasoning ability and self-efficacy in the material of arithmetic sequences and series learned using learning devices of web-based mathematics learning media | 29 | 0,10 | 0,140 |
| 2 | The results of students' reasoning ability and self-efficacy in the material of arithmetic sequences and series learned using learning devices of reading books | 29 | 0,09 | 0,140 |

In Table 4. above, it is obtained that the data on the results of students' reasoning ability and self-efficacy for the material on arithmetic sequences and series learned using web-based learning media are normally distributed. This is known from the large L count < L table at a significance level of 5%, namely (0.10 < 0.140). The data on the results of students' reasoning ability and self-efficacy for the material on arithmetic sequences and series learned using the learning device of reading books are normally distributed. This is known from the large L count < L table at a significance level of 5%, namely (0.09 < 0.140).

***Diseminate***

During the course of the trial, the final device is acquired after the requirements for validity and effectiveness have been satisfied. The next step is to carry out limited distribution, which will be done in the form of distributing the final device to the MGMP forum at MAN 1 Medan. This will be marked by the submission of the learning device to the MGMP forum. The hope is that mathematics teachers who are members of the forum will be able to use the learning device in subsequent learning. Immediately after the delivery of the completed product, the most important stage is to provide the findings of the development to the full population that is participating in this research.

**Discussion**

Research shows that students who learn with web-based learning media perform better in reasoning ability and self-efficacy on arithmetic sequences and series than those who use textbooks; specifically, the average test scores of students using web-based media are higher than those using textbooks. The results of this study support the research of (Kusuma, Dwi Hendra, 2015) , which concluded that learning devices of web-based mathematics learning media can improve the results of reasoning ability and self-efficacy of students compared to learning devices of reading books. The results of the study also concluded that the development of web-based mathematics learning media learning devices in their research using the 4D product development model combined with the Dick and Carey learning development model found from the results of the study that there were differences in users of web-based learning media on the test results of students' reasoning ability and self-efficacy (Ertin, Aini, 2018). The results showed that the students' reasoning ability and self-efficacy who were taught using web-

based learning media were higher than the results of students' reasoning ability and self-efficacy who were taught using textbook media that were already suitable for use. Learning using web-based learning media provides a new atmosphere in the learning process that students will learn well if students can bring the context of what is being learned into the application of real life every day and get benefits for themselves.

## D. Conclusions

This research draws numerous findings from its analysis and discussion: 1. The designed Based on the results of the research and discussion that has been done, it can be concluded that the following things The web-based mathematics learning media that has been developed has met the eligibility criteria in terms of material, appearance, interactivity, and ease of use. This eligibility was obtained based on the results of validation by material experts, media experts, as well as the results of limited trials and extensive trials conducted on students. This web-based mathematics learning media has proven effective in improving students' mathematical reasoning abilities. This is shown by a significant increase in mathematical reasoning ability scores after students use the developed learning media compared to before using the media. The use of web-based mathematics learning media also makes a positive contribution to increasing students' self-efficacy. Students show increased confidence in their abilities to understand and solve mathematical problems, as well as increased motivation and independence in the learning process.

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