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Google sites-based math book development on statistical materials to improve students' understanding of mathematical concepts

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Abstract

Background: The learning process in mathematics significantly impacts students' comprehension, particularly due to the scarcity of practical learning tools for understanding mathematical concepts. This challenge has led researchers to focus on developing innovative and practical learning media to enhance students' grasp of these concepts.
Aim: This study aimed to determine the effectiveness of a math book based on Google Sites, assessing its validity, practicality, and impact on students' understanding of mathematical concepts.
Method: The Research and Development (R&D) approach was employed using the ADDIE model, which includes Analysis, Design, Development, Implementation, and Evaluation. The study involved 61 students, with 30 from class VII D as the experimental group and 31 from class VII A as the control group.
Results: The math book developed using Google Sites was found to be valid and feasible, with media and material experts rating it at 85% and 80% respectively. Practicality was supported by a student response questionnaire showing an 86% positive response. The experimental class demonstrated a higher average understanding of mathematical concepts (79) compared to the control class (62).
Conclusion: The study concluded that the math book based on Google Sites is a valid, practical, and effective medium for enhancing students' understanding of mathematical concepts.

INTRODUCTION

Education is a form of dynamic cultural manifestation and full of developments. Changes or developments in aspects of life have changed the human paradigm in seeking and obtaining information (Arumsarie et al., 2019). Education affects a country's productivity by increasing labor's collective ability, expanding knowledge of new information, and becoming innovators in technological development (Ortega et al., 2022). According to Article 3 of Law Number 20 of 2003 on the National Education System, the purpose of national education is to develop abilities and shape the character and civilization of a dignified nation in order to educate the nation's life. The goal of national education is for students to become people who are faithful and devoted to God Almighty, noble, healthy, knowledgeable, capable, creative, independent, and democratic (Nasution, 2016). Learning is a process or action to develop skills and knowledge (Hadi Mousavi, 2020). One of the most important subjects to learn in education is mathematics.

Mathematics is a science we need to realize is needed in everyday life. Mathematics has an essential role in advancing human thinking and is the basis for the development of modern technology (Arifin & Herman, 2018). Every human being can create and develop a technology

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requiring a powerful mastery of mathematics. Mathematics is generally challenging, sometimes producing more negative emotions than the discipline (Yllana-Prieto et al., 2023). Teachers should make students feel comfortable and have greater self-confidence to reduce their anxiety in this subject (Ledesma et al., 2023). The purpose of learning mathematics at school, according to Permendiknas 2006, is to understand concepts, explain and apply them efficiently, flexibly, and accurately, and be able to solve a problem (Handayani, 2016). Therefore, learning math must be accompanied by understanding and knowledge to solve it.

The purpose of mathematics is for students to understand mathematical concepts and be able to solve mathematical problems. Comprehension is a systematic process of understanding and conveying what has been learned (Thanheiser, 2023). Learning mathematics requires specific skills to organize and control the thinking process, especially in understanding concepts where each material has a different way of solving problems. After learning mathematics, many students need help understanding the concepts of mathematical material, even the simplest ones, such as multiplication or division. The difficulties that arise make it difficult for students to understand what they are learning (Novitasari, 2016.). There are two possibilities if a student cannot explain a math question. The first is that the student does not understand the solution to the given question, so cannot communicate it. The second is that the student understands the math question's solution but cannot communicate it correctly (Farida, 2015).

Concept understanding is one of the mathematical abilities or skills that students are expected to achieve when learning mathematics. This ability is intended to be achieved by showing that students understand the concepts studied, explain how concepts relate to each other, and use concepts effectively, accurately, and appropriately in problem-solving (Handayani, 2016). Efforts to develop students' mindsets to carry out the process of abstraction, generalization, and idealization so that students can adequately determine mathematical concepts (Albar et al., 2017). To ensure that students are genuinely engaged in the learning process, teachers must be able to conduct learning in innovative and creative ways Mathematical understanding is based on abstractions that require understanding to develop mathematical mindsets and skills (Tar et al., 2022).

We are still experiencing the transition of a new life (new normal) from the COVID-19 pandemic to normal life. This situation has a significant impact, one of which is in the field of education (Boukranaa et al., 2023). Learning in the 2019-2020 period was carried out online, and starting from the beginning of 2021, the Minister of Education and Culture announced that schools could resume offline / face-to-face learning by implementing health protocols. During the pandemic, the world of education must transform to follow changes in the learning system by utilizing internet technology (Adisel & Prananosa, 2020). Teachers must be able to develop technology to make it easier for students to learn independently at home. The increasing need to rely on technology in education is now more relevant (Gandolfi et al., 2021). In face-to-face learning, media is needed to help students understand the material presented by the teacher, one of which is in mathematics because the field studied can be abstract and requires critical and logical thinking patterns (Purwanti et al., 2016).

Students still depend on learning media that they find easy to understand and access. The package books loaned by students are rarely used correctly. Summaries of material are what students need, so that students can more easily find what material to use. The rapid development of mobile technology is present in the education sector (Farida, 2017). E-learning was

introduced to emphasize using mobile technology tools in the educational process. The benefits of e-learning are that it can enhance learning and help students by providing them with assignments, answers, and online discussion boards (Pahrudin et al., 2021). Educational institutions should be able to adapt teaching methods to mobile technology, providing better learning tools for students.

In the implementation of school education in teaching and learning activities, teaching materials play a very important role because they make it easier for teachers and students to carry out the learning process (Legendari & Raharjo, 2016). Technological advances and their rapid evolution have a positive impact on the industrial and service sectors, where education benefits the most (Miranda et al., 2021). Utilizing technological tools in solving various types of problems can have a positive impact on development and interest in mathematics, as well as increasing the level of basic knowledge using digital technology (Aktayeva et al., 2022).

Based on an interview with a math teacher at SMP Negeri 38 Semarang, he said that some students do not understand if the explanation of the material is only with a textbook. They find it difficult to imagine and understand the meaning of the material that is only explained without any visual media. They often feel bored when learning takes place, which ultimately reduces the level of understanding of students' mathematical concepts and has an impact on students' math scores. The learning outcomes of class VII SMP Negeri 38 Semarang seen from the test score data are still found students who need remedial. These results are seen from Permendikbudristek Number 21 of 2022 Criteria for Achievement of Learning Objectives (KKTP) still in the interval 0 - 54 is in the criteria for incomplete which requires remedial in all parts, and is in the interval 55 - 69 in the criteria for incomplete which requires remedial in the necessary parts only.

One of the materials studied in mathematics class VII even semester is Statistics. Researchers chose this material because one of the problems that students often encounter in solving it is problems related to finding the average, median, mode, and data presentation. The ability to understand mathematical concepts in this material is still not optimal. This is due to a lack of curiosity about new things and misconceptions about the material being studied. Where in the learning process students only memorize formulas without understanding the concept of each material (Cahani et al., 2021). Therefore, there is a need for learning media that is easily accessible to students with facilities that students can afford.

Learning becomes interesting with the presence of media that helps the learning process of students to better understand the material presented by the teacher, including in mathematics, because it is abstract and requires logical thinking. There are many learning media that can be used in the form of a website, one of which is Google sites (Rikani et al., 2021). Google sites as the main platform for creating a student-centered learning environment (Fong et al., 2012). This is in line with research (Sari & Suswanto, 2017) Sari & Suswanto who found that the use of web-based learning media is very effective during the learning process. The purpose of using website links so as not to burden students' cellphone memory (Sari et al., 2021). Research (Jubaidah & Rizki, 2020), that Google sites is one of Google's products as a tool that allows ordinary people to easily manage websites. Jubaidah and Zulkarnain also said that all learning activities can be stored on Google sites. For example, we can enter the attendance list, materials, and assignments on the Google sites website that has been prepared.

Several studies have developed learning media based on Google sites such as those conducted by Taufiq et al. (2021), as well as Jubaidah & Zulkarnain's research (2020). This shows that many people are still interested in this website. Based on the problems faced by researchers, researchers are interested in trying to utilize the Google website as a means to facilitate student access to e-book math books. The purpose of this research is to develop Google sites-based math learning media on Statistics material and to find out whether the developed media is valid, practical, and effective to use.

METHODS

This study uses the Research and Development research method. Development research is used to make products and test how effective they are. The product of this research is a math learning media that uses the Google website. Researchers used the ADDIE model, which consists of five stages: analysis, planning, design, development, implementation, and evaluation.

Design:

In this development research, researchers used the ADDIE model which consisted of five stages, namely Analysis, Design, Development, Implementation, and Evaluation.

Participants:

This research was conducted at SMP N 38 Semarang involving class VII D as the experimental class and class VII A as the control class. The researcher chose class VII D as the experimental class and class VII A as the control class by random sampling because the learning has only been guided by the textbook from the government.

Instruments:

Data collection in this study to determine the feasibility and practicality of the media was carried out using a media expert validation questionnaire, material expert validation, and student response questionnaires. Then to find out the results of increasing students' understanding of mathematical concepts, an n-gain test was carried out through the final test.

Data Analysis:

To find out whether students' mathematical understanding has developed, the average student used one-party t test and n-gain test. The results of the one-party t test showed that at $n_1 = 30$ and $n_2 = 31$ with a significant level of 5%, the $t_{table} = 1.6711$ and $t_{count} = 4.317$ showed that $t_{count} > t_{table}$ so that H_0 was rejected. So it can be concluded that the average ability to understand the mathematical concepts of the experimental class is better than the control class. Then in the n-gain test seen from the analysis of the average of the pre test score, namely the previous daily test and the post test score, it shows that the experimental class = 0.41 is better than the control class = -0.03. It can be said that the ability to understand the mathematical concepts of the experimental class increased because it was at a value of $0.30 \leq (g) < 0.70$ including moderate interpretation while the control class was at a value $(g) < 0.30$ low interpretation. The results of data acquisition are evaluated with the t table and Likert scale.

RESULTS AND DISCUSSION

Result

In this study, the ADDIE model was used to produce a Google sites-based math book product. The following is a complete summary of product development results based on the ADDIE model:

Analysis

This analysis was carried out by making initial observations to collect data about student needs. The target in using this learning media is class VII. Researchers received information that the problem that occurred was the lack of innovation in the use of teaching materials in learning. Another problem is the lack of students in understanding a mathematical concept which results in decreased student learning outcomes. This is because in the learning process the teacher conveys material to students only in the same direction, students are less active in learning, so that students' understanding of concepts decreases.

Design

At this product planning stage the researcher made a design plan to develop learning media based on Google sites. The software used in making this media is Canva. The next stage is collecting data or learning materials needed for making media such as: competencies, application design, subject matter, YouTube links. After determining the statistics material as learning material, the researcher collected material based on existing class VII mathematics textbooks.

The stage of making this media design includes making an initial appearance design on Google Sites so that it looks attractive with a choice of several menu buttons. The initial appearance of this math book starts from learning objectives, material descriptions, learning videos, problem simulations, problem evaluation. The steps for making the math book material for researchers use Canva.

Development

In this development stage, the researchers developed the results of a Google Site-based math book product design. The results of the media development that have been made are then validated by media experts and material experts. This validation aims to find out the deficiencies that exist and need to be corrected or added so that the Google sites-based math book will be better and more suitable for use. The following is the result of the product design. The following is the result of the product design.

Figure 1. Display of The Math Book Start Menu

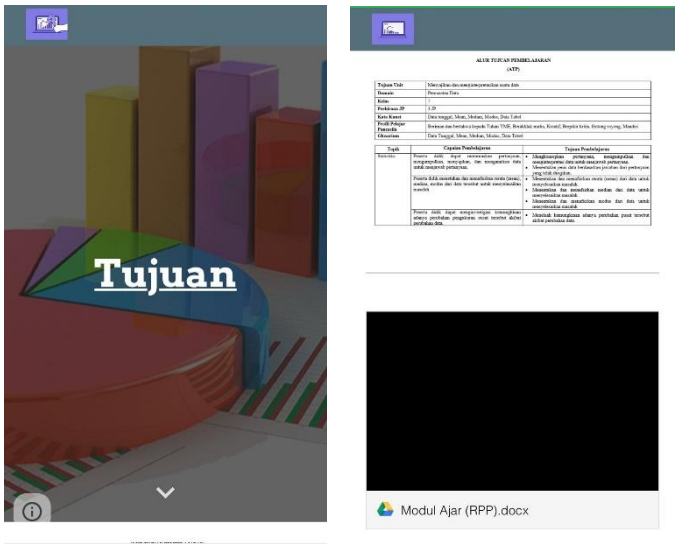


Figure 2 Destination Menu

Figure 3 Material Menu

The Google Sites-Based Math Book product has been validated by media experts, obtaining the following results: (1) General assessment aspects, related to the development of media that are interesting, easy to understand and have advantages over conventional learning media. (2) Presentation of learning related to the content of the material and various practice questions. (3) The feasibility of language that is easily understood by students. (4) Product display with attractive and easy-to-read color and image designs. (5) Product benefits that can be used by teachers to facilitate students in learning. (6) Appropriateness of indicators to express students' mathematical ideas orally and in writing. The validation results of media experts show an average of 85.87%, so it can be said that Google sites-based math book media is very feasible to use.

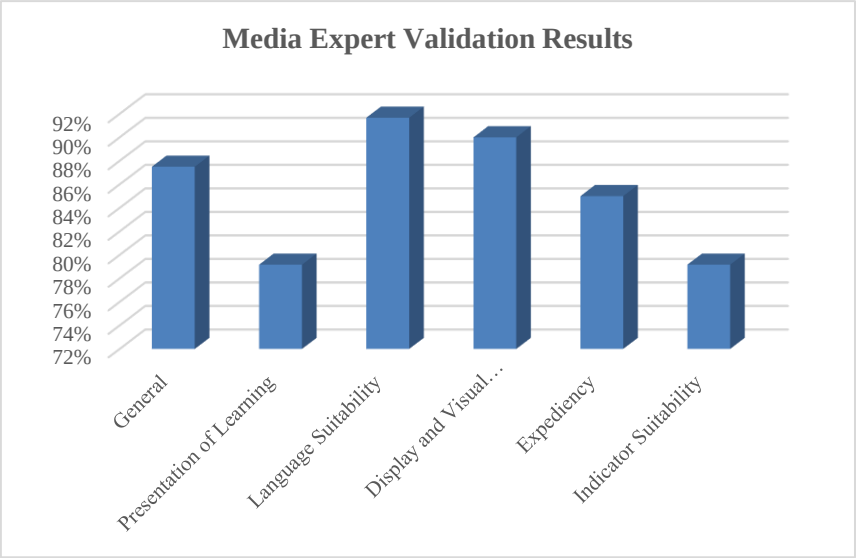


Figure 4. Graph of Media Expert Validation Results

Then, based on comments and suggestions from material experts, the following conclusions were obtained: (1) The substance aspect of the material which contains a description of the material which is arranged interactively and is easy to understand as well as practice questions to increase students' understanding of mathematical concepts. (2) Language in presenting material that is formulated clearly and briefly. (3) The language used is standard and easy to understand according to the intellectual development of students. (4) The benefits of media that can facilitate students to learn. (5) Appropriateness indicators understand, interpret and evaluate students' ideas. The results of the validation of material experts show an average of 80.36%, so that it can be said that Google sites-based math book media is feasible to use.

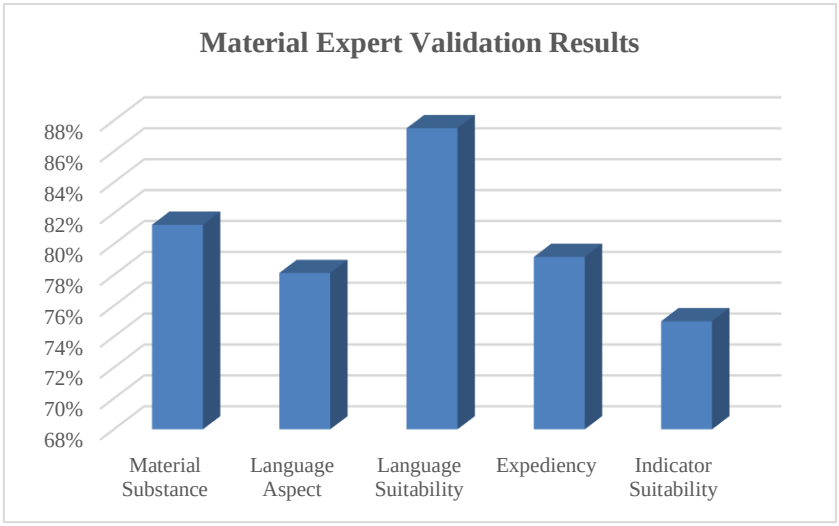


Figure 5. Graph of Material Expert Validation Results

Implementation

Google sites-based math book products can then be tested on learning. The selection of subjects in this study was adjusted to the situation and condition of the school, which was carrying out even semester learning and the material used in this study was statistics. The use of the developed learning media was carried out by dividing into two classes, namely the class that

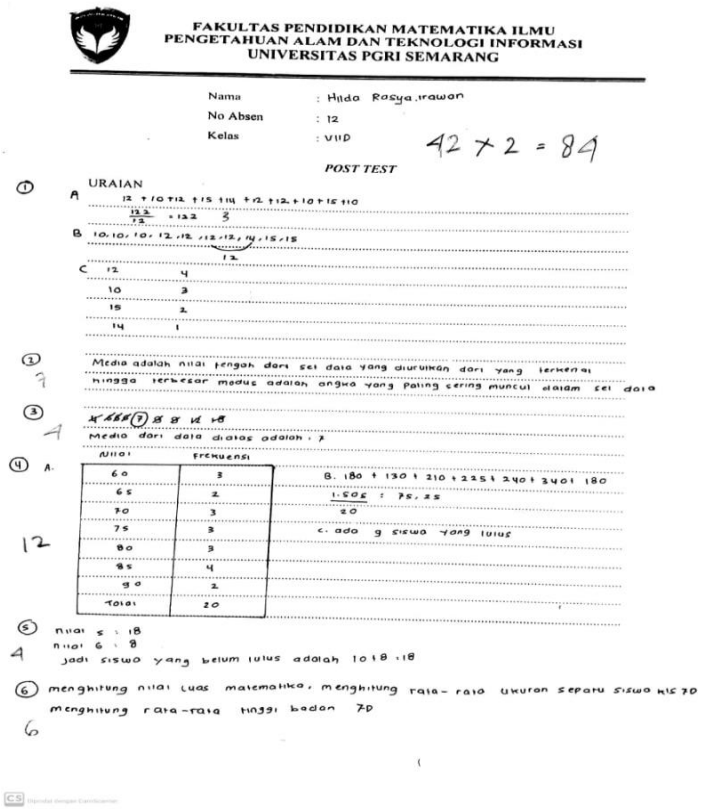
used the google sites-based math book media as the experimental class in class VII D and the class that did not use the google sites-based math book media as the control class in class VII A. Product trials held on May 11 – May 19, 2023 to find out how successful the resulting product has been on students' ability to understand mathematical concepts.

Figure 6. Learning Documentation

Evaluation

This development research aims to produce quality Google Sites-based Math Book learning media products and the influence of Google Sites-based Math Books in the experimental and control classes, in particular:

a. Evaluation of the quality of instructional media based on the practicality of the media depends on the results of media expert questionnaires, material expert questionnaires, and student response questionnaires. The evaluation aims to improve the quality of google sites-based math book products. The google sites-based math book product was declared valid based on the results of a media expert and material expert questionnaire with an average percentage of 83%, indicating that the google sites-based math book product was generally useful.
b. The impact assessment of the use of google sites-based math books to improve students' understanding of mathematical concepts can be seen based on the results of the post test. The post test results in the experimental class of 79 which were considered good were the impact of the benefits of using google sites-based math books. Here is one of the post test results,


FAKULTAS PENDIDIKAN MATEMATIKA ILMU
PENGETAHUAN ALAM DAN TEKNOLOGI INFORMASI
UNIVERSITAS PGRI SEMARANG

Nama : Hilda Rasya.irawan
No Absen : 12
Kelas : VIID

42 × 2 = 84

POST TEST

① URAIAN

A 12 + 10 + 12 + 15 + 14 + 12 + 12 + 10 + 15 + 10

132 : 12 = 11

B 10, 10, 10, 12, 12, 12, 12, 12, 14, 15, 15

12

C | | |
|---|---|
| 12 | 4 |
| 10 | 3 |
| 15 | 2 |
| 14 | 1 |

③ Modus adalah nilai tengah dari sel data yang diurutkan dari yang terkecil hingga terbesar modus adalah angka yang paling sering muncul dalam sel data

③ Median dari data diatas adalah : 7

④ A.

Nilai	Frekuensi
60	3
65	2
70	3
75	3
80	3
85	4
90	2
Total	20

B. 180 + 130 + 210 + 225 + 240 + 340 + 180

1.505 : 75,25

20

C. ada 9 siswa yang lulus

⑤ nilai ≤ : 18

nilai 6 : 8

jadi siswa yang belum lulus adalah 10 + 8 : 18

⑥ menghitung nilai luas matematika, menghitung rata-rata ukuran sepatu siswa kls 7D

menghitung rata-rata tinggi badan 7D

Figure 7. Sample Post Test Results

To see the results of improvements in using google sites-based math book products and without using google sites-based math book products, an N-Gain test will be carried out.

Table 1. Gain Classification (g)

Value	Interpretation
(g) < 0,30	Low
0,30 ≤ (g) <0,70	Medium
0,70 ≤ (g) <1,00	High

The pre-test average is 67, while the post-test average is 79. These results can be used to measure the increase in students' understanding of mathematical concepts in statistical material by using the formula,

$$N - Gain = \frac{score\ posttest - score\ pretest}{score\ maximum - score\ pretest}$$

$$N - Gain = \frac{79 - 67}{100 - 67} = \frac{79}{100} = 0{,}36$$

The g value obtained is in the middle range based on the n-gain score data. So it can be said that there is an increase in students' understanding of mathematical concepts after using Google sites-based math books. This is also based on the student response questionnaire as follows,

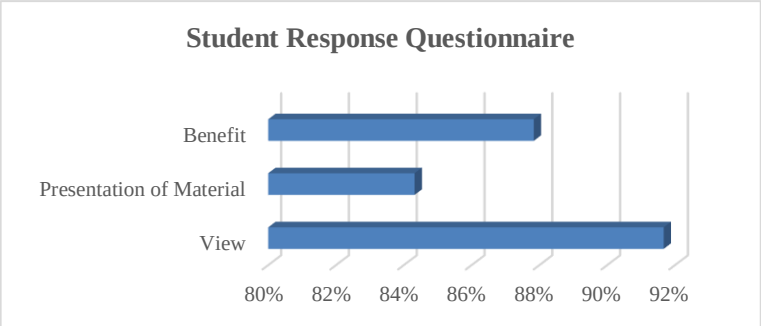


Figure 8. Graph of Student Response Questionnaire

Google sites-based math book can improve students' ability to understand mathematical concepts in statistics material, based on student response data.

Discussion

Development research or research (R&D) is the type of research conducted. To improve students' mathematical understanding, researchers developed a math book based on Google sites. The ADDIE model was used to develop this product, which consists of five steps: analysis, design, development, implementation, and evaluation.

In the first stage, namely analysis, researchers conducted observations at school by conducting interviews with mathematics teachers regarding the learning process applied. The results of the interview obtained information that in the learning process the teaching materials used were only textbooks borrowed from the school library and did not use learning media. At this stage, it was found that students of SMP Negeri 38 Semarang still needed help understanding mathematical concepts in statistics, especially when known data were presented in tables. The analysis of the right solution is to develop learning media that can help students understand and hone skills in statistics material, one of which is by using Google sites-based math book media that can improve students' understanding of mathematical concepts. The pre-test and post-test results of students in class VII D show an increase in understanding of mathematics lessons. This means that this media has an effect in improving students' understanding of mathematical concepts based on pre-test and post-test evaluations. (Nuryati et al., 2022) It is proven that using Google Sites can help increase student motivation and interest in learning, which increases students' understanding of concepts. Then explained that using Google Sites by combining Google Forms can make it easier for teachers to monitor students in a disciplined manner to increase teachers' abilities in technology-based learning. Then (Bangun et al., 2022), using Google sites that ordinary users easily manage does not require complicated high-level programming languages.

The design of math book media is based on Google Sites that can be accessed easily using links on all internet devices. Math content is presented as a design with Canva's help, including statistical material, mean, median, mode, and presentation of data in tabular form. This device is packaged neatly and aesthetically with color gradations that can attract students. (Waraga et al., 2023) Explained that Google Sites can be accessed anytime, and teachers can upload learning materials, give assignments, and monitor student assignments, but this device must use a good internet network. Students become happier to learn using Google Sites learning media than conventional learning (Devya et al., 2022), proving that fraction material lessons can

improve numeracy skills and increase activity during lessons. (Gunawan et al., 2023) Using Google Sites as learning media can further enhance student creativity and productivity.

The development stage, where the result of this step is a Google sites-based math book learning media product, which will be validated by media and material experts. This is in accordance with research (Buchori et al., 2015), so that the product to be tested is really suitable for use in research, media experts and material experts are validated. The results of the calculation of the percentage of media expert feasibility show that the percentage is in very good qualifications, 85.87%. While the material expert obtained a percentage of the feasibility assessment results on material validation of 80.36%. So that the product can be said to be valid because the percentage obtained from the validator is good.

Next is the implementation stage. At this stage, the researcher implemented the revised Google sites-based math book product in teaching and learning activities. Researchers used class VII D as the experimental class. Before the product was used for learning, researchers analyzed the initial data of the experimental class and control class to ensure that both classes were at the same starting point. The initial data used came from the previous daily test on the material. Furthermore, researchers used Google sites-based math book media products to improve students' understanding of mathematical concepts. The research was conducted for 3 meetings in the experimental class using Google sites-based math book products and in the control class without using Google sites-based math book products.

The use of learning media math book based on Google sites is a new thing for students and teachers. By using a math book that is made practical and attractive appearance makes students more enthusiastic in learning because it is easy to understand the material and can learn anytime and anywhere. Learning media math book based on Google sites will foster student interest in learning, so that students' understanding of the material increases.

The last stage is the evaluation stage, at the evaluation stage using the average results of the post-test assessment of the experimental class and the control class. The results showed that the understanding of the concept of the experimental class was better than the control class, with an average of 79 and 62 respectively. After conducting all stages of this development research, so it can be said that this Google sites-based math book fulfills the relevant elements used in learning to improve students' mathematical understanding. In line with research (Figueiredo & Bidarra, 2015) which says learning media that utilize technology has the potential to challenge students to be actively involved in learning, because it encourages students to explore new things.

Implication

Based on the discussion above, it shows that "Development of a Google sites-based math book on statistical material to improve students' understanding of mathematical concepts" is appropriate for use in teaching and learning activities according to media experts and material experts. Practical media used in learning. In addition, Google sites-based math book media is better than without using Google sites-based math books to improve understanding of mathematical concepts.

Limitation and Suggestion for Further Research

After the Google sites-based math book product was used in the learning process, it turned out that the school's Wi-Fi facilities were inadequate. This resulted in the learning process slightly hampered. Then the learning process carried out must be in accordance with the independent curriculum which applies the suitability of the characteristics of students in that environment.

CONCLUSIONS

Based on the results of development research, math books created by researchers to help students understand mathematical concepts can be considered valid and feasible to use because of the results of validation by media experts and material experts. The math book made by the researcher to improve students' mathematical understanding can be said to be practical based on the results of the student response questionnaire. Math book based on google sites to improve students' ability to understand mathematical concepts developed by researchers can be said to be effective in increasing understanding of concepts. The results show that the average n-gain value for the experimental class is 0.41 for the medium category and the average n-gain value for the control class is -0.03 for the low category. The average difference in understanding the mathematical concepts of the experimental class was 79 and that of the control class was 62. This shows that Google sites-based math books are an effective source of mathematical learning.

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AUTHOR CONTRIBUTIONS STATEMENT

AA will organize the article and deepen its content, DDA will process the data and adapt the article template, and WK will source references and handle the submission via the Online Journal System (OJS).

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