



Jurnal Eduscience (JES)

Volume 11, No.1

April, Year 2024

Submit : 29 July 2023

Accepted : 01 April 2024

DEVELOPMENT OF MATHEMATICAL DERIVATIVE BOARD PROPS TO IMPROVE STUDENTS' MATHEMATICAL CONCEPT UNDERSTANDING

Putri Elmania¹, Siti Syahirani², Ayu Safitri³, M.Ilyas Lubis⁴, Arianto⁵,

Pendidikan Matematika, Fakultas Keguruan dan Ilmu Pendidikan,
Universitas Al Washliyah Medan
putrielmania7@gmail.com
082360150917

Abstrak

The feasibility results were obtained based on the results of the validation questionnaire for the mathematics derivative board props for each validator, namely media experts, who obtained a percentage result of 78.24% in the "Good" category. The material expert obtained a percentage result of 86% in the "Very Good" category. Small group students obtained a percentage result of 83.5% in the "Very Good" category. The average percentage of the three validators is 82.63% in the "Very Good" category. In this way, the mathematics-derived board teaching aids are declared suitable for use in the learning process. This result is based on the average pretest score of 40.5 and the average posttest data result is 83.5 and the N-Gain calculation is 0.72 with the interpretation "High" so it can be said that there is an increase in understanding of mathematical concepts.

Keywords: tools display; board derivative mathematics; understanding draft

INTRODUCTION

Education is a choice that aims to influence and help children to increase knowledge, physical fitness, and work enthusiasm to gradually guide children toward their highest dreams. (Kholik, N, 2020). A child can live happily and everything he does is beneficial for himself, his beliefs, society, the country, and the world in general. Apart from that, education is an adult's effort to guide teenagers toward maturity while also helping children learn how to carry out life's obligations responsibly and independently (Adawiyah et al., 2023).

Mathematics equip participant educate to have ability mathematical so that capable think systematic , critical , logical , effective, creative , attitude honest and disciplined , as well form power reason for solving something problem. Subordinate ideas are high-level numerical ideas that are a way to learn Calculus after Functions and Limits. One way to train students' abilities in understanding draft Mathematics is by giving questions using board media derivative (Amin & Harahap, 2023).

Understanding concepts is an ability related to understanding mathematical ideas comprehensively and functionally. Students' understanding of mathematical concepts is more important



than just memorizing (Fahrudin, Achmad Gilang, Zuliana, & Bintoro, 2018). Understanding students' mathematical concepts is very important for students, not just memorizing concepts but also understanding these concepts. The concept of learning is the main result of education and is the basis for students' thinking to solve problems based on the theory learned. Aledya, V. (2019), that understanding mathematical concepts is the ability to explain a situation using different words and being able to interpret or draw conclusions from tables, data, graphs, and so on. In order for a student to be able to solve problems in learning, the student must know the relevant rules obtained from these concepts (Putri, DIA, 20, 20). Learning mathematics functions to train brain growth and intelligence. The study of mathematics is necessary to develop problem-solving and analytical skills (Dalimunthe et al., 2021).

In addition, studying mathematics helps a person develop methodical, scientific, logical, critical thinking skills and increases creativity. So that mathematics is easy for students to understand. Good mathematical principles must be understood by students (Harahap, 2018).

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

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

This is in accordance with research by Diana , P., Marethi, I., & Finally, AS (2020) found that children in one school had poor concept understanding abilities. Many factors, including students' internal characteristics and teachers' external factors, may be the cause of students' low understanding of mathematical concepts (Amintoko, 2019). variables that are beyond the student's reach, such as learning



tactics or procedures. Internal factors such as feelings and attitudes towards mathematics are factors that students have. Interactive learning media is used because students' knowledge of mathematical concepts is still low. Learning materials based on derivative board props are interactive learning tools that can be used to improve understanding of concepts (Indrasvari et al., 2021).

Based on the results of interviews conducted by researchers with several class XII students at SMK PAB 1 Helvetia, it can be concluded that mathematics is a subject that is difficult to understand. One of the materials that students consider difficult is the derivative of functions. Function derivatives are difficult to understand because students do not understand the basic concept of function derivatives. Many factors cause students' lack of understanding of mathematical concepts at school. Apart from interviewing several class XII students, the researcher made observations by giving mathematics questions with indicators of concept understanding.

Research conducted (Lismareni, 2018) also shows that the use of derivative board teaching aids is effective on mathematics learning outcomes in derivative material in class XI of SMA Negeri 1 Pajar Bulan in the 2017/2018 academic year. Likewise, research conducted by (Anjelita, 2019) shows that the use of fraction block teaching aids can increase students' understanding of concepts in class XII TKR SMK PAB 1 Helvetia Medan. Furthermore, research (Wahyudi, 2020) shows that Montessori-based multiplication board teaching aids can help understand the concept of multiplication. Based on the background of the problem above, the author conducted research with the title "Development of mathematical derivative board teaching aids to improve students' understanding of mathematical concepts at SMK PAB 1 HELVETIA MEDAN".

RESEARCH METHODS

Researchers use the type of research and development or better known as type of research R&D (*Research and Development*). According to (Sugiyono, 2019), research and development are research methods used to produce specific products, and test the effectiveness of those products. In the field of education, this method can be used to develop books, modules, learning media, instrument evaluation, curriculum models, etc. (Hamdi, 2020).

This type of research is different from other educational research because the aim is to develop products based on The trials are then revised to produce a product that is suitable for use. Model The development used in this research is ADDIE (Analysis, Design, Development, Implementation, and Evaluation).



Time and place of study

Study this development tool shows board derivative mathematics on the material Derivatives conducted at the school "SMK PAB 1 HELVETIA MEDAN". Labuhan Deli District, Deli Serdang Regency, North Sumatra Province. This research was carried out during the odd semester in the 2023/2024 academic year. The subjects in this research were class XII-electricity² students. In this case, the object of this research was students' understanding of mathematical concepts.

Procedure

Understanding mathematical concepts is an ability related to understanding comprehensive and functional mathematical ideas. Students' understanding of mathematical concepts is more important than just memorizing. Understanding students' mathematical concepts is very important for students, not only for solving mathematics problems but also for understanding other mathematical concepts. One of the mathematical materials that is difficult for students to understand is the derivative of functions. This is because function derivative material is abstract material and requires a strong conceptual understanding.

One effort to improve students' understanding of mathematical concepts is to use appropriate learning media. Appropriate learning media can help students understand mathematical concepts more easily and meaningfully. Teaching aids are one type of learning media that can be used to improve students' understanding of mathematical concepts. Teaching aids can provide concrete and interesting learning experiences for students.

Procedure The development model used in this research is the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. The procedure for developing the ADDIE model is as follows:

1. Analysis, the first stage is analysis to determine the initial needs in developing this teaching aid.
2. Design, the second stage is the stage of creating a design for the teaching aids that will be developed.
3. Development, this stage is the process of making props.
4. *Implementation* (Implementation) The teaching aids that have been developed and declared fit for testing by media expert lecturers, material expert lecturers, and mathematics teachers are then implemented to 25 students in class XII electricity² at SMK PAB 1 HEIVETIA MEDAN Then the participants students fill out a media evaluation questionnaire.
5. Evaluation, this evaluation stage is the final stage of the development of the teaching aids carried out. At this stage, the researcher conducted a formative evaluation and summative evaluation. Formative evaluation is carried out by collecting data at each stage which is used to improve the



mathematical derivative board teaching aids, while summative evaluation is carried out at the end of the research to find out the results of the development of mathematical-derived board teaching aids.

Data, Instruments and Data Collection Techniques

The data collection techniques used in this research are:

1. Test. The test instrument to measure the ability of learning achievement is in the form of Indonesian language learning results in reading.
2. Non-test. The non-test data collection technique in this study used a questionnaire. The research instruments used to obtain data from this research include:
 - a. Instrument Validation Instrument validation includes three components, namely:
 - a) Validation Instrument for Media Validation Experts tool show done by one person lecturer in the Mathematics Education Study Program University Alwashliyah Medan and eye teacher lesson mathematics specifically material derivative function in XII electricity ² at SMK PAB 1 HEIVETIA MEDAN. The validation expert tool shows This aim For carrying out due diligence tool display seen from aspect appearance and usability.
 - b) Validation Instrument for Material Experts Validation material done by one person lecturer in the Mathematics Education Study Program University Alwashliyah Medan.
 - c) Validity Instrument For Small Group Validation This was carried out by 5 students in class XII electricity ² at SMK PAB 1 HEIVETIA MEDAN. Validation This aims to carry out a due diligence tool display.
 - b. Test Questions The test for obtaining learning outcomes used is to compare the results of the pretest and posttest which are used to show an increase in understanding of concepts.

RESULTS AND DISCUSSION

By using the ADDIE model which consists of five stages, this research and development developed a product in the form of a mathematical derivative board teaching aid. This research and development aim to find out whether mathematical derivative board teaching aids are useful and whether people can better understand mathematical concepts by helping them.

Results Validation Expert Media

The media expert validation results were obtained from a questionnaire validation sheet filled out by field supervisors and tutors who are experts in learning media at Alwashliyah University and Pab 1 Helvetia Vocational High School. The results of media expert validation are presented in the table.

Table 1. Results Validation Expert Media

No	Aspect	No Item	Validator		Average (%) Per aspect	Category
			I	II		
1	Material Teach	1	4	4	83.33%	Very Good
		2	4	4		
		3	5	4		
2	Education	4	5	5	95%	Very Good
		5	4	5		
3	Power Stand	6	3	4	66%	Good
		7	3	3		
		8	3	3		
		9	3	2		
4	Efficient	10	5	4	90%	Very Good
		11	5	4		
		12	5	4		
5	Aesthetics	13	5	4	60%	Enough
		14	4	3		
6	Material Media	15	3	2	85%	Very Good
		16	5	5		
		17	4	3		
Average (%)			82.35%	74.12%	78.24%	Good

According to the table above, the media expert assessment of each validator shows a percentage result of 82.35% for the "Very Good" category and 74.12% for the "Good" category. The average percentage of the two validators was 78.24% for the "Good" category. Thus, it is shown that mathematically derived board teaching aids are suitable for use in the learning process.

Results Validation Expert Material

The aim of the material expert validation carried out by lecturers from Medan Alwashliyah University and a mathematics teacher at S MK PAB 1 Helvetia was to find out how effective the mathematics derivative board teaching aids were. The following material expert validation results:

Table 2. Results Validation Expert Material

No	Aspect	Number Item	Validator		Average(%) Per Aspect	Category
			I	II		
1.	Learning	1	4	5	86.67%	Very Good
		2	3	5		
		3	4	4		
2.	Education	4	4	5	85.71%	Very Good
		5	5	5		
		6	4	5		
		7	3	5		
		8	3	5		
		9	3	5		
		10	5	4		
Average (%)			79%	95%	86%	Very Good

According to the table above, the material expert assessment of each validator, validator I obtained a percentage result of 79% in the "Very Good" category, and validator II obtained a percentage result of 95% in the "Very Good" category. The average percentage of the two validators is 86% in the "Very Good" category. Thus, it is shown that mathematically derived board teaching aids are suitable for use in the learning process.

Validation results of small group students

The results of the expert validation of small group students were obtained from the questionnaire validation sheet filled in by five classes. The media expert validation results can be seen in the following table;

No.	Aspek	Nomor Butir	Validiator					Rata - rata Per Aspek	Kategori
			I	II	III	IV	V		
1	Efektivitas	1	4	5	4	5	4	84	Sangat Baik
		2	5	4	3	4	4		
2	Implementasi	3	5	5	5	4	4	88	Sangat Baik
		4	5	5	4	3	4		
3	Materi	5	4	4	3	4	5	80	Baik
		6	4	4	4	4	4		
4	Pembelajaran	7	4	4	4	3	3	82	Sangat Baik
		8	5	4	4	5	5		
Rata - rata (%)			90	87,5	77,5	80	82,5	83,5	Sangat Baik

Based on this table, the assessment of each validator's small group of students, namely validator I, obtained a percentage result of 90% in the "Very Good" category. Validator II obtained a percentage result of 87.5% in the "Very Good" category. Validator III obtained a percentage result of 77.5% in the "Good" category. Validator IV obtained a percentage result of 80% in the "Good" category. Validator V obtained a percentage result of 82.5% in the "Very Good" category. The average percentage of the five validators is 83.5% in the "Very Good" category. In this way, the mathematics-derived board teaching aids are declared suitable for use in the learning process.

Results of Increasing Students' Understanding of Mathematical Concepts

Data on the increasing understanding of mathematical concepts with the help of mathematical derivative board teaching aids were obtained from pretest and posttest scores from large groups of students at the implementation stage. The scores from the pretest and posttest are used to determine the increase in understanding of mathematical concepts with the help of class XII mathematics derivative board teaching aids on functional derivative material. The pretest and posttest were given in class XII TP 2 SMK PAB 1 Helvetia with a total of 24 students.

The average value of the pretest data results is 40.5 and the average value of the posttest data results is 83.5, thus indicating an increase in understanding of mathematical concepts. From the average of the pretest and posttest, the N-Gain value will be looked for in order to interpret the increase in understanding of mathematical concepts. The following is the N-Gain calculation:

$$G = \frac{\text{Post test average} - \text{Pretest average}}{100 - \text{Pretest average}}$$
$$= \frac{83,5 - 40,5}{100 - 40,5} = \frac{43}{59,5} = 0,72$$

Based on the results of the N-Gain calculation above, the comparison of pretest and posttest scores in the learning process assisted by derivative board props is 0.72 with the interpretation "High" so it can be said that there is an increase in understanding of mathematical concepts. Therefore, it can be concluded that mathematics derivative board teaching aids can improve students' understanding of mathematical concepts.

CONCLUSION



Based on the results of research and development that has been carried out regarding the development of mathematical derivative board teaching aids used in the learning process to increase the understanding of mathematical concepts for class:

1. Tool shows board derivative mathematics on the material developed derivatives worthy for use in class XII TP 2 SMK PAB 1 Helvetia. Feasibility results obtained based on the results questionnaire validation tool show board derivative mathematics each validator viz earned media experts results percentage 78.24% with “Good” category. Material experts obtain results percentage of 86% with the category “Very Good”. Student group small obtained results percentage 83.5% with the category “Very Good”. The average percentage from all three validators is 82.63% with the category “Very Good”. Thereby tool shows board derivative mathematics stated worthy for use in the learning process.
2. Tool show board derivative mathematics can increase understanding draft mathematical student class XII TP 2 SMK PAB 1 Helvetia on the material derivative function. This result is based on the results The average pretest score is 40.5 the average posttest data result is 83.5 and the N-Gain calculation is 0.72 with the interpretation of “High” so can be said that exists enhancement understanding draft mathematical.

THANK YOU

We would like to thank the tutor's interns and supervisors 3 interns who have guided us in producing the development product board derivative mathematics and friends who have helped in writing the journal.

REFERENCES

- Aji, VG (2016). Development of Mathematics Addition Teaching Tools to Improve Elementary School Students' Understanding of the Concept of Addition
- Aledya, V. (2019). Ability to Understand Mathematical Concepts in Students. *May*, 0–7.
- Amintoko. (2019). The effect of using interactive multimedia on students' ability to understand mathematical concepts. *FIBONACCI: Journal of Mathematics and Mathematics Education*, 2 (2), 8-18.
- Anjelita, R. (2019). Use of Fraction Block Teaching Aids to Improve Students' Understanding of Concepts in Fraction Material Class III MIS Lamgugop Banda Aceh



- Diana, P., Marethi, I., & Pamungkas, AS (2020). Students' Ability to Understand Mathematical Concepts: An Overview of Mathematics Anxiety Categories. *SJME (Highest Journal of Mathematics Education)*, 4 (1), 24-32.
- Fahrudin, Achmad Gilang, Zuliana, E., & Bintoro, HS (2018). Increasing Understanding of Mathematical Concepts through Realistic Mathematics Education Assisted by Bongpas Teaching Aids. *Scientific Journal of Mathematics Education*, 1(1): 15.
- Hadiyanti. (2019). Understanding mathematical concepts in mathematics learning. *National Semester of Mathematics and Mathematics Education*, 2 (3), 231-234.
- Jeheman, AA, Gunur, B., & Jelatu, S. (2019). The influence of a realistic mathematical approach on students' understanding of mathematical concepts. *Mosharafa: Journal of Mathematics Education*, 8 (2), 191-202.
- Kholik, N. (2020). *New Breakthroughs in Human Character Formation in the 21st Century: Al-Attas' Holistic Education Ideas*. EDU PUBLISHERS.
- Lisamareni, N. (2018). The Effectiveness of Derivative Board Teaching Aids on Class XI Students' Mathematics Learning Outcomes. *Journal of Mathematics Education Innovation*, Vol. 1 No.1.
- Putri, HE, Muqodas, I., Wahyudy, MA, Abdulloh, A., Sasqia, AS, & Afita, LAN (2020). *Mathematical skills and instrument development*. UPI Sumedang Press.
- Wahyudi, A. (2020). Development of Montessori-Based Multiplication Material Mathematics Learning Props. *Journal of Educational Management* Volume 4 No.2.
- Sugiyono. (2019). *Quantitative, Qualitative, and R&D Research Methods*. Bandung: Alfabeta.
- Hamdi, USA (2020). *Quantitative Research Methods Applications in Education*. Yogyakarta: Deepublish.
- (Hajerina et al., 2022) Adawiyah, R., Kholizah, S., & Harahap, R. D. (2023). *Literature Study : Utilization of Audio-Visual Media in Science Subject Matter for Junior High School Students*. May, 68–72.
- Amin, M. T., & Harahap, R. D. (2023). Analysis of students learning interest in biology subject matter of viruses in grade X senior high school. *BIO-INOVED : Jurnal Biologi-Inovasi Pendidikan*, 5(2), 179. <https://doi.org/10.20527/bino.v5i2.15549>
- Dalimunthe, R. R., Harahap, R. D., & Harahap, D. A. (2021). Analisis Minat Belajar Siswa Sekolah Dasar Terhadap Mata Pelajaran IPA Pada Masa Pandemi Covid-19. *Jurnal Basicedu*, 5(3), 1341–1348. <https://doi.org/10.31004/basicedu.v5i3.888>
- Fitri, N. W., Subarinah, S., & Turmuzi, M. (2019). Analisis Kesalahan Newman Dalam Menyelesaikan



Soal Cerita Materi Turunan Pada Siswa Kelas XII. *MANDALIKA Mathematics and Educations Journal*, 1(2), 66. <https://doi.org/10.29303/mandalika.v1i2.1559>

- Hajerina, H., Suciati, I., & H. Mailili, W. (2022). Analisis Kesalahan Mahasiswa pada Mata Kuliah Kalkulus Diferensial Materi Turunan. *EQUALS: Jurnal Ilmiah Pendidikan Matematika*, 5(1), 24–33. <https://doi.org/10.46918/equals.v5i1.1238>
- Harahap, R. D. (2018). Kepemimpinan Kepala Sekolah Dalam Meningkatkan Motivasi Mengajar Guru Di Smp N 2 Sigambal. *Jurnal Eduscience*, 5(1), 47–52. <https://doi.org/10.36987/jes.v5i1.892>
- Indrasvari, M., Harahap, R. D., & Harahap, D. A. (2021). Analysis of the Impact of Smartphone Use on Adolescent Social Interactions During COVID-19. *Jurnal Penelitian Pendidikan IPA*, 7(2), 167–172. <https://doi.org/10.29303/jppipa.v7i2.622>
- (Fitri et al., 2019) Adawiyah, R., Kholizah, S., & Harahap, R. D. (2023). *Literature Study : Utilization of Audio-Visual Media in Science Subject Matter for Junior High School Students*. May, 68–72.
- Amin, M. T., & Harahap, R. D. (2023). Analysis of students learning interest in biology subject matter of viruses in grade X senior high school. *BIO-INOVED : Jurnal Biologi-Inovasi Pendidikan*, 5(2), 179. <https://doi.org/10.20527/bino.v5i2.15549>
- Dalimunthe, R. R., Harahap, R. D., & Harahap, D. A. (2021). Analisis Minat Belajar Siswa Sekolah Dasar Terhadap Mata Pelajaran IPA Pada Masa Pandemi Covid-19. *Jurnal Basicedu*, 5(3), 1341–1348. <https://doi.org/10.31004/basicedu.v5i3.888>
- Fitri, N. W., Subarinah, S., & Turmuzi, M. (2019). Analisis Kesalahan Newman Dalam Menyelesaikan Soal Cerita Materi Turunan Pada Siswa Kelas XII. *MANDALIKA Mathematics and Educations Journal*, 1(2), 66. <https://doi.org/10.29303/mandalika.v1i2.1559>
- Hajerina, H., Suciati, I., & H. Mailili, W. (2022). Analisis Kesalahan Mahasiswa pada Mata Kuliah Kalkulus Diferensial Materi Turunan. *EQUALS: Jurnal Ilmiah Pendidikan Matematika*, 5(1), 24–33. <https://doi.org/10.46918/equals.v5i1.1238>
- Harahap, R. D. (2018). Kepemimpinan Kepala Sekolah Dalam Meningkatkan Motivasi Mengajar Guru Di Smp N 2 Sigambal. *Jurnal Eduscience*, 5(1), 47–52. <https://doi.org/10.36987/jes.v5i1.892>
- Indrasvari, M., Harahap, R. D., & Harahap, D. A. (2021). Analysis of the Impact of Smartphone Use on Adolescent Social Interactions During COVID-19. *Jurnal Penelitian Pendidikan IPA*, 7(2), 167–172. <https://doi.org/10.29303/jppipa.v7i2.622>