The Development of Digital Teaching Materials Based on Microlearning Integrated with Flipbook to Help Students Improve Mathematical Communication Skills on the Topic of Linear Equations in Class VIII at SMP Negeri 17 Medan.

Hotber Parasian Hutagaol[1*]; Denny Haris[2]
Universitas Negeri Medan[1*], Universitas Negeri Medan[2]
hotber.parasianh@gmail.com[1], dennyharis08@gmail.com [2]

Abstrak

Penelitian ini bertujuan untuk: (1) memperoleh bahan ajar digital berbasis Microlearning yang valid, praktis dan efektif sehingga dapat meningkatkan kemampuan komunikasi matematis siswa; (2) mendeskripsikan peningkatan kemampuan komunikasi matematis siswa melalui bahan ajar digital berbasis Microlearning. Subjek dalam penelitian ini adalah siswa kelas VIII-5 SMP Negeri 17 Medan tahun ajaran 2022/2023, sedangkan objek dalam penelitian ini adalah bahan ajar digital berbasis Microlearning pada materi Persamaan Garis Lurus. Penelitian ini adalah penelitian Research & Development (R&D) menggunakan model pengembangan 4D yaitu Define (pendefenisian), Design (perancangan), Develop (pengembangan) dan Disseminate (penyebaran). Hasil penelitian ini menunjukkan bahwa: (1a) Bahan ajar digital berbasis Microlearning berdasarkan nilai dari validator berada dalam kategori valid dengan nilai rata-rata untuk materi adalah 3,64 dan nilai rata-rata untuk media adalah 3,46; (1b) Bahan ajar digital berbasis Microlearning termasuk dalam kategori sangat praktis dengan perolehan nilai respon guru sebesar 90,63% dan respon keseluruhan siswa sebesar 80,09%; (1c) Bahan ajar digital berbasis Microlearning telah memenuhi kriteria efektif ditinjau dari ketuntasan belajar secara klasikal dengan persentase 85,71%, ketercapaian indikator/tujuan pembelajaran tiap indikator telah tercapai; dan (2) Kemampuan komunikasi matematis siswa meningkat, dilihat berdasarkan kemampuan komunikasi masing-masing indikator yang telah mengalami peningkatan dan peningkatan nilai N-Gain dari pretest dan posttest yang diperoleh adalah 0,47 berada dalam kategori sedang.

Kata Kunci: bahan ajar digital, microlearning, kemampuan komunikasi matematis, flipbook, persamaan garis lurus.

Abstract

This study aims to: (1) obtain Microlearning-based digital teaching materials that are valid, practical and effective so as to improve students' mathematical communication abilities; (2) describe the improvement of students' mathematical communication skills through Microlearning-based digital teaching materials.

The subjects in this study were class VIII-5 students of SMP Negeri 17 Medan for the academic year 2022/2023, while the objects in this study were Microlearning-based digital teaching materials on Straight Line Equations. This research is a Research & Development (R&D) research using a 4D development model namely Define, Design, Develop and Disseminate. The results of this study indicate that: (1a) Microlearning-based digital teaching materials based on the validator's are in the valid category with an average score for material is 3.64 and an average score for media is 3.46; (1b) Microlearning-based digital teaching materials are included in the very practical category with a teacher response score of 90.63% and an overall student response of 80.09%; (1c) Microlearning-based digital teaching materials have met the effective criteria in terms of classical learning completeness with a percentage of 85.71%, the achievement of indicators/learning

objectives for each indicator has been achieved; and (2) the students' mathematical communication abilities increased, judging by the mathematical communication abilities of each indicator that had increased and the N-Gain value increase from the pretest and posttest obtained was 0.47 in the medium category.

Introduction

Mathematics is one of the disciplines that plays an important role in the world of education, especially in the development of science and technology. As Rusffendi (in Noordyana, 2016: 120) stated that "mathematics is important as a guide to thought patterns and as a shaper of attitudes". However, in reality Nurkamila et al (2018: 72) stated that mathematics is still considered a difficult subject for most students. This is because most students master mathematics by memorizing without understanding, so that when given questions with different contexts, students have difficulty solving them.

The National Council of Teachers of Mathematics (in Effendi, 2020: 2) states that there are five standards of mathematical ability that students must have, namely problem-solving skills, communication skills, connection skills, reasoning skills, and representation skills.

Communication skills are very important for students to master. This is in line with Baroody's opinion (in Ariawan & Nufus, 2017: 86) stating that there are at least two important reasons why mathematical communication skills in mathematics learning need to be developed among students, namely: (1) Mathematics as language means that mathematics is not only a tool for thinking, a tool for finding patterns, solving problems or making decisions, but mathematics is also a tool that is invaluable for communicating various ideas clearly, precisely and accurately; (2) Mathematics learning as social activity means as a social activity in mathematics learning, also as a means of interaction between students, and also communication between teachers and students. However, in reality, mathematical communication skills are still low among students in Indonesia. Therefore, in the learning process, it is necessary to create a conducive learning atmosphere and help students achieve mathematics learning goals, in this case especially improving mathematical communication skills.

This is in line with the results of an interview conducted with Mrs. Maryuna as a mathematics teacher at SMP Negeri 17 Medan, she said that students still have difficulty in communicating the meaning of the math problems given, such as illustrating images, explaining symbols/units in mathematics. In addition, students are still always fixated on numbers. They are also less able to connect the material with the previous material. The next obstacle encountered is related to the learning process which still uses textbooks as the only source of learning in class VIII-1. Therefore, if we pay attention to the needs of students for supporting learning resources, then the learning resources that can improve students' understanding and quality are by using teaching materials that are in accordance with student characteristics.

In the industrial era 4.0, teaching materials have developed towards digital teaching materials. Research examining the use of digital teaching materials in learning has been conducted by Musdzalifah & Rohayati (2018: 7) which shows that digital teaching materials are suitable for use in learning". In addition, research conducted by Agung & Akhyar (2019) concluded that the development of teaching materials in the form of digital modules is in line with developments and innovations in the field of education and in accordance with the current digital era".

One of the efforts that can be used to develop digital teaching materials is based on microlearning. Noriska et al (2021: 101) explains that Microlearning can help students to learn a material with a short and focused duration, so that the amount of information needed is right to help students achieve learning goals. However, Fajaroh et al (2021: 228) states that "digital teaching materials based on microlearning still need to be packaged in the form of an e-book display". Therefore, digital teaching materials based on microlearning need to be integrated through flipbooks.

Sari & Atmojo (2021: 6081) explained that technological developments innovate the

concept of this flipbook digitally to visualize books into three-dimensional e-books, with page displays that can be opened like reading a book on a monitor screen. Based on research and development that has been carried out by previous researchers, it supports researchers to develop mathematics learning teaching materials with the latest in the form of digital teaching materials based on microlearning integrated with flipbooks on one of the mathematics materials, namely linear equations. However, in fact, in the field, there is no digital teaching material based on microlearning integrated with flipbooks in class VIII of SMP Negeri 17 Medan. Therefore, this study aims to identify the need for the development of digital teaching materials based on microlearning integrated with flipbooks to help students improve their mathematical communication skills in linear equation material in class VIII of SMP Negeri 17 Medan.

Referring to the problems above, the objectives of the research are as follows: (1) to determine whether digital teaching materials based on microlearning are valid, practical and effective in improving students' mathematical communication skills, (2) to determine students' mathematical communication skills after using digital teaching materials based on microlearning.

Method

This research was conducted at SMP Negeri 17 Medan in the even semester of the 2022/2023 academic year with research subjects consisting of validators (lecturers and teachers) and 32 students in grades VIII-5. The object of the research is digital teaching materials based on microlearning with flipbooks on the Straight Line Equation material, using the research and development (R&D) method with the 4-D model. The research instruments include material validation sheets, media, lesson plans, mathematical communication skills tests, and teacher and student response questionnaires. The research stages include define (analysis of curriculum, students, concepts, tasks, and learning objectives), design (selection of media, format, initial design, lesson plans, and preparation of test standards), development (expert validation and trial to students through pretest-posttest), and disseminate (distribution of validated teaching materials). Data analysis techniques include expert validation, practicality based on response questionnaires, effectiveness based on classical learning completeness, and improving mathematical communication skills using N-Gain analysis. Teaching materials are said to be valid if they are in the category of quite valid to valid, practical if they get a minimum response of 51%, and effective if at least 85% of students achieve a score of ≥ 75 with a minimum indicator achievement of 65%. The increase in mathematical communication skills is measured through the analysis of each indicator and the calculation of N-Gain.

Result and Discussion

Description of Define Stage
Front- End Analysis
Based on the interview results, it was found that teachers still use the lecture method during the learning process because most students only wait for information and explanations of the material from the teacher. In addition, based on the results of observations of learning materials at SMP Negeri 17 Medan, several weaknesses were found in the teaching materials used by teachers, including learning materials that are presented only in ready-made form (ready mode). In fact, students of SMP Negeri 17 Medan have recognized and used developing technology such as cellphones and laptops. However, these facilities have not been utilized optimally. Based on the results of interviews with mathematics teachers at SMP Negeri 17 Medan, it was found that the school still uses the K-13 curriculum. The Straight Line Equation material is studied in class VIII in the odd semester.

Description of the Design Stage
Criterion test construction
The test developed is a test of students' mathematical communication skills on the Straight Line Equation material.
Media selection
The preparation of digital teaching materials based on microlearning uses the assistance of Flip PDF Professional media.
Format selection
Background
Material Flow
Video

Intial design
Lesson plan (RPP)

This learning activity consists of three activities, namely introduction, core and closing. Each learning activity is described in the activities of teachers and students. The time allocation for class VIII-5 SMP Negeri 17 Medan consists of 10 JP 40 minutes and for each meeting allocated 2 JP 40 minutes. The Learning Implementation Plan (RPP) that has been made can be seen in the attachment section.

Description of Development Stage
Field Trials

The data obtained from this field trial activity are the results of students' mathematical communication ability tests, student response results, and teacher responses to the developed digital teaching materials. The trial results show that microlearning-based digital teaching materials meet the criteria of practicality, so the trial was only conducted once.

Practicality Analysis

Practicality refers to the degree to which the validator considers the intervention usable and preferable under normal conditions. Practicality criteria are obtained through students' practicality assessments and teachers' responses to microlearning-based digital teaching materials.

Effectiveness Analysis

Student learning completion classically in field trials

Table 1. Classical Learning Completion

Information	Pretest		Posttest	
	Number of Students	PKK	Number of Students	PKK
Complete	5	17,86%	24	85,71%
Not Completed	23	82,14%	4	14,29%
Amount	28	100%	28	100%
Overall Category of Students	Not Completed		Complete	

Description of improving mathematical communication skills through N-Gain values

Table 2. Nilai N- Gain

Katergori	Pretest	Posttest
Nilai Rata – Rata	55,00	76,19
Nilai N- Gain	0,47	
Kategori N- Gain	Sedang	

Disseminate Stage Description

This dissemination stage is carried out after the digital teaching materials based on microlearning are in valid, practical and effective criteria. This dissemination stage aims to introduce digital teaching materials based on microlearning so that they can be used by all students in the learning process for this school year and the following school year.

Discussion of Research Results
Validity of Digital Learning Materials Based on Integrated Microlearning Flipbook Developed

Based on the validation results of the digital teaching materials based on integrated flipbook microlearning that were developed, it was obtained that the components in the Learning Implementation Plan (RPP) with a value of 3.43 were declared valid with a good category. Furthermore, the validation results of the material with a value of 3.64 and media with a value of 3.46 in the digital teaching materials based on microlearning that were developed were also valid with a good category. The mathematical communication ability test that was developed was also in the valid criteria with a value of 3.58 and was included in the good category.

The research results and opinions above are supported by research on the development of microlearning-based teaching materials in the educational innovation diffusion course by Noriska Jessi et. al (2021) where, based on the results of expert validation analysis and revisions that have been carried out, it was obtained that the development of microlearning-based teaching materials is valid in terms of content and construct validation and can be applied.

Practicality of Digital Teaching Materials Based on Integrated Microlearning Flipbooks Developed

Based on the results of teacher and student responses that have been carried out, it was obtained that the development of microlearning teaching materials is very practical and can be used. Furthermore, the results of Rahayuningsih's research, A (2017), which showed that the development of digital mathematics teaching materials produced

practical teaching materials. Based on the description above, it can be concluded that the digital teaching materials developed have met the practicality as expected. Thus, the digital teaching materials based on microlearning that were developed are easy and can be used by teachers and students.

Effectiveness of Digital Learning Materials Based on Integrated Flipbook Microlearning Developed

The increase in mathematical communication skills is measured based on several indicators, namely classical learning completion, namely a minimum of 85% of students taking part in learning are able to achieve a minimum score of 75, achievement of learning indicators/objectives of 75% for each indicator of mathematical communication skills is obtained by a minimum of 65% of students against the formulated learning objectives, the increase in students' mathematical communication skills can be seen through the analysis of the increase in students' mathematical communication skills in each indicator and the N-Gain analysis.

Classical Learning Completion

In this study, the percentage of classical completion obtained from the pretest was 17.86% of students who completed (with the overall category of students not completing) and in the posttest it became 85.71% of students who completed (with the overall average category of students being completed).

Learning Indicator Achievement

The increase in students' mathematical communication skills based on the indicators from pretest to posttest is as follows, the writing/explaining indicator increased by 46.43%, the drawing indicator increased by 53.57%, and the mathematical expression indicator increased by 57.14%.

N-Gain Analysis

The N-gain value obtained was 0.47 in the moderate category. So the increase in students' mathematical communication skills in this study was "increased" with a moderate increase category. So it can be concluded that the mathematical communication skills of class VIII-5 students at SMP Negeri 17 Medan increased before and after the learning process.

Conclusion

Based on the results of the analysis and discussion in this study, several conclusions are presented as follows:

1. The purpose of this development research is to produce valid, practical and effective digital teaching materials based on microlearning. The validity, practicality and effectiveness of digital teaching materials based on microlearning are summarized as follows:

2. Digital teaching materials based on Microlearning integrated with flipbooks are in the valid category reviewed based on the value of the validator with an average value for the material of 3.64 and an average value for the media of 3.46.

3. Digital teaching materials based on Microlearning integrated with flipbooks are included in the very practical category with a teacher response value of 90.63% and an overall student response of 80.09%.

4. Digital teaching materials based on Microlearning integrated with flipbooks have met the effective criteria reviewed from the classical learning completeness with a percentage of 85.71% and the achievement of learning indicators/objectives for each indicator has been achieved.

Digital teaching materials based on microlearning integrated with flipbook in this study can improve the mathematical communication skills of students of SMP Negeri 17 Medan. The improvement of students' mathematical communication skills is based on the acquisition of N-gain values and the improvement of each indicator. The improvement based on the N-gain value

obtained is 0.47 in the moderate category. The increase in indicators from pretest to posttest is as follows: the writing/explaining indicator increased by 46.43%, the drawing indicator increased by 53.57%, and the mathematical expression indicator increased by 57.14%.

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