THE DEVELOPMENT OF MATHEMATIC LEARNING USING VIRTUAL REALITY ASSISTED BY MILLEALAB APPLICATION

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ABSTRACT

This research is motivated by the finding that some students have difficulty understanding the concepts of LCM and GCF, because they have difficulty explaining the basics and distinguishing between LCM and GCF, which causes a decrease in learning motivation. Some students have not been able to explain the basic concepts well, and have difficulty in distinguishing between LCM and GCF, resulting in decreased learning motivation. Therefore, innovation in mathematics teaching methods is needed to make learning more interesting and effective. One solution is learning media facilitates students understanding through Virtual Reality technology. This research aims to produce Virtual Reality learning media that is valid, practical and appropriate for the MilleaLab Application. This research applies the ADDIE Research and Development (R&D) method. The research subjects were elementary school students from 2 classes: limited scale, and large scale. At each stage, referring to open media innovation in mathematics learning, the product was validated by experts who confirmed its suitability for students. Large-scale students response data showed a positive rate of 87,78% , classified as ''Good'', indicating it can help students understand the material well. Trial data indicates that some students understand the functions and operation of Virtual Reality, but still required guidance in its use. Based on these result, it is recommended that an intensive and structured introduction and training in the use of Virtual Reality be provided. Ongoing mentoring is needed to ensure students fully understand the function and operation of Virtual Reality device, thereby maximizing their learning potential.

Keywords: Elementary School, Learning Media, MilleaLab Application, Virtual Reality.

PRELIMINARY

Mathematics plays a vital role in education, but its abstract and complex nature discourages many students from learning it (Febriyandani & Kowiyah, 2021). Students often consider mathematics to be the most complex subject, leading them to give up quickly when faced with questions or problems (Nahdania & Ain, 2024). According to (Jannah et al., 2023) Mathematics is a difficult and often boring subject. Sometimes, it can be intimidating (Harrington et al., 2022; Viesel-Nordmeyer et al., 2023). However, for some student mathematics is considered challenging (Aulia et al., 2024). This is due to the limited availability of learning media and their suboptimal implementation. Furthermore, the

success of mathematics learning is greatly influenced by the methods and media used by educators to deliver the material to students (Ulfahyana & Sape, 2024). Therefore, innovation in the development of learning media is crucial to improving students' mathematical understanding.

Efforts to obtain learning media are accompanied by developments in Science and Technology (IPTEK) (Jannah et al., 2023; Purnomo et al., 2024; Putri Lestari et al., 2024; Tafonao, 2018). Research conducted by (Mulyani Fitri & Haliza Nur, 2021) states that a teacher who utilizes technological media in explaining material will make it easier for students to understand and their interest in learning will be greatly increased, helped, and learning will become easier. Through innovative media, the learning process can be made enjoyable and prepare students to follow the latest developments (Kowiyah et al., 2018; Ni Made Sinta Suwastini et al., 2022; Resti et al., 2024). This is supported by the statement (Minat et al., 2024) who stated that the use of smartphones and computers can be used as media to assist the student learning process. The teaching materials development must also align with the curriculum and technological advancements (Widianti et al., 2024). Therefore, to support learning, the use of smartphones can be utilized.

Advances in the current digital era, based on (Iskandar Alam et al., 2024) support the use of technologies such as VR or Virtual Reality that can be utilized for the quality of multimedia-based learning and the development of open media. Virtual Reality is used in this study using the MilleaLab platform. In addition (Lubna et al., 2021; Permana, 2024) stated that there are many features including a combination of images, videos, and backsound that make it easier for students to undertand the teaching material, this will be obtained in digital media. Then there is previous research conducted by (Febriana et al., 2023) stated that teaching media with Virtual Reality can convey mathematical material, because through videos and explanations in it will give a real feeling to students according to the material, the results obtained were 97.6% in the ''very good'' category after being implemented in the learning process. Supported by research (Alkahfi et al., 2024) shows that the use of Virtual Reality learning media with MilleaLab animations provides concrete learning and positive responses from students. MilleaLab is an application that facilitates the rapid creation of Virtual Reality content through a drag & drop method without the need for programming, and allows for the ordering of 3D assets if needed. The MilleaLab cloud system manages the entire content creation process, and the application can be downloaded through the Google PlayStore. Therefore, the application of Virtual Reality assisted teaching media by Millealab

application is very worthy of continued development and integration in learning and education.

In mathematics, students tend to memorize formulas but fail to grasp basic concepts, imitate teachers' probem solving methods, and lack conceptual understanding of the learning material (Sutopo & Ratu, 2021). Researchers found evidence from research journals that some students lacked understanding of the LCM and GCF materials. Students were unable to explain basic concepts well and had difficulty distinguishing between LCM and GCF. These difficulties were caused by several factors, including a lack of clear and in depth explanations from teachers and a lack of pratical practice and conceptual understanding (Izzah et al., 2024) in a recent study, students experienced difficulty understanding materials. Currently, the curriculum emphasizes creativity, and students have varying levels of creativity. Therefore teachers are required to be innovative and interactive.

Based on previous research, researchers are interested in developing mathematics learning media that utilized Virtual Reality technology, supported by MilleaLab application, in line with current developments. This research aims to produce valid, practical dan appropriate Virtual Reality learning media supported by the MilleaLab application, specifically for LCM and GCF materials. Therefore, based on the background above, the formulation of the research problem is: how is the development of Virtual Reality media assisted by MilleaLab application for LCM and GCF materials?

METHODS

This research employed a Research and Development (R&D) method. The product developed in this study was a Virtual Reality supported by the MilleaLab application. MilleaLab is a 3D based learning and content creation platform that allows users to easily create and access immersive educational materials. This research design applied the ADDIE model, which consists of five stages: analysis, design, development, implementation and evaluation (Fayrus & Slamet, 2022)
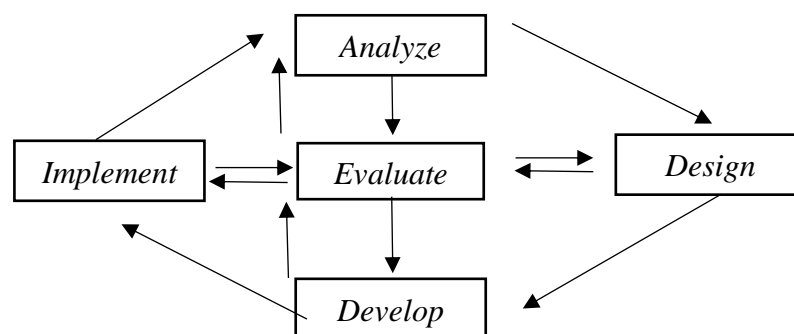

Figure 1. ADDIE Model

Figure 1 illustrates the ADDIE Model, which refers to five research stages: (1) Analysis, (2) Design, (3) Development, (4) Implementation, and (5) Evaluation. The five development steps required to produce a product ready for implementation are as follow:

Analysis

The analysis stage involves interviews. Interviews are conducted to identify the needs of educators and students regarding mathematics learning activities.

Design

The design stage is carried out in the MilleaLab application, with the initial steps being design, such as creating a storyboard, compiling materials and quizzes, and collecting assets, images, symbols, and backsound.

Development

In the development stage, the instruments needed for the research are reviewed and the developed media is ready for validation by experts. This experts will validate the product developed in the MilleaLab application. The product validity and usability are calculated using the following percentage formula (Septyaningrum & Lestari, 2023).

$$P = \frac{F}{N} \text{ x } 100\%$$

P: Validity percentage
F: Total score
N: Maximum score
So, Maximum score = Highest score x Number of Respondents

From the assessment result obtained to measure the level of product feasibility, learning media can be deemed good if it has at least valid validation result. Validity can be interpreted using the following criteria.

Table 1. Validity Criteria (Septyaningrum & Lestari, 2023)

Percentage	Criteria
81% - 100%	Very Good
61% - 80%	Good
41 – 60%	Fairly Good
21% - 40%	Not Good
0% - 21%	Very Bad

According to the assessment criteria above, if the learning media meets a percentage of >61% the product can be considered feasible and can be tested on students.

Implementation

After going through the development stage and being validated by experts, a trial was conducted on fifth grade students. This aimed to obtain suggestions and comments, which

were included in the student response questionnaire output regarding the developed product, namely Virtual Reality assisted by Millealab.

Evaluation

This stage was carried out as a process of improving the shortcomings and weaknesses of the developed product. This resulted in a proven, practical learning medium in the form in interactive Virtual Reality media assisted by MilleaLab application fot the subjects of LCM and GCF.

The subject of this study involved validation tests by lecturers and educators. the subjects in the implementation process were fifth grade students, divided into a small scale trial of 6 students and a large scale of 30 students. The data used in the study were obtained from interviews and observations. Questions and answers were discussed directly with respondents, namely educators and students.

RESULT AND DISCUSSION

Result

Based on the ADDIE model stages, which refer to the development evaluation stage, which influences the quality improvement of the developed product. The research result include data regarding the feasibility of using Virtual Reality media supported by the MilleaLab application, as well as the LCM (Correlation of the Core Values of the Concept) and GCF (Fraction of the Basic Principles of the Concept) materials, which have characteristics in the application or software and the technology used. The results are as follow:

Analysis stage

To guide the development of this learning media, the researcher reviewed national and international journals, which served as a basis for interviews with fifth grade elementary school teachers. Three main analyses were conducted: 1) Student analysis, 2) Teacher analysis, and 3) Material Analysis

1)   Student analysis

This analysis was conducted to determine student characteristics based on several aspects og gender, learning style, and technological ability. Grade V students aged 8-12 years (in concrete operational stage) tended to be quieter during classroom learning activities, while some male students appeared less quiet and more active. In terms of learning style, most students prefer to learn in groups, actively move, undertake projects, and show interest in using digital media. Therefore, thr ability to use media

and learning resources with the use of technology is quite good, because most are able to demonstrate adequate skills in using it.

2) Teacher analysis

The use technology in teaching and learning activities has not been fully implemented. The understanding and ability of class teachers towards technology greatly influences the development of the media used. Teachers often face difficulties in managing students during the learning process. This is due to the lack of variation in the use of interesting media

3) Material Analysis

In this analysis to identify learning outcomes or (CP) and learning objectives (TP) in the fifth grade material contained in the independent curriculum. In this problems obtained based on interviews and observation that students still have difficulty distinguishing when to use LCM and GCF in story problem, as well as confusion in factoring numbers.

Design stage

Next, at this stage the design for the product being developed is developed. The following is an example of media developed using the MilleaLab application. The learning media includes animations (a school building, several students and teachers, story based questions through dialogue and classroom activities) images related to the subject matter, learning videos, backsound and text. The following is preview of the initial design of the MilleaLab application.

| (a) | (b) |

Figure 2. (a) and (b) Media design Virtual Reality

Development stage

At this stage, after the initial product design was completed, the researcher continued with the creation of a research instrument outline for the validation sheet. The researchers conducted validation with experts, including two lecturers specializing in subject matter, two lecturers specializing in media, two lecturers specializing in language, and two educators,

namely fifth grade elementary school teachers. This ensured that the material, media and language in the developed product were appropriate for students. The following are the results of the expert validation test.

Material validation expert

This process focused on lecturers specializing in mathematics, focusing on aspects of material suitability, accuracy and curiosity. Based on the validation notes from the two subject matter experts, several suggestions were made: improving the material definition (add visuals or videos), splitting the images into the LCM and GCF, and including a calendar during the simulation. According to the subject matter experts, ''Once revised based on input and suggestions, the Virtual Reality assisted by MilleaLab Application is suitable for use by students as learning media.''

Media validation expert

In this second process, validation was conducted with media expert lecturers, focusing on aspects of display quality, software engineering, implementation, and compability. Based on the validation notes from the two experts, several suggestions were obtained, including adding sound for greater interactivity and adjusting the standpoint to a location within student reach. The validation results by the experts concluded, ''The Virtual Reality learning media supported by the MilleaLab application is valid and suitable for use according to the revised notes''.

Language validation expert

The validation process, directed at language expert lecturers, aimed to obtain suggestions regarding the language used in the pop-up learning media. The focus was on clarity, communicativeness, appropriateness to students developmental levels, and language consistency. Suggestions were given regarding the voiceover, which needed adjustments. Therefore, according to the language experts, after revising several recommended sections, ''This Virtual Reality learning media supported by MilleaLab application is ready for students to use.''

Teacher validation

The validation process by educators is one way to maximize this learning media, ensuring that it aligns with the learning and that the learning activities provide an interactive and immersive learning experience for fifth grade students.

The following are the validation results from several validators who completed a questionnaire related to the product being developed.

Table 2. Validation Results

Expert	Result	Category
Material	94,62%	Very Good
Media	89,09%	Very Good
Language	92,00%	Very Good
Teachers	90,91%	Very Good

Based on the validation results by experts and educators, it can be concluded that the interactive Virtual Reality by assisted MilleaLab applications meets the validity criteria. Therefore, it is suitable for testing with students.

Implementation stage

Following validation with expert validators and educators, implementation was conducted to determine student responses using the Virtual Reality by MilleaLab application that had been developed. This process involved distributing a questionnaire to students on a limited scale in class A, totaling six students. The responses from students as initial users are as follow:

Table 3. Limited Scale Response Result

Aspect	Total Score	Max Score	Percentage
Quality, Appearance, Presentation of Material, and Benerfits	346	360	96%

The table above shows that the developed media is highly suitable for use in learning. Therefore, it can be continued in a large scale learning process in Class B, a different class with 30 students. The student responses are as follows:

Table 4. Large Scale Response Result

Aspect	Total Score	Max Score	Percentage
Quality, Appearance, Presentation of Material, and Benerfits	1544	3039	85,78%

The table above shows that the average score of student responses was 85.78%, which falls into the ''Good'' category. This indicates that the learning media developed by the researchers can be used in the learning process in fifth grade elementary school.

Evaluate stage

This evaluate stage addresses the assessment of the developed media. This research used a feasibility test for learning media to determine the effectiveness of the developed product. During the trial, several students understood the function and operation of Virtual Reality. However, they still needed guidance on how to use it. Based on the results of this study, it recommended that the introduction and training process for using Virtual Reality be provided to students in a more intensive and structured manner. Ongoing mentoring is necessary to ensure students understand the function and operation of the Virtual Reality

device, thereby maximizing their learning potential.The suggestions provided in the validation stage served as an evaluation for revising the product, making it a suitable medium for testing with fifth grade elementary school students.

Discussion

Virtual Reality (VR) is a device that presents a three dimensional virtual display by combining physical and virtual environments simultaneously (Azmi et al., 2024). What makes Virtual Reality ideal as a learning medium is its ability to deliver experiences that are impossible in the classroom. Furthermore, Virtual Reality offers advantages for the quality of learning in digital era, namely by providing a sense of ''experiencing'' concepts directly, thereby deepening understanding and increasing student knowledge. The use of Virtual Reality not only offers an engaging experience but can also increase participation, learning motivation and cognitive abilities. In line with research by (Menhard, 2024), integrated Virtual Reality technology can increase engagement and motivation when conducting realistic and interactive simulations, thereby helping to understand the subject matter well.

One promising application is the MilleaLab app, a virtual reality based learning platform and device that allows students to interact directly with learning content. This app provides a variesty of assets that can be tailored to the needs of the content or learning materials. The use of apps correlated with virtual reality can ensure that learning media evolves with the times, so connecting students digitally.

In education, the use if Virtual Reality (VR) can create an engaging and interactive learning environment and provide hands-on experiences in learning activities. The attractive feature of VR technology is its ease of access, allowing it to be used anywhere and anytime. Therefore, providing opportunities for students to learn and enhancing educational development.

The advantage of using VR is that it can lead to innovation in the development of learning media, which impacts tudents enthusiasm for learning by providing a realistic experience (Monita & Ikhsan, 2020). Virtual Reality technology offers significant advantages as a learning medium, providing direct visualization and entertainment with 3D object and events that cannot be reached in the real life. The game-based approach can increase student engagement and motivation and facilitate teachers in understanding students learning style (Dian Hendrayana et al., 2022).

The use of Virtual Reality can be a new active learning tool, overcoming the limitations of space and time in conventional learning, which has not experienced

much innovation. This technology supports improving the quality of education, both in terms of quality and attitudes, because it allows monitoring of learning content, methods, and the most effective stages of Virtual Reality utilization in student learning (Anisa et al., 2024). The results of the development of learning media in the form of products that create space for questions and material, innovation in mathematic education, making the material easier to understand and helping reduce student boring in learning mathematics, which was previously considered difficult.

In practice, the MilleaLab application can be used to create mathematics learning content, specifically on the subject of LCM and GCF. Through a Virtual Reality approach, the MilleaLab application allows students to explore and practice directly in a virtual space, for example by identifying the differences between LCM and GCF, presented in a dialogue or story-based problem. This application helps foster deeper conceptual understanding, while also serving as a digital, student-centered learning evaluation and monitoring facility.

CONCLUSION

The development process for Virtual Reality learning media using the MilleaLab app, uses the ADDIE model. At each stage, referring to an innovative teaching media for mathematics learning, the product has been validated by several validators, who have confirmed its suitability for use by students, thus helping them understand the material well. This is demonstrated by data obtained through the implementation phase.

Therefore, the researcher hopes that this research will not stop there. However, in the future, it is hoped that further research will be conducted to develop this media. Making it even better and more applicable to more innovative learning experiences that not only offer engaging experiences but also increase student participation, motivation, and cognitive abilities.

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