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DEVELOPMENT OF INTERACTIVE LEARNING MEDIA ON THE MATERIAL OF RELATIONS AND FUNCTIONS IN MIDDLE SCHOOL STUDENTS

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ABSTRACT

This study intends to develop interactive learning media based on relationships and functions. The type of research used is development research that aims to produce a product. This study uses the Plomp development model. The sample of this study was eighth-grade students at Public Middle School 1 Bonepantai. The media development instruments in this study were validation sheets for media experts, validation sheets for material experts, and response questionnaire sheets for students and teachers. Data analysis uses quantitative descriptive analysis. The results of the study indicated that validation from media experts and material experts showed that the media met the criteria for being worthy of being tested. In addition, the results of the student response questionnaire on the interactive learning media developed were also positive; this can be seen from the average percentage of the student response questionnaire, which reached 90% with an excellent category, and the results of the teacher response questionnaire reached 91% with an excellent category. Therefore, interactive learning media meets practicality and learning merit criteria.

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1. INTRODUCTION

Education is basically an interaction between teachers and students. To achieve the desired learning objectives, interaction between educators and students is very important during the teaching and learning process (Ghanizadeh, 2017; Kioupi & Voulvoulis, 2019). In order for students to be successfully involved in various learning activities, teachers must provide a learning environment that encourages positive interactions with them. In addition, Education places a high value on mathematics as a tool of science (Bishop, 2020; Belbase et al., 2022). Given the importance of mathematics as a basic discipline, formal instruction in mathematics at all levels requires careful consideration. Students need mathematics to understand the idea of counting, which makes learning other topics and understanding how to use numbers in everyday life easier (Vos, 2018; Sowder, 2020).

Understanding concepts or procedures is only one aspect of learning mathematics; there are many other benefits as well (Rittle-Johnson, 2017). We can develop a logical, systematic mindset by frequently practicing solving mathematical problems (Sawhney et al., 2019). An individual's mindset for problem-solving improves with increased practice.

In the material on relations and functions, students are required to understand basic concepts such as the definition of relations and functions and to be able to apply this knowledge in the context of mathematical problems (Hatisaru & Erbas, 2017). In addition, understanding of function graphs and relational operations is also an important part of this material. The use and utilization of learning media is still lacking, especially in learning relations and functions, because it is only limited to the presentation of textbooks and blackboards (del Cerro Velázquez & Morales Méndez, 2021). As a result, students find learning in the classroom to be less engaging. The use of learning media makes it easier for students to access information, helping them achieve their learning goals (Haryana et al., 2022; Muhaimin & Juandi, 2023). Using various senses like sight and hearing can enhance learning effectiveness significantly more than relying solely on one sense.

Teachers can use learning media as an intermediary to help students understand the material, ensuring its effectiveness and efficiency (Masran et al., 2017; Siregar et al., 2021). Learning media is anything that can be used to convey messages and stimulate students' thoughts, feelings, attention, and will so that it can encourage the student learning process (Akugizibwe & Ahn, 2020; Attard & Holmes, 2022). Through interactive multimedia, students will easily understand the meaning conveyed by the teacher, and the learning process is more conducive. Until now, the majority of teachers have tried to ignore learning media when teaching a material in front of students (Hung et al., 2017). Teachers rely solely on speaking or lecture techniques with the assumption that when the topic is delivered verbally, it is implied that students understand what is being conveyed. It is precisely through conversation that students quickly forget, leaving no intrinsic data in their memory. In addition, learning with media will make it effortless for students to understand the ideas that are attached to their memory (Chiu & Mok, 2017; Borba, 2021).

Learning media can be utilized as a tool to produce effective and efficient learning (Nurfalah et al., 2021). The purpose of using learning media is to facilitate efficient learning. Learning media is critical for conveying knowledge because it makes it appear clearer and more entertaining. Learning mathematics using animation can influence students to use creative ways of thinking to build mathematical concepts (Kobandaha et al., 2022).

Therefore, in terms of presentation, teachers need to be creative not only in understanding the material to be delivered clearly but also in the delivery methods that will be used. Teachers must overcome challenges in the learning process, relying on learning media to support school activities (Lawrence & Tar, 2018). A teacher must have creativity in mixing learning in the classroom so that it is not rigid and monotonous. In addition, teachers must also have supporting competencies in the field of information

and communication technology to develop ICT-based learning media (Wang et al., 2024). Information and communication technology significantly enhances teachers' ability to perform their main tasks.

Learning media is one of the supporting factors in presenting material. As a source of independent learning for students, the learning process requires intriguing and enjoyable learning media. Students will be psychologically interested and enthusiastic to learn both inside and outside the classroom as a result of captivating learning media (Clark, 2002; Ramlah et al., 2022; Fitriani, N., & Leton, 2024). This media can also help teach abstract concepts so that they will be more easily accepted by students. Optimization and use of appropriate media are a means to make the process of delivering learning materials to students more effective (Castro-Alonso, 2021; Ziatdinov & Valles Jr, 2022). We expect students to comprehend the presented material more easily, necessitating attention to their learning efforts.

Teachers need learning media that illustrate the concept of "active students" and "creative teachers." However, some mathematics teachers tend to employ learning media that are available during teaching activities (Muhammad et al., 2022; Laswadi et al., 2022). Such media cannot encourage students to learn as they are; they are not developed by following the character of the students. There are various applications that can be used in designing learning media, such as Prezi, Google Docs, Impress-LibreOffice, SlideFlight, Keynote, Macromedia Flash, PowerPoint, and other learning media applications (Chou, 2015; Hart-Davis & Hart-Davis, 2017; Hillman et al., 2019; Mahendra, 2021). Of the many applications, each of these software has its advantages and disadvantages, but the easiest to use and find is PowerPoint because it is one of the applications that already exist on laptops/computers. Microsoft PowerPoint is an application program that can be used to create presentations or plan other activities, including using it as a learning medium at school. The use of PowerPoint can increase student interest and involvement during the teaching and learning process (Mensah & Nabie, 2021; Ou & Ou, 2024), help students focus more, and avoid distractions so that they can learn well.

A preliminary study conducted by researchers with mathematics teachers at public middle school 1 Bonepantai found that previously in schools there were very few who used learning media. In addition, many teachers continue to rely on traditional lecture methods. Teachers rarely use learning media, especially IT-based learning media, and have not been able to create interactive learning media because there has been no socialization about improving teacher skills and creativity through the development of interactive learning media. Teachers are required to be able to develop skills in creating learning media, especially since the media is not yet available at school. For this reason, teachers must have sufficient knowledge and understanding of learning media. Based on the problems mentioned above, the researcher decided to conduct research on the development of interactive learning media on the material of relations and functions in public middle school.

2. METHOD

This type of research is development research, whose goal is to create an effective product. To produce a particular product, research can be used in the form of needs analysis, and the product is first tested for its effectiveness. Research is necessary to test the product's effectiveness for the wider community. We conducted this research at Public Middle School 1 Bonepantai during the odd semester of 2023/2024.

The researcher chose to use the Plomp model for development research. Plomp's development phases include the preliminary investigation phase, which involved conducting teacher interviews, analyzing the curriculum, characterizing students, and analyzing teaching materials. The design phase is designing interactive learning media; the realization/construction phase produces interactive learning media, which is then called prototype 1, which is ready to be validated and tested; and the test, evaluation, and revision phase, namely prototype 1, is tested and evaluated, intended to find out two things, namely the quality of interactive learning media developed according to experts and the quality of interactive learning media according to the target users, namely teachers and students, and implementation is carried out in the field to see the level of practicality and effectiveness of the product.

The media development instruments in this study are validation sheets for media experts, validation sheets for material experts, and questionnaire sheets for student and teacher responses. The data analysis technique used in this study is quantitative descriptive analysis, including expert validation sheet data analysis and teacher and student response data analysis. Expert validation sheet data analysis is carried out by examining the expert validation result sheets, focusing on media and material assessment aspects, to obtain a detailed description of the validator's assessment. The average assessment that has been obtained is converted back into an interactive learning media feasibility category so that conclusions can be drawn based on the feasibility criteria in the following Table 1.

Table 1. Expert Validation Assessment

Value	Criteria
Yes	Suitable
Undecided	Less Appropriate
No	Not Appropriate

We analyzed student and teacher response data using a Likert scale. The Likert scale consists of two forms of questions, namely positive questions (scored 4, 3, 2, and 1) and negative questions (scored 1, 2, 3, and 4). There are four scale options provided with the format: Disagree, Disagree, Agree, and Strongly Agree. The percentage of the assessment scale is presented in Table 2 as follows:

Table 2. Student Response Assessment Score

Interval % Score	Criteria
75% <score≤ 100%	Excellent
50% <score≤ 75%	Good
25% <score≤ 50%	Quite Good
≤25%	Not Good

According to the assessment Table 2 above, learning media is good if it meets more than 50%. Learning is said to be included in the positive category if it has obtained a percentage score equal to 50% or more than 50% (≥50%).

3. RESULTS AND DISCUSSION

Results

The development of this interactive learning medium was carried out using the Plomp development model, which consists of five phases: the preliminary investigation phase, the design phase, the realization/construction phase, the test, evaluation, and revision phases, and implementation. The purpose of this study was to develop valid, practical, and effective interactive learning media for teaching relations and functions to grade VIII public middle school students or equivalent. This learning media has several components, namely: competency achievement indicators, several examples of relations and functions in everyday life, and several animations that make it easier for students to understand the material contained therein.

We designed this interactive learning media to allow students to interact directly with it. This media can not only be accessed via cellphones but also on other devices, such as laptops and so on, allowing students to access it anytime, anywhere. Therefore, this media can increase students' learning motivation when studying relations and functions, thus affecting their ability to understand the concept.

In this study, researchers used expert validation sheets as a tool to display validator responses and input on the media created. The created media was then submitted to the validator. After assessment, the validator recommended testing this media with revisions or improvements.

We tested the interactive learning media in class VIII of public middle school 1 Bonepantai. Learning was carried out as usual; namely, the researcher delivered the material using this learning medium, after which the researcher took data on student activities during the learning process in the form of student response questionnaires. The following interactive learning media that was developed is presented in Figure 1.

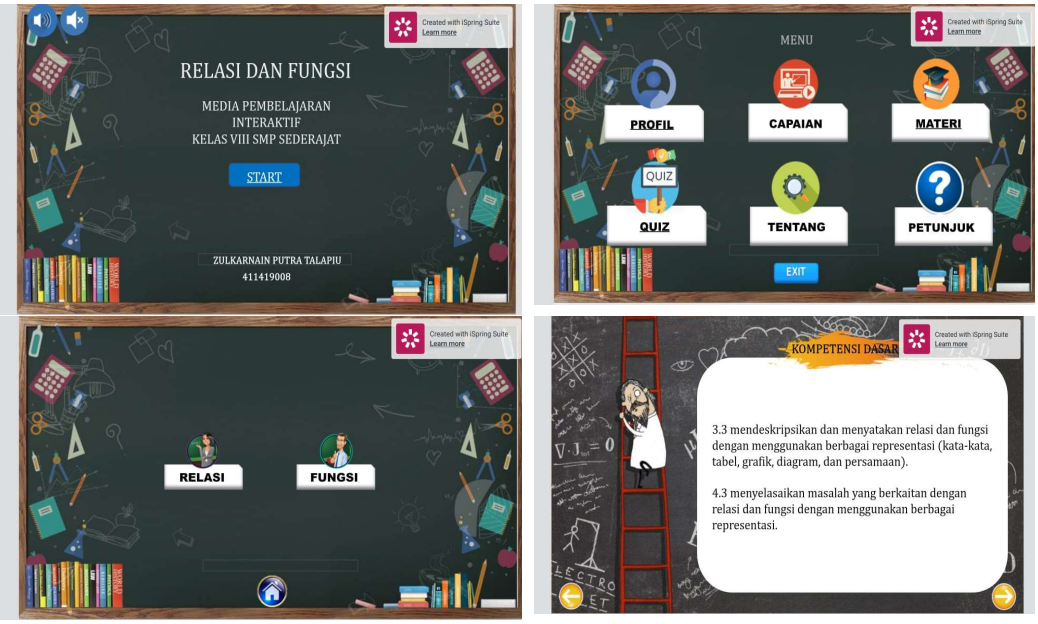

Figure 1. Interactive Learning Media

Discussion

The creation of this interactive learning media utilized the Plomp development paradigm, comprising five phases: preliminary study, design, realization/construction, testing and assessment and revision, and implementation (Plomp, 2013; Siswanto & Peni, 2023). This project aimed to provide realistic, practical, and successful interactive learning media focused on relations and functions for eighth-grade public middle school students or their equivalents. This educational medium comprises various components, including competency achievement indicators, multiple instances of relationships and functions in daily life, and several animations that facilitate student comprehension of the subject presented.

Based on the research results, there are five phases involved in developing interactive learning media in the form of this Android application. Starting with the preliminary investigation phase, there are two activities carried out: conducting a learning needs analysis and a learning context analysis. We carry out the learning needs analysis to gather information about the discrepancy between the learning conditions and the expected competencies. Meanwhile, the learning context analysis is a study of environmental factors that influence learning effectiveness, including school facilities, curriculum, and teacher readiness in teaching. The learning needs analysis revealed the challenges students faced during the learning process. Meanwhile, in the learning context analysis, it was found that schools were still using the 2013 curriculum, as well as limited projectors for learning, and teachers still needed training to visualize learning materials to make them more interactive. Based on this, researchers have developed interactive learning media that students can access on smartphones, aiming to enhance their learning interest. The idea is supported by the function of interactive learning media based on Android, according to Aziz & Amidi (2021), who stated that the main

function of interactive learning media is to increase interest in learning, eliminate boredom, and help achieve learning goals.

The next step is the design phase, which involves designing the media and instruments for use. There are 4 activities carried out at this stage, namely technology selection, material design, flowchart design, and research instrument design. Researchers chose to use the Microsoft PowerPoint application, the iSpring Suite, and the 2 APK Builder website to create interactive learning media for Android. Their choice is supported by the opinion of Baker et al. (2018), namely that PowerPoint allows the creation of learning materials easily, adding text, images, videos, and animations without requiring technical skills. As well as the opinion of Aryanti (2021), namely that with the help of iSpring Suite, the material created can be converted into an interactive e-learning module that can be accessed online or on mobile devices. And also the opinion of Senanayake et al. (2021); meanwhile, the 2 APK builder websites allow the development of web-based Android applications without writing code, accelerating the conversion process and supporting various file formats. These three tools support the theory of constructivism in learning, which emphasizes active student interaction with the material to strengthen their understanding.

The third phase is the realization/construction phase. This phase is the process of compiling interactive learning media. The composition of interactive learning media is relevant to the opinion of Rozi & Kristari (2020), namely the main display (home screen), learning material menu, exercises and simulations, evaluation and feedback, settings, and user profiles. In addition, Li et al. (2018) also added that interactive learning media can be created starting with the introduction, learning materials, interactivity, evaluation, feedback, and conclusions. Based on these two opinions, researchers combined and modified the composition to align with the school curriculum. This resulted in a structure starting with a home page followed by menu options such as profile, achievements, materials, quizzes, about section, and instructions to produce prototype 1.

The next phase is the test, evaluation, and revision phase. There are 3 main activities in this phase, namely validation, revision, and limited trials. In this phase, the researcher uses an expert validation sheet that has been previously designed in the design phase as a tool to see responses and input from validators regarding the interactive learning media that has been created.

The validation of this interactive learning media involved 6 validators (3 media expert validators and 3 material expert validators). In the validation sheet for media experts, the researcher used 21 assessment aspects. In the analysis carried out on the 21 assessment aspects, there were only 2 aspects that received a "doubtful" assessment, which indicates that most of the assessment aspects on the validation sheet for media experts have met the established criteria. However, there are several elements that still require further evaluation or improvement to achieve optimal standards.

Meanwhile, in the validation sheet for material experts, the researcher used 12 assessment aspects. Of the 12 aspects evaluated in the validation sheet for material experts, only one received a "doubtful" assessment. This outcome shows that most of

the learning materials are very much in accordance with the criteria expected by the experts. The "doubtful" assessment on 1 aspect indicates that there is little uncertainty regarding the feasibility or suitability of that 1 aspect but does not significantly affect the overall quality of the material.

Prior to entering the limited trial stage, the researcher identified several deficiencies in the media, specifically in relation to the media components under development. The researcher received several suggestions for improvements or revisions related to media development. The researcher modified the media made based on the validator's suggestions. Prototype 2, the result of this improvement or revision, is now ready for limited trial testing.

In the limited trial, the researcher chose class 8.1, which consisted of 21 students and 1 mathematics teacher at public middle school 1 Bonepantai. The researcher delivered the material as usual, using interactive learning media. Thereafter, the researcher took data on student activities during the learning process in the form of student response questionnaires and teacher response questionnaires.

From the data of the results of the analysis of the questionnaire assessment of student and teacher responses, it can be seen from the percentage of eligibility, namely, the student response score is 90% with a very good category, and the teacher response score is 91% with a very good category. Furthermore, the class results and suggestions inform the revisions made to this interactive learning media. This is relevant and supported with the opinion of Sugiyono (2017), who stated that the evaluation score with a percentage of 80% - 100% is included in the "very good" category and indicates that a learning media has functioned optimally and can be used with little or no revision. And the last phase, or the fifth phase is the implementation phase. This interactive learning media in the form of an android application will be tested on a larger group than before, namely the entire grade VIII of public middle school 1 Bonepantai.

4. CONCLUSION

The development of interactive media using the Plomp model and based on the results of media and material expert validation has been tested in a limited way in this case by looking at student responses. The validation outcomes from media and material specialists indicate that the media satisfies the testing standards. The outcomes of the student response questionnaire regarding the developed interactive learning media were favorable, evidenced by an average percentage of 90%, categorized as excellent, while the teacher response questionnaire yielded a score of 91%, also categorized as excellent. Therefore, the interactive learning media based on relations and functions, developed by the researchers, is suitable for use in the classroom learning process.

As a suggestion, the results of this study can be a reference for teachers in improving mathematics learning outcomes through interactive media. Further research is necessary to develop interactive digital media on a broader scale.

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