Needs Analysis of Augmented Reality (AR) Based Learning Media Development in Road and Bridge Construction Subjects

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Abstract: The purpose of this study is to analyze the needs of students in the development of Augmented Reality (AR) media on food chain material. This research is classified into development research developed with the ADDIE model. It's just that the research was only carried out at the analysis stage, namely material analysis and needs analysis. The subjects involved in this study were teachers and students of XI 1 DPIB. Data collection in the study was carried out using the literature study method and interviews. The research instrument used is the teacher and student media needs interview sheet. The data obtained in the study were then analyzed descriptively quantitatively and qualitatively. Quantitative analysis was carried out to analyze the results of the questionnaire using the percentage formula, while qualitative analysis was carried out by describing the results of the research and relating them to the results of previous studies. The results showed that the concept in the material analysis of bridge parts material contained 25% concrete and 75% abstract. And based on field studies, teachers and students in learning only use printed books from schools, so they are unable to show the 3 dimensions of an object. Teachers and students also need to improve the use of media, one of which can use A-media.

Keywords: Augmented reality; Media; Needs of analysis

Introduction

The Education System Law No. 20/200 states that education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, thus becoming an important foundation for the progress of a nation. National education goals have a central position as a reference in the implementation of education in Indonesia (Suyudi et al., 2023). All orientations of national education activities substantially refer to the objectives of national education (Sharma, 2022). One of the education that implements national goals to improve the quality of human resources in Indonesia is vocational education (Wany et al., 2024). Vocational High School (SMK) is a school that plans students to work directly according to the skills taught (Afif et al., 2024). The specific skills provided at SMK are tailored to the expertise program in each SMK, in achieving the objectives of the SMK, an effective and enjoyable learning activity is needed (Amirudin et al., 2024).

Learning activities that are active, creative, effective, and fun can be carried out in various ways, one of which is through the use of learning media (Triningsih et al., 2023). As stated by Fitriatien et al. (2024) and Sesrita et al. (2023) learning media can influence good material mastery, learning outcomes, and success in classroom learning. With the development of science and technology, of course, the learning media that is used also develops. The utilization of technology as a learning media can support the learning process to run well and effectively (Utami, 2022).

One of the efforts that can be made to realize these educational goals is by utilizing learning media

(Magdalena et al., 2024). Learning media is basically one of the important components in the learning process, where learning media can act as a bridge between teachers and students (Febriyanti et al., 2021; Miasari et al., 2022; Trisiana, 2020). The material presented by the teacher will be more easily understood by students if accompanied by the use of media (Handayani et al., 2021). The existence of learning media will be able to create direct interaction between teachers and students, students and learning resources, so that through this interaction process students can learn independently with the abilities of each student (Feri et al., 2021; Isnaeni et al., 2020; Tafonao, 2018). The advantages of learning media are that they are able to clarify the presentation of teaching materials, overcome the limitations of space, time, and human senses, increase students' enthusiasm for learning, increase student learning activeness, students can learn independently according to their abilities and interests, and provide the same perception for students (Antari et al., 2019; Qistina et al., 2019).

However, the reality in the field shows that not all teachers are able to utilize learning media properly. This is due to the lack of supporting facilities for media development and the lack of teacher ability to develop the media itself. This statement is in line with the results of preliminary observations carried out at SMK Negeri 2 Padangsidimpuan. The observation results show that the quality of learning developed is still lacking, because teachers have not been able to develop a new innovation creatively to support the student learning process. The new innovation is the development of digital-based learning media. This can be proven when carrying out the learning process, teachers only use material books obtained from school and use limited media. Teachers are also still comfortable using conventional methods such as lectures in the process of explaining learning materials, especially road and bridge construction subject matter. If this method will continue continuously, it will have a negative impact on the learning process. Given, that each subject matter must have its own characteristics. The lack of teacher innovation in developing this media will affect the smooth process of learning activities in the classroom.

Teacher innovation in the learning process in today's digital era is needed to maximize the learning process. One of them is by utilizing various existing media. Learning media used in the learning process will arouse student learning motivation and be able to increase student understanding of the lesson (Pambudi et al., 2018). Learning media that are currently not widely used by teachers in rural schools are digital media based on Augmented Reality (AR). Augmented Reality (AR)-based media is a learning media whose technology combines virtual objects into the real environment, so as to make users see the real world with virtual objects that have been generated from this technology (Firdanu et al., 2020; Panduwinata et al., 2021). AR-based media is one of the effective interactive media used to introduce natural science materials in order to stimulate children's imagination, so that it will motivate them to learn (Amdani et al., 2022). In planning the selection of learning media, of course, beforehand you have to analyze the advantages and disadvantages in order to make maximum use and reduce the impact caused by existing deficiencies and provide other alternatives to minimize the shortcomings of the media. The advantages of AR media are interactive, effective, simple object modeling, cost-effective, and easy to use (Hakim, 2018). Apart from these advantages, the disadvantages of this AR media are that it is too sensitive to changes in the user's point of view, there are still few media developers, and the memory required for operating this media is quite large (Waliyansyah et al., 2021).

Many types of media that can be used in learning such as adobe flash, Lectora insipire, Augmented reality, and many more. Adobe flash software has the advantage of making it possible to create animations using code so as to reduce file size, but has disadvantages in making designs that require users to master coding which is quite complicated and time consuming and computers that want to play flash animations must have a flash player, which must be installed online first (Habibi et al., 2020). Lectora inspire software has the advantage of complete features and templets, but has the disadvantage of its complicated use requiring high leptop specifications (Zuhriya, 2019). Then Augmented reality based on android, with the advantages of its lightweight software and the features available in it are easy to understand (Cao et al., 2023). Media results that can be saved in various extensions and can be opened on laptops, computers, and student smartphones in a state not connected to the network so that they can repeat the subject matter anywhere and anytime (Yasin et al., 2023).

The phenomenon of the high number of smartphone users is certainly an opportunity in the world of education. The existence of smartphones also brings great opportunities to develop learning media. One of the benefits that can be taken from the existence of this technology is to utilize it as an effective, creative and educational learning media. So that the collaboration of technological developments in the form of Augmented Reality with the rapid use of smartphones among vocational students gave birth to a learning media in the form of augmented reality applications that can be used in smartphones. With the Augmented Reality technology as a learning media can have a positive impact on students, especially in learning.

Several studies that have been conducted previously reveal that the use of augmented reality

media in the learning process has a significant impact in improving vocabulary mastery and learning outcomes (Saputri, 2017). Other research results also reveal that Augmented Reality (AR) media has significantly been able to improve student learning outcomes, especially in the cognitive domain (Qorimah et al., 2022). In addition to being able to improve students' cognitive abilities, AR media is also able to improve the ability of deaf children to recognize the culture of Yogyakarta (Imawati et al., 2018). So based on some previous research results, it can be said that AR media has various positive benefits in improving students' cognitive abilities. It's just that in previous studies there have been no studies that examine related to the analysis of the needs of Augmented Reality (AR) based learning media development. So this research is focused on these studies with the aim of knowing the needs of students in the development of Augmented Reality (AR) media on the material of bridge parts.

Method

This research is a Research and Development (RnD) study, which was developed with the ADDIE development model. The ADDIE development model has five stages of development consisting of analysis, design, development, implementation, evaluation stages. However, in this study, only the analysis stage was used, which is the stage of gathering information. The analysis in this study was carried out on material analysis and analysis of teacher and student needs. The subjects involved in this study were teachers and students of class XI DPIB at SMK Negeri 2 Padangsidimpuan. Data collection in the research was carried out using the literature study method and interviews. Literature studies are conducted to collect relevant research and sources and review the concept of food chain material used as a basis for developing AR-based media. While the field study method by interviewing the media needs of teachers and students. The research instrument used is the teacher and student media needs interview sheet. The data obtained in the research were then analyzed descriptively quantitatively and qualitatively. Quantitative analysis was carried out to analyze the results of interviews using the percentage formula, while qualitative analysis was carried out by describing the results of the research and linking them with the results of previous studies.

Result and Discussion

Result

Augmented Reality (AR) based learning media development research on bridge parts is carried out up to the material analysis stage and the needs of teachers

and students. So there are two main findings in this study. The first finding relates to material analysis. Material analysis is carried out through a literature study process carried out on the book Road and bridge construction of SMK Negeri 2 Padangsidimpuan bridge parts material. The basic competency contained in the content of learning objectives is that students are able to recognize, classify bridge parts. Furthermore, concept analysis is carried out which is divided into several concept classifications, namely concrete concepts, concepts without observable or abstract examples, abstract concepts with concrete examples, concepts based on principles, concepts involving symbols, concepts stating processes, concepts stating attribute names, concepts stating attribute sizes. This concept classification aims to find out the concepts in the material so that it is suitable for developing Augmented Reality (AR) media. Concept analysis on the material of the parts of the bridge is presented in table 1 and Figure 1.

Table 1. Concept Analysis of Bridge Parts Material

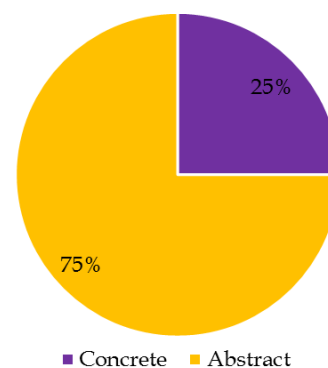| Concept definition	Concept type
Basic introduction to bridge construction	concrete
Classification of Bridge Types	concrete
Nature and classification of bridges	abstract
Grouping of Bridge Parts	abstract
Superstructures	abstract
Substructures	abstract
Foundation Structure	abstract
Function of each structure	abstract

Figure 1. Diagram of concept analysis results of bridge parts material

Based on the results of the analysis of the table above, it is obtained that the concept of bridge parts material has two types of concepts, namely concrete concepts 25%; and abstract concepts 75% of the two concepts, abstract concepts dominate food chain material. Abstract concepts can affect student understanding, this is because abstract concepts will affect student understanding of the material presented, for this reason a medium is needed to be able to convey

information from these abstract concepts. The second finding in the research relates to the analysis of teacher and student needs.

In analyzing the needs of teachers and students, an initial analysis through direct interviews is needed to identify the need for the development of Augmented Reality (AR) media in learning. The results of teacher needs for AR-based media are presented in Table 2.

Table 2. Teacher Needs Analysis of AR Media

Concept Definition	Concept type
What types of media are used in teaching?	Only use printed books provided by the school
Has digital media been applied in learning?	not yet available
Do you think the use of learning media in the classroom is important?	It is actually important, even good for students to easily absorb what is delivered. However, it is constrained by the facilities available.
Students at SMK Negeri 2, especially class XI DPIB, have all used android sir? Or an estimate of how many percent sir?	Most of them already use an android because school needs also sometimes require a cellphone. Class XI DPIB students almost all use Android, you see, all have WA numbers.
Is it necessary to use AR media in bridge parts material?	There needs to be an improvement in the use of media, one of which can use this AR media so that students are interested and learning is more fun because it is game-based and IT that can be used on students' cellphones.
Is AR Media an interesting media in the learning process?	Because it has never been applied, maybe this media will be a solution in learning activities so that learning becomes more interesting for students.

Based on the analysis of teachers' needs for AR media in bridge parts material, the type of learning media used by teachers in the classroom is printed book media provided by the school by the teacher. Digital media has never been used at all for learning facilities in the classroom. XI DPIB class students already use smartphones, so they can combine with AR technology. The teacher also revealed that there is a need for improvement in the use of media, one of which can use this AR media so that students are interested and learning is more fun because it is based on games and IT that can be used on students' cellphones. Because it has never been applied, the teacher also revealed that this media might be a solution in learning activities to make it more interesting for students. After knowing the teacher's needs for AR media development, the research then continued to analyze students' needs for AR media. The results of the needs analysis are presented in Table 3.

Table 3. Analysis of Student Needs for AR Media

Interview questions	answers
Is learning road and bridge construction fun?	Actually in class we lack books, 1 book for two, so it's still lacking.
In the media class, do you use learning media, for example, Interactive LKPD, videos, PPT or others?	Nothing, we still use the textbooks and then the father explains what is in the book, sometimes we are told to have group discussions.
Are you all using Android?	Everyone has a cell phone. We have a class group too.
What material is difficult to understand?	Road and bridge parts
What is causing you difficulty?	It's difficult, sometimes it's not clear which parts are which. I want the bridge to be shown directly so that it is easy to understand. Plus the class only has 2 hours of lessons so it's limited, repeating lessons sometimes can't be done because the book is limited.
Here's an example of Augmented reality learning media how, do you think there is no need for media like this?	Necessary, very interesting. Plus it can be accessed on a Smartphone, making it easier for us to recognize abstract parts of the bridge.
If this is implemented, would you be interested in learning like this?	Possibly interesting kk, because I've never tried it before. And we can see the object without having to present the real object in class.

Based on the results of the analysis of student needs for Augmented Reality media in the material of bridge parts, in the learning process the teacher only uses printed books given by the school to convey the material. They have difficulty recognizing and identifying the parts of the bridge. This is due to the images in the printed book are only abstract. Students revealed that there is a need for a medium that is able to show an abstract object in the real world, to facilitate the recognition of the object. In addition, all students already use smartphones. Collaboration between technology and smartphones will produce an interesting learning media for students, namely augmented reality.

Discussion

The first finding of the study shows that in the material of bridge parts there are 25% concrete and 75% abstract concepts. These results show that abstract concepts are more than concrete concepts. Concepts in the learning process that do not include real examples are called abstract concepts (Apriyantini et al., 2024; Khairunisa et al., 2024; Micallef et al., 2024). The learning process with abstract concepts is usually used to train students' critical, active, and creative thinking processes in an effort to solve unreal problems (Fathonah et al., 2024; Mardhiyah et al., 2021; Pasca et al., 2024; Putri et al., 2024). Therefore, the role of a strong mind with mastery of principles, concepts, and generalizations is needed in learning abstract things. Abstract concepts can affect student understanding, this is because abstract concepts will affect student understanding of the material presented, for this reason a medium is needed to be able to convey information from these abstract concepts (Hidayat et al., 2024; Ndoh et al., 2024; Ratnawati et al., 2020).

The lack of concrete examples makes abstract concepts difficult for students to understand (Dobler et al., 2024; Yulistia et al., 2024). So the need for a learning media that is able to facilitate the cultivation of learning concepts that concretize various abstract concepts in learning materials (Parmadi et al., 2024; Sari et al., 2022). Learning media is one of the important means to convey information from teachers to students so that it can be conveyed properly. Learning media consists of non-digital and digital media. Digital media is media that requires gadgets, computers, or other digital equipment. Non-digital media is media that uses objects, humans, and the surrounding environment (Qorimah et al., 2022). The media currently needed by students in developing thinking concepts is digital media or ICT, this media is needed to create a modern learning atmosphere (Ambe et al., 2024; Prihantini et al., 2024). This is because ICT can be used to create contemporary learning conditions (Shohibatul, 2024).

The second finding in the study shows that teachers and students need Augmented Reality (AR) based learning media. This is because teachers and students need media that is able to clarify learning material and has an attractive appearance so that it can attract student interest in learning. Augmented Reality (AR) media is a technology-based learning media that allows a person to interact with objects either virtual or real (Firdanu et al., 2020). Augmented Reality (AR) media in the teaching and learning process is developing very quickly, this is because AR media can become a new computing platform in the field of education (Bahri et al., 2020; Hakim, 2018). Augmented Reality provides many benefits for education, namely being able to increase student motivation to learn, concretize concepts that are abstract, and as a means to develop student creativity (Amdani et al., 2022; Firdanu et al., 2020; Panduwinata et al., 2021). In addition, through AR media, students will achieve more targets from the learning objectives set by the teacher and teachers are also able to actively participate in implementing AR technology even though they have no previous experience (Waliyansyah et al., 2021). The phenomenon of high smartphone usage among students has a positive effect on the learning process.

The results of this study have differences with the results of previous studies, where previous studies emphasize the benefits of Augmented Reality-based learning media on student learning outcomes, while the results of this study focus on analyzing the needs of teachers and students of Augmented Reality media. The results of previous studies reveal that the use of augmented reality media in the learning process has a significant impact in improving vocabulary mastery and learning outcomes (Saputri, 2017). Other research results also reveal that Augmented Reality (AR) media has significantly been able to improve student learning outcomes, especially in the cognitive domain (Qorimah et al., 2022). So based on the results of research supported by previous research, it can be said that AR-based learning media is the learning media needed by students to concretize various abstract concepts, so that students are able to improve their cognitive abilities and learning outcomes.

Conclusion

Based on the results of the needs analysis as the basis of the development of Augmented Reality media on the parts of the bridge it can be concluded that the material of the parts of the bridge has two concepts of the seven types of concepts developed. The concept contained in the material of the parts of the bridge is 25% concrete and 75% abstract. So, the development of learning media is needed to facilitate students in learning abstract concepts in the material of the parts of the bridge The results of the analysis of the needs of teachers and students show that teachers and students want to use Augmented Reality (AR) media to be used as a solution for students in the learning process, especially in the material of the parts of the bridge As a follow-up, the suggestion put forward is to develop Augmented Reality (AR) media in the classroom learning process.

Author Contributions

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Conflicts of Interest

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