



Could Android Learning Media Based on Visual Representation Improve Students' Representation Abilities? : Reconsidered from a Student Teacher Perspective

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Abstract: This study aims to describe visual representation-based android learning media to improve students' representation abilities based on the views of teachers and students. This research involved 39 science teachers and 181 junior high school students in Lampung province. The method used in this study is a mixed method with an explanatory sequential design in order to obtain quantitative and qualitative data through questionnaires and interviews. The results of the study show that teachers and students have a positive perception of the development of visual representation-based android learning media. This study found the fact that there were several factors that caused teachers not to pay attention to students' representation abilities. The teacher believes that the use of learning media can train students' representation abilities and have an impact on increasing student representation abilities.

Keywords: Android Learning Media; Representation Ability; Visual Representation

Introduction

The 21st century that students are currently experiencing has brought changes in all areas of life, including in the field of education. Students' needs for various skills for future provision that are increasingly complex need to be provided by education providers, one of the ways is by integrating 21st century skills in schools (Rahman, 2019). One of the 21st century skills that is important and needed by students is problem solving skills (Kennedy et al., 2016). The supporting abilities needed by students to be able to master problem solving skills is representational abilities (Meltzer, 2005; Scheid et al., 2018; Theasy et al., 2018).

In the stages of activities required to demonstrate problem-solving skills, starting from identifying problems, understanding the nature of the problem, to assessing the progress of the solutions found, requires representational abilities (Rahman, 2019). This is

because the ability to represent can provide a better understanding of the problem because all information in the form of concepts or phenomena in the problem can be linked clearly (Scheid et al., 2018; Theasy et al., 2018). Students' understanding of various information is very important for future career preparation because it is also related to students' communication skills. Students can express their ideas well if they understand the information correctly (Fatmawati et al., 2022; Patriot et al., 2018).

Science learning is one of the lessons that is considered difficult by both teachers and students. One factor that supports this statement is that the concepts in science learning are abstract and complex (Gnidovec et al., 2020; Liono et al., 2021). Students' representational abilities are important to be trained in learning science concepts because they can help students break down complex concepts to become clearer and more convincing (Evagorou et al., 2015). Representational

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abilities help students to develop their knowledge and skills in solving problems (Dimas et al., 2018).

In science learning, students do not only rely on verbal explanations or only in the form of text, but can utilize various forms of representation such as pictures, symbols and graphics (Nitz et al., 2014). Besides being used to explain a concept, representational abilities can also be used to support statements, solve problems, or make predictions (Kozma & Russell, 2005). However, many studies reveal that students' representation abilities, whether verbal, pictorial, graphs, diagrams or symbols, are still in the less capable category (Dimas et al., 2018; Fatmawati et al., 2022; Prahani et al., 2016). Therefore, students' representational abilities need to be a concern in learning science at school.

One form of seriousness in organizing science learning that trains students' representational abilities is to provide support to students to be able to study independently anywhere and anytime by utilizing technological developments (Grant, 2019; Hsieh & Tsai, 2017). Technology that continues to develop both in terms of quality and quantity until now allows students to visualize and increase their understanding through various forms of representation (Fatmawati et al., 2022). Currently, the use of technology in learning is very suited to the characteristics of generation Z students. Generation Z is a generation that is very literate in technology or known as the net generation (Mansur & Ridwan, 2022; Sa'pang & Purbojo, 2020). This generation is more familiar and even dependent on smartphones (Mansur & Ridwan, 2022).

Smartphones are one of the technologies that can support activities in science learning (Bano et al., 2018). In learning, generation Z like conveying information in visual form, are involved in various activities, expect appreciation for their efforts, and only have short periods of focus. This can be used by teachers to make technology as a learning media that can be used by students to collaboratively solve problems (Sa'pang & Purbojo, 2020).

Research on the use of android smartphones for science learning has been carried out, such as the use of learning android smartphones by creating virtual laboratories (Arista & Kuswanto, 2018), augmented reality to teach the concept of the human circulatory system (Gnidovec et al., 2020) and macromolecular concepts (Lee & Tucker-Kellogg, 2020), as well as android learning media to teach acid and base concepts (Kaukaba & Lutfi, 2022).

A good android learning media is marked by the use of visual representation elements (Kumar & Goundar, 2019). The use of appropriate visual representations such as pictures, graphs, diagrams, and others in science learning can help make it easier for

students to understand concepts (Evagorou et al., 2015; Inaltekin & Goksu, 2019; Rau, 2016; Tytler et al., 2020; Yoon et al., 2021). However, many previous studies show that until now learning about the circulatory system is still taught using lecture and discussion methods and pays little attention to the use of learning media that is in accordance with the characteristics of the circulatory system concept which requires concept visualization (Fajar, 2016; Novianto et al., 2018). Apart from that, to support generation Z's understanding in learning about the circulatory system, there must be relevance between the material and their lives (Sa'pang & Purbojo, 2020). Therefore, this research needs to be carried out so that we can find out what the perceptions of teachers and students are if Android learning media is developed based on visual representations on circulatory system material to improve students' representation abilities. The results of this research can be used as guidelines in developing Android learning media so that Android learning media development results can be obtained that can improve students' representational abilities. These findings can also provide an overview of the readiness of teachers and students in utilizing Android learning media.

Method

This study uses a mixed methods design with an explanatory sequential design strategy. The research was carried out through two phases of data collection, namely collecting quantitative data and then collecting qualitative data to explain the quantitative results (Creswell, 2012). The respondents in this research consisted of 39 science teachers and 181 students. Quantitative data was obtained by filling out questionnaires which were distributed online. After analyzing the results of the questionnaire, then semi-structured interviews were conducted with 6 teachers. The research design scheme can be seen in Figure 1.

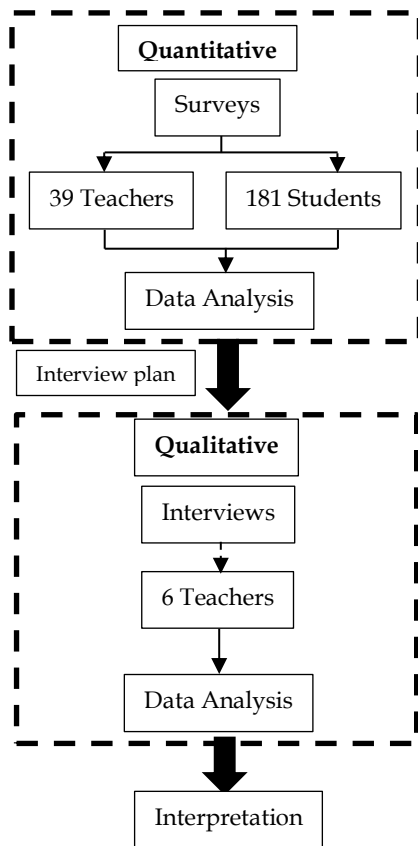


Figure 1. Research Design Scheme

The questionnaire consists of four aspects, namely mobile learning, android learning media based on visual representations, circulatory system learning, and representation abilities. The questionnaire uses the Guttman scale with "Yes" and "No" answer choices. (Sudjana, 2005). The results of the questionnaire were analyzed from the percentage of respondents' answers to see the perceptions of teachers and students towards android learning media based on visual representations. The next stage, semi-structured interviews. Following are some examples of questions asked in semi-structured interviews (1) What reasons did you consider when choosing instructional media? and (2) Can the learning media you choose improve students' representational abilities?

Result and Discussion

Data regarding teachers' and students' perceptions of the development of Android learning media based on visual representation to improve representation abilities in this research was obtained through filling out a questionnaire. The results of the questionnaire filled out by 39 science teachers in Lampung Province are shown in Table 1.

Table 1. Percentage of Teacher Perception Questionnaire Results (n=39)

Questions	Percentage (%)	
	Yes	No
The importance of using mobile phones in learning	94.90	5.10
Utilization of mobile phones in learning	76.90	23.10
Visual representations can clarify concepts	79.50	20.50
Difficulties in learning the circulatory system	97.40	2.60
Training of student representation abilities in learning	57.70	42.30
The need for android learning media using various visual representations	100.00	0.00
The need for learning media applications to improve representational abilities	92.30	7.70

The survey results on teachers showed that the use of technology such as mobile phones is important in science learning and around 76.9% of teachers have used it in the learning process. However, teachers still find it difficult to teach circulatory system material to students. This has an impact on how easy or difficult the concept is to be accepted by students, so this needs to be a concern. Students' understanding of a concept in the teacher's view is influenced by the use of various forms of visual representation such as pictures, graphs, tables, and others. One of the signs that students have understood the concept well is that students are able to explain the concept in various representations. However, currently teachers have not trained students' representation abilities so that it has an impact on students' conceptual understanding. The existence of the use of learning media applications that can make it easier for students to learn anywhere and anytime accompanied by various explanations of concepts using visual representations is believed by the teacher to help students learn abstract science concepts.

The results of the survey on 181 students showed that they felt happy when learning science using their mobile phones and happy when explaining concepts using visual representations such as pictures. This has an impact on the ease of students in understanding the concept clearly. Lack of use of visual representations in learning the circulatory system can cause students to experience difficulties in understanding the concept. The ease of access in learning the concept of the circulatory system accompanied by various forms of appropriate visual representations is believed to help students.

Table 2. Percentage of Students' Perception Questionnaire Results (n=181)

Questions	Percentage (%)	
	Yes	No
Use of mobile phones in learning	90.10	9.90
The feeling of pleasure when learning by using a mobile phone	92.30	7.70
Feelings of pleasure when learning by using visual representations (pictures, graphs, icons, etc.)	90.60	9.40
It's easy to understand concepts while learning using visual representations	85.10	14.90
Difficulties in learning the concept of the circulatory system	86.20	13.80
The need for learning media that can be accessed anytime, anywhere	91.20	8.80

Mobile learning considers the process of learning mediated by handheld devices such as smart phones with various aspects of convenience obtained, ubiquity, flexibility, and increasingly diverse capabilities of these devices have generated great interest from educators in using them to improve pedagogy (Kearney et al., 2015). Technology has provided new possibilities and

opportunities for new learning perspectives, including the relationship between teachers, students, and learning materials (Sulisworo & Toifur, 2016). Excerpts from interviews that have been conducted with science teachers can be seen in Table 3.

At this time the use of mobile learning is starting to be done a lot, some teachers are familiar with mobile learning and apply it through the use of smart phones in learning to access information via the internet. Teachers already know that one of the advantages of mobile learning is that it provides opportunities for students to be able to access learning anywhere and anytime. The teacher stated that "*Mobile learning is learning that uses technology assistance and can be accessed and studied anywhere. Besides that, it makes learning more interactive and fun, and allows students to manage their own study time more flexibly*". The main characteristics of mobile learning are portability, instant connectivity that they can be taken to different locations, they can be used to access a variety of information anytime and anywhere (Kutluk & Gülmez, 2014). Students can utilize mobile devices as instruments to improve the quality of their education, enhance their knowledge across multiple contexts and improving the learning outcomes of students (Camilleri & Camilleri, 2022).

Table 3. Results of the Teacher Interview

Questions	Teacher's Responses
What do you know about mobile learning?	As far as I know, mobile learning is learning using a mobile phone Learning methods use technological assistance and can be accessed and studied wherever we are
What do you think about learning using mobile phones?	Learning integrated with the internet using electronic devices Software that can be used as learning media that can be accessed anytime and anywhere Very helpful, teachers can make LKPD/modules that are digital and more attractive, for example using features that students can access easily and attract more students' attention in studying certain material, especially science which requires lots of illustrations & pictures Very helpful. I once used a smartphone to access quizzes via quizzes Learning using a smartphone is very helpful because it makes it easier for students and teachers, I have used it before, especially during the pandemic I've used it before and it really helps because it makes the class come alive. Students are looking for additional references and they can directly fill in the answers on the student worksheet on the smartphone Helping teachers manage and evaluate learning, such as using online educational games to reflect on student understanding
What do you know about representational abilities? How important is the ability of representation possessed by students?	I have used my cell phone as a medium to access information containing learning materials. I use the E-LKPD (live worksheet) to facilitate students in the learning process As far as I know, representation ability is the ability of students to read/explain something through pictures, not just writing The ability to see, observe, understand something through various forms, such as images, video, audio, animation, etc., is very important. Very important I've just heard about the term representational ability and it's probably very important for students I don't know the details about what indicators are contained in the representation, I have never measured students' representation abilities

Questions	Teacher's Responses
How do you improve student representation ability? Has the representational ability of students been considered so far?	Rewriting material through pictures, not just writing, such as mind mapping Unnoticed By providing teaching using pictures or videos, it gets less attention I usually stimulate students to understand and explain again through presentations By doing practicum, I as a teacher provide teaching materials such as videos, pictures, or infographics. But I still don't pay enough attention to it because I don't understand it
What media do you use to teach the concept of the circulatory system? What things are considered when choosing the learning media?	The media used is usually only in the form of video & PPT. These two things were chosen because of the limitations of using other media Videos appropriate to the learning concept Pictures or videos Considering the school and the environment, maybe it's better to use videos or simulations
Can the learning media that you use improve students' representation abilities?	Textbooks, pictures, diagrams, 3D models, props, animated videos considering aspects of attractiveness and ease of access It seems lacking but can improve even a little. Didn't pay much attention to it Have never developed an instrument for assessing student representation abilities, so don't know Not yet, because there are still many learning media that have been used so far only made to complete administration or made inadequately
Can the use of visual representations help students understand science concepts more clearly?	It's very helpful because children tend to understand things more easily when they see visually either pictures of symbols or graphics compared to just text Yes, it can make students understand concepts more realistically Help students I write material on the blackboard not only using text but also symbols, graphics, pictures even though the pictures are not as good as in books so that children understand better.
	Very helpful but pictures, symbols, and graphs must be relevant to the concepts being taught. Yes, that's right. The aim is to reinforce the concept

At this time the use of mobile learning is starting to be done a lot, some teachers are familiar with mobile learning and apply it through the use of smart phones in learning to access information via the internet. Teachers already know that one of the advantages of mobile learning is that it provides opportunities for students to be able to access learning anywhere and anytime. The teacher stated that *"Mobile learning is learning that uses technology assistance and can be accessed and studied anywhere. Besides that, it makes learning more interactive and fun, and allows students to manage their own study time more flexibly"*. The main characteristics of mobile learning are portability, instant connectivity that they can be taken to different locations, they can be used to access a variety of information anytime and anywhere (Kutluk & Gülmez, 2014). Students can utilize mobile devices as instruments to improve the quality of their education, enhance their knowledge across multiple contexts and improving the learning outcomes of students (Camilleri & Camilleri, 2022).

Currently, electronic devices such as cellphones are widely used in learning with various ways of using them, some teachers use cellphones to facilitate students searching for various information via the internet, discussing, and as a form of reflection on understanding of the material, such as through quizzes and live

worksheets. The teacher stated that *"Learning using cellphones will make students feel that they are not studying so that the material being studied will be easy to understand, besides that, features that can be accessed via cellphones which are already sophisticated will attract students' attention more"*. They may perceive that some technologies are useful for them, particularly if they help them increase their productivity and there are positive and significant relationships between the students' perceived ease of use and between their attitudes and intentions to continue using them. It presumes that facilitating conditions are significantly correlated with the students' willingness to use them, as well as with their active engagement with them (Camilleri & Camilleri, 2022). There many research, confirming that joy can bring positive experiences and outcomes also bring enthusiasm, feeling of challenge, cooperation, and excitement as well as success (Grace et al., 2020; Hernik & Jaworska, 2018).

In addition, there are several things that teachers need to pay attention to when using smartphones for learning. The teacher stated that *"We must also care and understand that the use of smartphones in learning also has risks that need to be considered, for example, the risk of dependence, challenges in managing access and use of smartphones"*. It is important for students to get

instructional support so that their learning process is monitored. Teachers can provide support via mobile learning applications (Baars et al., 2022). The use of m-learning in the teaching and learning process will become a more natural and effective way of learning for this generation and enable vulnerable people to be able to access knowledge (Criollo-C et al., 2021).

The achievement of learning objectives and student success in learning is one of the indicators that the mobile learning application used during learning is an effective way. Representational abilities can be trained during the learning process by introducing students to various elements of visual representation. There are several teachers who do not know the ability of representation so that the ability of representation is still not considered. The teacher said that *"I just heard it, maybe it's important for students"*. In addition, teachers who already know about representational abilities also say that they have not paid attention to it. *"Of course, the ability to represent is very important for students to have because with this ability students will more easily understand concepts, remember information obtained in learning, but I don't pay much attention to it"* said one teacher. Representational ability is needed by students who must be trained so that students can build a deeper understanding of the concept (Utami et al., 2019). Visual information that enters the human working memory will be selected and when the information is meaningful it will be stored in long-term memory (Setyarini et al., 2017).

The use of various forms of visual representation in a mobile learning application can train students to have representational abilities. Teachers believe that the use of visual representations such as pictures in explaining concepts to students can help students understand concepts clearly and help students build their representation ability. The teacher stated that *"By providing direct experience, providing teaching materials accompanied by good pictures, and holding discussions with groups can train students to represent concepts"*. However, the students' representation abilities have not been measured by the teacher so it is not known how their representation abilities develop. The teacher said that *"I have never measured students' representational abilities"*. The use of visual representation elements consisting of pictures, graphs, tables, diagrams, and others can help students understand concepts more clearly because with these visual representation elements they can summarize a lot of information well (Evagorou et al., 2015). The use of learning media that students can access for learning and is equipped with various elements of appropriate visual representations and is given space for students to practice making representations and teacher to monitor the representations that have been made by students in the learning process are believed by teachers

and students could improve students' representation abilities.

Conclusion

Teachers and students have a positive perspective on the use of android learning media based on visual representations in science learning to improve students' representational abilities. Based on the results of teacher interviews, The teacher believes that the application of visual representation-based android learning media can make students not only master science concepts, but also have the ability to represent as one of the abilities needed to master 21st century skills, namely problem-solving skills. In addition, teachers also need these learning media to be used in science learning so that they can practice students' representational abilities.

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Author Contribution

Delis Amala contributed to making the instrument, collecting data and writing the article. Marina Setyarini contributed as a supervisor in writing article and as a corresponding author. Meanwhile, Tri Jalmo contributed as a supervisor in making instruments, analyzing research data, and writing article.

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Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this paper.

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