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Investigation of Student Difficulties in Basic Physics Lectures and Readiness to Implement Physics Problem Solving Assisted by Interactive Multimedia Android in Indonesia

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Abstract

This research is a qualitative case study research. This research was conducted in the physics education study program, Muhammadiyah University of Makassar, Indonesia. The research subjects consisted of two lecturers of basic physics subjects, forty students in the first semester, and third-semester physics students. The data collection technique is done through a non-test in the form of 1) questionnaire for students consisting of two types. The first questionnaire was to trace students' responses to basic physics concepts, and the second questionnaire was to track students' responses to the use of ICT media in basic physics courses; 2) observations are made to get an overview of the lecture process; 3) interviews were conducted with 2 physics lecturers to know the readiness of students in basic physics lectures, and the difficulty of the lecturers in facilitating the lecture. Based on the analysis of the results of student questionnaires it becomes clear that students are less motivated to take basic physics courses because of unpreparedness to learn, reference books and learning resources have not been used, they do not use learning media, have not shown critical thinking skills, also students do not provide responses or questions during the lecture process. Based on the results and analysis of research data, it can be concluded that the basic physics course design shows an effective and fundamental potential for building critical thinking skills through interactive multimedia physics android.

Keywords: student learning difficulties, physics problem solving, interactive multimedia android.

Introduction

The development of information and communication technology is very rapid, especially in the current era of the industrial revolution 4.0, this also has a great influence on the world of education, especially in learning, so that there is a very fast shift in the learning paradigm from traditional learning to learning based on information and communication technology. This concept gave birth to a culture of digital literacy, problem-solving skills, and creativity. The shift in the learning paradigm based on information and communication technology demands the development of learning designs that can produce productive, innovative, and creative Indonesians (Mardiana & Kuswanto, 2017). To answer the challenges and learning problems in the current global era, all parties involved, directly or indirectly, must have the ability to utilize technology as a learning medium.

To improve the quality of education of the Indonesian people in the era of the 21st century, every university must have the responsibility to prepare the Indonesian generation to be ready to enter social life. Higher education is required to be able to compete globally. In the context of preparing and improving the quality of education, universities are allowed to develop curricula according to the demands of the Indonesian National Qualifications Framework. Therefore, higher education development must be continued in developing curriculum at the Study Program level, and increasing partnerships or stakeholders or another world of work (Nggadas & Ariswan, 2019).

A qualified human being is a person who can think critically, creatively, logically in responding to various problems, so that he can become a problem solver in every aspect of life. The important goal of education in the era of the industrial revolution 4.0 is to build a smart society that can solve problems wisely and correctly. This is in line with the objectives of Indonesian National Education, namely to educate the life of the nation and state (Turnip et al., 2016).

Physics has a very important role in all aspects of human life. Therefore, as fundamental science, physics has characteristics with a scientific basis in the form of facts, concepts, principles, laws, postulates, and theories (Fischer et al., 2014). Various abilities in studying physics prove that physics is a complex science, so it is necessary to optimize student abilities so that it can be understood properly and correctly.

Basic physics concepts can be packaged into computer simulations to bring students into conditions as young scientists. By using learning technology, students do not need to directly carry out physics experimental activities but can feel the conditions like scientists when interpreting simulations of physical phenomena properly. In learning physics, certain topics may not be visible or abstract, too fast to observe, require a long observation time. To overcome this, learning technology is needed that can visualize conditions that may not be possible through experiments in the laboratory (Ma'ruf et al., 2019).

Also, the main problem in learning basic physics focuses more on mastering concepts rather than problem-solving abilities. Students can solve simple quantitative problems, but fail to solve more complex and complicated problems. Therefore, based on the results of scientific research, basic physics is considered a difficult concept because it requires complex mathematical abilities, high metacognition, and the presence of misconceptions. The negative assumption is that physics is a difficult material so that it can reduce curiosity and motivation in the learning process (Saputri & Wilujeng, 2017).

With these problems, digital learning technology makes a positive contribution to facilitate physics students to develop problem-solving abilities. This technology is known as interactive multimedia physics android. This technology provides facilities to stimulate critical, creative, and innovative ideas in basic physics learning (Ma'ruf et al., 2020).

According to research data, the use of android applications in Indonesia has reached 66.13%. Android is considered capable of being an appropriate medium for delivering learning, especially for physics students because almost every student makes it an integral object in their daily activities. Therefore, android can be said to be a digital technology product that can be used anywhere. Android-assisted learning media are mobile technology devices that are easily accessible anywhere and anytime. The application of the use of Android-based learning media is one of the expected applications of the 21st-century learning style, which can also facilitate the emergence of a culture of digital literacy and ICT (Asif et al., 2019). The implementation of learning using smartphones and tablets can have a positive impact on the cognitive, metacognitive, affective, and socio-cultural dimensions for physics students.

Methodology

This research is a qualitative case study research. The case study method allows a researcher to scrutinize data in a specific context (Misdi et al., 2020). This research was conducted in the physics education study program, Muhammadiyah University of Makassar, Indonesia. The research subjects consisted of two lecturers of basic physics courses, forty students in the first semester, and third-semester physics students.

The data collection technique is done through a non-test in the form of 1) questionnaire for students consisting of two types. The first questionnaire was to trace students 'responses to basic physics concepts, and the second questionnaire was to track students' responses to the use of ICT media in basic physics courses. 2) Observations are made to get an overview of the lecture process. 3) interviews were conducted with two physics lecturers to know the readiness of students in basic physics lectures, and the difficulty of the lecturers in facilitating the lecture. Interviews were conducted on first semester students who were contracting basic physics courses and seventh-semester students who had previously contracted these courses. Interviews with students aimed to determine the readiness and difficulties of students in taking basic physics courses. The existence of this interview is synchronized with the results of the questionnaire that the students filled out. 4) Document analysis, namely after seeing the results of student questionnaires and the results of interviews with lecturers and students, to be more convincing about the results of the report, documents related to research are analyzed for their suitability with the learning activities carried out. These documents include lesson plans, assignments, test instruments, process scores, and results. The purpose of this document analysis is to determine the suitability between the planning made and the learning that is taking place in the classroom and is associated with student readiness to use interactive multimedia android.

The data obtained through questionnaires, interviews, and questionnaires will be analyzed as follows: 1) The data from the questionnaire results are analyzed quantitatively the number of frequencies on the Likert scale category of each questionnaire item. 2) The data from interviews and observations were analyzed descriptively qualitatively, and 3) The results of the document analysis were described through tabulation of the findings of the document analysis.

Results

The findings of the research investigation are divided into three parts, namely the results of the investigation of basic physics lectures, the results of lecturer interviews, and the results of student interviews related to basic physics lectures.

1. The results of the investigation of the basic physics lecture process through the results of student questionnaires can be seen in the following table.

Table 1. The results of student questionnaires in the basic physics lecture process

No	Perception	Percentage	
		Agree	Disagree
1	Initial knowledge of physics is important in following basic physics courses.	95,00	5,00
2	The concept of physics is difficult to understand when linked to everyday life.	5,00	95,00
3	I don't feel confident enough to ask a lecturer or friend about basic physics.	7,50	92,50
4	I am concerned about what people perceive me to be when I	7,50	92,50

No	Perception	Percentage	
		Agree	Disagree
	ask about basic physics concepts.		
5	If I feel that I am not able to apply physics concepts, I can freely ask the lecturers.	70,00	30,00
6	I need help understanding the concepts of physics through technology now, I feel free to use multimedia technology.	77,50	22,50
7	I think understanding basic physics does not affect my future.	60,00	40,00
8	I was among the students who were impatient doing basic physics problems, and I quickly gave up.	0,00	100,00
9	I can spend as much time as I want when I'm working on basic physics problems related to everyday life.	2,50	97,50
10	When I do basic physics problems I can imagine their use in physics applications.	10,00	90,00
11	The application of basic physics concepts can be interpreted in the use of learning media.	32,50	67,50
12	The application of basic physics concepts is presented in the module used as teaching material.	60,00	40,00

2. The results of interviews with basic physics lecturers related to student interest in basic physics courses and the difficulty of lecturers in facilitating lectures can be seen in the following table.

Table 2. Summary of lecturer interviews

Question	Lecturer Answer A	Lecturer Answer B
How is the enthusiasm of students following basic physics lectures?	Students are very excited about learning basic physics. They are enthusiastic because basic physics learn about natural phenomena	Students are enthusiastic about participating in the learning process, this can be seen that students are enthusiastic in seeking information from several sources related to basic physics material.
Are students equipped with 21st-century skills in basic physics courses	Yes, because it is part of the learning process.	Yes. Students are directed to be skilled in critical thinking and link previous knowledge with the information obtained.
What are your difficulties in facilitating basic physics lectures?	Some basic physics experiments that cannot be carried out cannot be facilitated.	The difficulty is there are several conditions where the learning objectives conveyed have not been maximally achieved due to time constraints.
What forms of learning effort have been observed and carried out by students?	Yes, when students are confused in class, they will try to find a solution by looking for good references from Android media.	In the lecture process, students can interact with other groups and convey ideas and concepts related to basic physics material. However, the obstacle is that some students

Question	Lecturer Answer A	Lecturer Answer B
		are not able to connect physics and its application.
Have you directed students to use android media? Explain why!	Yes, when students are explained, they are directed to be able to use all available technologies including Android media which is very easy to use.	Yes, because basic physics courses are indeed related to physics phenomena, learning media are needed to help students better understand basic physics.
Are basic physics courses already using interactive multimedia android? Explain why!	Yes, it's just not running optimally	Not yet, because the use of interactive multimedia android is not familiar to students.
How are students interested in basic physics courses	Students are very enthusiastic about learning basic physics, perhaps because it deals with interesting natural phenomena.	During the lecture process students are interested in discussing physical phenomena.

3. Results of student interviews

The results of interviews with first semester students who are contracting basic physics courses and third-semester students who have gone through basic physics courses can be seen in the following table.

Table 3. Summary of student interviews

Interview Questions	First-semester student answers	Third-semester student answers
Do you enjoy taking basic physics courses? Explain the reason!	I am happy because in basic physics courses I can find out more about physical phenomena	Happy concerning answering curiosity about physical phenomena
What benefits do you get after learning basic physics? Explain the reason!	Increase knowledge, insight, and curiosity about natural phenomena	Provides broad insights to magnify the almighty creation
What were your difficulties with learning basic physics? Explain the reason!	Sometimes the material is abstract, it cannot be observed direct, no learning media & difficult to learn the references.	The limitations of learning media and not real phenomenon can be observed.
What kind of effort did you put into learning basic physics?	Review the literature, looking for relevant internet sources.	Read lots of references
Are you interested in taking Astronomy courses? Explain the reason!	Very interested, because it encourages creative, imaginative, and critical thinking.	Interested, because curiosity about the universe is very high.
What would you like to gain from your basic physics course? Explain the reason!	Know more about the application of the use of physics in everyday life.	Characteristics of physical material and its relationship to everyday life.

Interview Questions	First-semester student answers	Third-semester student answers
Have you used multimedia android learning in basic physics courses? Explain the reason!	Not yet	Has never been

Discussion

Based on the analysis of the results of student questionnaires on the basic physics lecture process at the Muhammadiyah University of Makassar, it can be seen that students are less motivated to take basic physics courses because of their unpreparedness to learn, reference books and learning resources have not been used, do not use learning media, have not shown critical thinking skills, students do not provide responses and questions during the lecture process. Lecturers are more dominant in lecturing and sometimes ask students for discussions. Assignments in the form of diary notes and papers were the most frequently used. This is in line with the results of (Ma'Ruf et al., 2019) research which states that physics students are given more treatment to achieve their cognitive goals, while the aspects of thinking skills, both creative and critical, are not yet fully part of basic physics learning.

Based on the results of the analysis, interviews with basic physics lecturers expressed almost the same opinion that the enthusiasm of students was high enough to take basic physics courses, students' ability to master concepts was still inadequate, the use of media was still not optimal and less practical and the limited number of learning media. This is a challenge to develop learning technology that suits the needs of current physics students, namely digital technology and android technology. This concept is in line with the results of research, which states that Android-assisted mobile physics learning media developed specifically for physics material on elasticity can improve the thinking skills of physics students (Ma'Ruf et al., 2020).

Based on the results of interviews with students of two different generations, information was obtained that students like to take basic physics courses because they are related to daily life, this course adds knowledge, insight, and curiosity about natural phenomena. However, the difficulty of basic physics material is quite complex, abstract, difficult to observe, the references used are difficult to understand, the lack of learning media is used to explain the material. The positive thing that was conveyed by students was that the difficulty in reading literature could be helped by reading information on the internet from the authorized institution's website and the basic physics concept of fishing to want to know more.

The results of this study are supported by the results of other studies which state that the data on the level of understanding of basic physics concepts in Indonesia is at a very difficult level. 61.80%, while at the easy level it was 38.20%. One solution is to prepare good physics learning media in higher education is the best way to show abstract physics phenomena. Therefore, it is very important to strengthen and improve multimedia technology research at the university level, focus and strengthen the combination of advantages of traditional multimedia and teaching technology, to improve the quality of physics learning for prospective teachers (Ma'Ruf et al., 2019).

This is following the results of scientific research that learning physics only encourages students to memorize concepts and is less able to use these concepts if they encounter problems in real life related to these concepts. Also, students are less able to understand and identify problems, formulate problems, and determine solutions to solve new problems or situations at hand. This is what makes Indonesia's human resources only "a few" who act as the front guard in the industrial world

with critical and innovative thinking, while the rest only act as laborers, jobs that do not require deep thought.

The limitation of this research is that there are several limitations found, such as data collection which is still quite extensive, not specific, it leads to the profile of basic physics lectures which is integrated with physics android interactive multimedia and facilitates students to think critically. Giving student questionnaires in the lecture process still gives a lot of decisions at the middle point, namely between yes and no, so it needs more in-depth improvement.

Conclusion

Based on the results and analysis of research data, it can be concluded as follows: the basic physics course design shows an effective and fundamental potential for building critical thinking skills through interactive multimedia physics android, and excellent readiness of students to use interactive multimedia physics android in basic physics lectures. 21st century skills which are the main foundation for physics student teacher candidates in Indonesia are very likely to be accommodated through interactive physics android multimedia technology in basic physics courses.

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