Enhancement of Students' Concept Mastery through Science Learning using Android-based Interactive Multimedia

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Abstract

The low students' concept mastery in science learning is partly caused by learning media that is less varied and interesting. The learning media used in science learning is only in the form of textbooks, so they cannot visualize difficult and abstract material. This study aims to determine the enhancement of students' concept mastery through science learning using android-based interactive multimedia. This study is included in a quantitative descriptive by using a one group pretest-posttest design. The sample in this study was 28 students of seventh grade of junior high school at one of schools in Kamal-Bangkalan in the even semester of the 2023/2024 academic year. The research instrument used in this study is a concept mastery test. The data is analysed using the N-Gain technique. Findings indicated that there is enhancement in the students' concept mastery through science learning using android-based interactive multimedia which reached on 0.40 with moderate criteria. Based on these results, it can be concluded that the science learning with android-based interactive multimedia is able to enhance students' concept mastery on the topic of Indonesia ecology and biodiversity.

Keywords: android, concept mastery, interactive multimedia, science learning

INTRODUCTION

Natural Science learning is learning that includes aspects of knowledge and skills. Natural Science applies learning that is oriented towards the problem-solving process in everyday life (Annisa & Fatmahanik, 2023). Science material leads to systematic discovery of facts that involve student understanding, so that it can train students' scientific attitudes and processes (Rahmawati et al., 2023). Based on the statement above, science learning has the aim of increasing students' concept mastery so that they are able to solve problems in everyday life (Supriyono et al., 2023).

In general, teachers apply conventional methods in the learning process. The use of conventional methods is actually not wrong in learning because it builds direct interaction between teachers and students, however this method cannot engage students to learn actively (Hutapea et al., 2023). The conventional method is a method of delivering material which is carried out using the lecture method and only using textbooks which is not included in an effective learning method (Setiawan et al., 2023). The results of observations in one of schools in Kamal-Bangkalan and interviews with science teachers, showed that science learning was carried

out using the lecture method. In addition, the textbooks owned by students only contain limited materials and questions. Furthermore, it is also indicated that the students' concept mastery is low.

Concept mastery is one of the goals to achieve an effective learning process (Siahaan & Sihotang, 2023). Concept mastery is the ability of students to understand and re-express a learning concept that has been learned from the first time they have received it and relate it to everyday life (Sari et al., 2023; Fikriyah et al., 2020). There are indicators of concept mastery based on the revised Bloom Taxonomy, including classifying, explaining, interpreting, comparing, exemplifying, summarizing, and inferring (Febriyana et al., 2021).

Science concept mastery emphasizes the ability to solve problems by understanding and linking concepts and theories scientifically. Based on research by Rahmawati et al. (2023), the low concept mastery in science learning can be indicated from students who have difficulty in solving problems during the learning process. Based on the results of the pra-research in one of schools in Kamal-Bangkalan, it also shows that students' science concept mastery is still low, due to the lack of material related to everyday life and the learning process does not involve student activity. In addition, low concept matery is also caused by learning media that can not visualize abstract material (Rahmawati et al., 2023).

Learning media is used in delivering science material to support the teaching and learning process (Kustiati, 2022). Learning media is an object that makes it easier for teachers to deliver material in a more interesting and easy for students to understand (Maharani & Asyhari, 2020). Quality of learning process is based on learning media that is presented in a practical and innovative way (Winangsih & Harahap, 2023). Furthermore, the interactive multimedia as an innovative media can be applied in science learning to facilitate students' varied learning styles (Fikriyah & Ahied, 2022).

Multimedia is a combination of media such as text, images, sound or audio, video, and animation that helps students in comprehending science during the learning process (Winangsih & Harahap, 2023). Multimedia equipped with a system management tool so that it can be accessed by students easily that is called interactive multimedia. The control tool in interactive multimedia is called GUI (Graphical User Interface) in the form of buttons, icons, scrolls and others (Irwanto & Marliah, 2019).

The controller can be operated freely, making it easier for students to use interactive multimedia such as moving to the next material page and displaying videos (Priyanto & Nurgiyatna, 2022). The purpose of using interactive multimedia is to teach abstract material to students so that it is easier to understand and not monotonous (Maharani & Asyhari, 2020).

Along with the rapid development of technology, students spend more time using smartphones (Zulfa & Mujazi, 2022). Based on the results of the needs analysis

of 32 students, as many as 97% of students already have smartphones and choose the material on ecology and biodiversity of Indonesia packaged in smartphones to help students understand the concept. As many as 75% of students are also excited if the material is packaged in the form of images, audio, and video.

This condition can be utilized by teachers to conduct learning using interactive multimedia based on Android (Septiani et al., 2020). Android is a device used on smartphones to be able to access interactive multimedia anywhere and anytime. This is based on the results of interviews with science teachers in one of schools in Kamal-Bangkalan, the use of smartphones has not been optimal because they have never used android-based interactive multimedia to deliver science material.

A software called as construct 3 can be used in producing interactive learning media (Puspita & Listiadi, 2023). Construct 3 is one of the versions created by Scirra Ltd as a 2D game maker based on HTML 5. Using construct 3 makes it easier for users because it does not use complicated programming languages or coding and is sufficient with drag and drop (Afrianto et al., 2023). The ease of using construct 3 without having to learn a programming language can be utilized in producing interactive multimedia based on android and can be applied in achieving the success of the learning process, especially in students' concept mastery.

Based on research by Tristanti et al. (2021) explains that learning media

assisted by the construct software can not only increase student motivation and interest, but can present material in an interesting way, making it easier to interpret a concept, so that students quickly understand the material.

Ecology and biodiversity is one of science learning materials that study the relationship between living things and the environment as well as the uniqueness and complexity of living things (Widodo et al., 2021). Based on research by Purwanti & Kuntjoro (2020), the concept mastery on ecology and biodiversity of Indonesia is still relatively low because they still have difficulty in understanding the concept. One of factors that caused the problem is learning process that only focuses on memorizing and cannot visualize abstract material so that it affects on students' learning outcomes. Problems related to students' low concept mastery in science learning can be solved by using android-based interactive multimedia.

This is supported by research by Kustiati (2022) which shows that there are differences in learning outcomes using interactive multimedia and using the lecture method indicating that the students' learning outcomes using interactive multimedia are higher than using the lecture method. Based on research by Lindawati et al. (2023) also shows that the students' concept mastery reached in the very good category after using interactive multimedia.

This research is important to be carried out because interactive multimedia has several advantages, including being able

to be used by students in independent learning; providing a more effective and innovative learning atmosphere, and being able to increase students' learning motivation and understanding of concepts (Widodo et al., 2020; Hernawan et al., 2022). Interactive multimedia is also expected to be a solution for science learning because it can facilitate students' varying learning styles. This is because interactive multimedia is a learning media that combines several elements such as audio, video, and animation.

Based on the background description, it is necessary to conduct research with the aim of measuring the increase in students' concept mastery through science learning using Android-based interactive multimedia. In addition, the research question in this study is "How is the enhancement of students' concept mastery through science learning using Android-based interactive multimedia?"

METHOD

This type of research is quantitative descriptive research with the one group pretest-posttest design. The determination of the research design is based on the objective, that maximizing students in one class who require learning with interactive multimedia so that the enchancement of concept mastery can be achieved well. The research was conducted in one of junior high schools at Kamal-Bangkalan, East Java, Indonesia in the even semester of the 2023/2024 academic year.

The population in the study were students of all classes in the seventh grade at a school in Kamal-Bangkalan. Furthermore, the sample was determined using purposive sampling technique and resulted 28 students of class VII-G. The use of purposive sampling technique is based on certain criteria or considerations of the respondents (Lenaini, 2021). The criteria for sampling in this study were adjusted to the results of the pre-research questionnaire, needs, and observations which showed that students of class VII-G had difficulty in learning science material, which affected students' concept mastery.

The data collection technique was carried out using a test in the form of essay questions on one sample group. The test was carried out at the beginning and at the end of learning by giving the same test. The test was given with the aim of knowing the increase in students' concept mastery through learning using android-based interactive multimedia on the concept of ecology and biodiversity of Indonesia.

The test instrument is compiled based on the material and indicators of concept mastery that have been determined. The test is in the form of essay questions consisting of 2 concept mastery questions for each indicator in each sub-material, so that the total number is 10 questions. The compilation of the test instrument is adjusted to the indicators of students' concept mastery. In accordance with the revised Bloom's Taxonomy, the indicators of concept mastery in this study are adjusted to the sub-material, namely classifying, explaining, comparing, exemplifying, and concluding.

The stage after compiling the test

instrument is with the validity test conducted by two validators. The validation results can be used as a means of improvement before the test is given to students. Meanwhile, the test validation results show that the students' concept mastery test obtained a score of 91.39% (very valid), with details of 93.75% in the material aspect, 87.92% in the construction aspect, and 92.50% in the language aspect.

The test in the form of essay questions that have been improved, then used to determine the enhancement of students' concept mastery of the concept of ecology and biodiversity of Indonesia. The test was given to 28 students in one class twice, namely before and after learning using android-based interactive multimedia.

The data of students' concept mastery that has been obtained, is then analyzed to determine the enhancemnt of students' concept mastery. The data analysis technique used is the N-Gain test. The test was conducted on the results of the pretest and posttest using 28 samples. The N-Gain test was conducted using the SPSS program or using the following equation 1.

$$(N-Gain = \frac{Spost - Spre}{Smaks - Spre}...1)$$

Note:
S post = Average post-test score
S pre = Average pre-test score
Smax = Maximum vlue

The N-Gain score obtained by students is interpreted based on the criteria to determine the level of conceptual understanding. The N-Gain criteria can be seen in table 1 below.
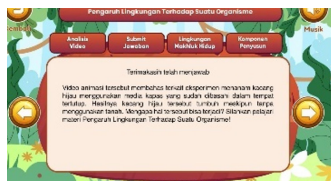
Table 1. N-Gain Criteria for Students' Concept Mastery

N-Gain	Criteria
(N-Gain) 0.7 ≥	Tall
0.3 ≤ (N-Gain) 0.7 <	Currently
(N-Gain) ≤ 0.3	Low

RESULT AND DISCUSSION

This study focuses on science learning using android-based interactive multimedia to improve students' concept mastery. Interactive multimedia in this study has been declared feasible with an average of 92.97% in the media aspect and 90.31% in the material aspect. The appearance of android-based interactive multimedia in this study is presented in Table 2 below.

Table 2. Display of Android-based Interactive Multimedia

Description	Figure
Display on smartphone after installation process is complete	
The content of interactive multimedia includes video analysis, discussion forums, games, and practice questions	
Feedback column in video analysis activities	

Students' concept mastery test was given to students before and after implementing learning using interactive multimedia. Furthermore, the test results were analyzed using the N-Gain formula. The N-Gain test conducted aims to determine the increase in students' concept mastery on each indicator. The results obtained are presented in table 3 below.

Table 3. Enhancement of Students' Concept Mastery of Each Indicator

Indicators of concept mastery	N-Gain Score	Criteria
Classifying	0.58	Moderate
Explain	0.40	Moderate
Compare	0.28	Low
Exemplifying	0.39	Moderate
Conclude	0.38	Moderate

Based on the N-Gain test output table for each indicator above, it shows the results of each indicator of students' concept mastery, namely (1) the classifying indicator obtained an N-Gain score of 0.58 with moderate criteria, (2) the explaining indicator obtained an N-Gain score of 0.40 with moderate criteria, (3) the comparing indicator obtained an N-Gain score of 0.28 with low criteria, (4) the exemplifying indicator obtained an N-Gain score of 0.39 with moderate criteria and (5) the concluding indicator obtained an N-Gain score of 0.38 with moderate criteria.

As for the results of the enhancement

Table 4. Enhancement of Classical students' concept mastery

Criteria	N-Gain	
	Frequency	Percentage
High	2	7.14%
Moderate	18	64.29%
Low	8	28.57%
Total	28	100%

in classical students' concept mastery is presented in detail in Table 4 as follows.

The data shows that 2 out of 28 students gained improvement with high criteria. Furthermore, 18 out of 28 students gained improvement with moderate criteria, and 8 out of 28 students gained improvement with low criteria.

The results of the descriptive analysis of pretest and posttest of students' concept mastery are shown in Table 5 which obtained an average N-Gain of 0.40 with moderate criteria. These results indicate that students' concept mastery has increased in the moderate category after learning using android-based interactive multimedia assisted by construct 3.

The data shows that the average value of the concept mastery test obtained by students during the pretest was 34.50 with a minimum score of 23 and a maximum score of 43. The average value of the concept mastery test obtained by students during the posttest was 60.57 with a minimum score of 30 and a maximum score of 85.

Table 5. Descriptive Analysis of Pretest and Posttest of Students' Concept Mastery

	N	Pre-test	Post-test	N-Gain	N-Gain Category
Minimum	28	23	30		
Maximum	28	43	85	0.4	Moderat
Average	28	34.50	60.57		

The results of the analysis of students' concept mastery showed a difference in the increase in students' pretest and posttest scores. Based on these results, the use of android-based interactive multimedia can make it easier for students to understand learning concepts. This is in accordance with research by Putri & Gusnedi (2023), interactive multimedia can be used to make it easier for students to understand learning concepts.

Based on research by Rahmawati et al. (2023), low students' concept mastery in science learning is seen from students who have difficulty solving problems in the learning process. Based on a preliminary study, it also showed that students' concept mastery of science material is still low, due to the lack of material related to everyday life and does not involve student activity. In addition, low conceptual understanding is caused by learning media factors in the form of books that do not visualize abstract material.

These problems result in students being unable to understand and solve questions that require students' concept mastery. One of the criteria for questions that require students' concept mastery is questions about students' conceptual understanding. Students must be able to work on tests by describing the answers to determine the increase in students' concept mastery in each indicator. Purwanti & Kuntjoro (2020) stated that the understanding of concepts in the material of ecology and biodiversity of Indonesia is still relatively low. This causes students to have difficulty in understanding and solving questions

related to the material given by the teacher. Therefore, improvements are needed in the implementation of learning in order to overcome the problem of students' concept mastery, especially in science learning.

The solution to this problem can be done by using learning media. According to Maharani & Ashhari (2020), stated that learning media is an object that makes it easier for teachers to deliver material to be more interesting and easy for students to understand. Interactive multimedia as one of the media can be applied in learning. Multimedia that is equipped with a system management tool so that it can be accessed by students is called interactive multimedia. The use of android-based interactive multimedia assisted by construct 3 is the right solution in overcoming the problem of low understanding of students' concept mastery in science learning.

Furthermore, there are also differences in the results of students' concept mastery tests on each test item. The results of the differences in the average pretest and posttest of students' concept mastery of each test item can be seen in Figure 1.

Figure 1 shows that there is a difference in the average pretest and posttest of each question item according to the indicator of students' concept mastery. The first indicator is classifying, in the first question the average pretest score was 40 and the average posttest score was 79. The N-Gain result for the first question was 0.65 (moderate). The second question obtained an average pretest score of 79 and an average posttest score of 90. The N-Gain result for the second question was 0.52
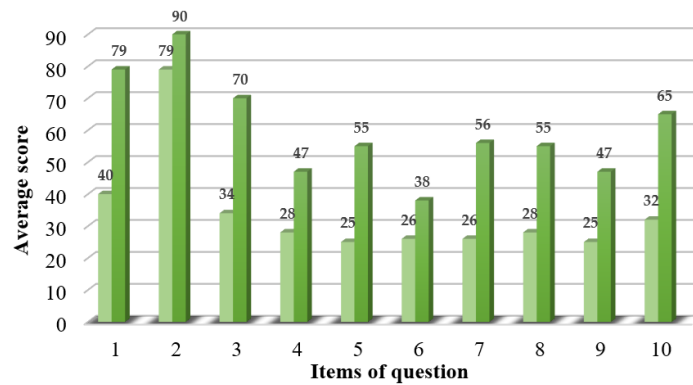
Figure 1. Difference in Pretest and Posttest Average In Each Question Item

(moderate).

These results show an increase in scores, supported by an average on the classifying indicator of 0.58 (moderate). The classifying indicator is in accordance with the sub-material of environmental influences on an organism in interactive multimedia. The environment of living things and the components contained in interactive multimedia are equipped with explanations, images, animated videos and supported by practice questions and games. This helps students to be able to categorize and group according to the concept of the materia (Muslim et al., 2021).

The second indicator is explaining, in the third question the average value obtained pre-test of 34 and the average value post-test of 70. The third question was 0.52 (moderate). The fourth question obtained an average value of pre-test of 28 and the average value of post-test of 47. The N-gain score of fourth question is 0.26 (low), this is caused by the student factor of not explaining the answer according to the concept (Rinjaniet al., 2022). These results show an increase in scores, supported by an average of N-Gain on the indicator

explains 0.40 (moderate). The indicator explains according to the sub-material of interactions between components of the ecosystem in interactive multimedia. The concept of ecosystems and interactions between components of the ecosystem contained in interactive multimedia is equipped with explanations, images, animated videos and supported by practice questions and games. In accordance with research by Santhalia & Sampebatu (2020), interactive multimedia helps students understand the material.

The third indicator is comparing, in the fifth question the average is obtained pre-test of 25 and the average value post-test of 55. The N-gain score of fifth question was 0.40 (moderate). Furthermore, the sixth question obtained an average value of pre-test of 26 and the average value of post-test of 38. The N-gain score of sixth question is 0.16 (low), this is caused by the student factor who does not explain the comparison between the two concepts and only explains one concept.

These results show an increase in scores, supported by an average of N-Gain score on the indicator explains 0.28 (low). The indicator compares according to the

sub-material on differences in biodiversity in Indonesia with other parts of the world. Differences in the distribution of fauna in Indonesia and threats to biodiversity in Indonesia in the form of pollution and global climate change contained in interactive multimedia equipped with explanations, images, animated videos and supported by practice questions and games.

The fourth indicator is to give an example, in the seventh question the average value obtained is pre-test of 26 and the average value of post-test of 56. The N-gain score of the seventh question was 0.41 (moderate). In addition, the eighth question obtained an average value of pre-test of 28 and the average value of post-test of 55. The N-gain score of the eighth question is 0.38 (moderate).

These results show an increase in scores, supported by an average of N-Gain on the exemplary indicator of 0.39 (moderate). The exemplary indicator is in accordance with the sub-material of human influence on ecosystems in interactive multimedia. The influence of humans on ecosystems in the fields of agriculture and food production and environmental pollution contained in interactive multimedia is equipped with explanations, images, animated videos and supported by practice questions and games. In accordance with research bu Widariet al. (2021), presentation of material equipped with visual images and examples can help students understand the material so that they can improve their understanding of concepts.

The fifth indicator is concluding, in the ninth question which the average value was obtained pre-test is 25 and the average value of post-test is 47. The N-gain score of the ninth question is 0.29 (low), this is due to the factor of students not having concluded the concept as a whole (Rinjaniet al., 2022). Furthermore, the tenth question obtained an average score of pre-test of 32 and the average value of post-test of 65. The N-gain score of the tenth question is 0.49 (moderate). This result shows an increase in the score, supported by an average of N-Gain on the exemplary indicator of 0.38 (moderate). The indicator concludes in accordance with the sub-material of biodiversity conservation in interactive multimedia. Biodiversity conservation methods and conservation benefits in interactive multimedia are equipped with explanations, images, animated videos and supported by practice questions and games. In accordance with research by Kumalasari & Anggraito (2023), the systematic presentation of material supported by images, audio, and video in interactive multimedia can help students understand material concepts effectively to improve students' concept mastery.

The results obtained showed an enhancement in students' concept mastery in the comparing indicator, although in low criteria. This is caused by the factor of students who do not pay attention to the questions, so they are mistaken in describing the comparison of the two concepts. In addition, most students do not describe the comparison between the two concepts, so they only explain one concept.

The time limitation of only 40 minutes also affects the activity in completing test, in which the ideal time to do the test should be 60 minutes. This makes students cannot complete the test optimally. The students' desire to immediately complete the questions and cause a lack of concentration in observing the questions can be factors of low score test (Demaryanti & Suryadi, 2021). There was an increase even though it was in the low criteria according to the research by Delianyet al. (2019), which revealed that enhancement of students' concept mastery in science learning was supported by interactive multimedia to visualize abstract material related to fauna.

The findings indicate that there is an enhancement of students' concept mastery through the science learning using android-based interactive multimedia. According to research by Widodoet al. (2023), there was an increase in students' concept mastery after the use of interactive multimedia in learning. In addition, the increase in students' concept mastery in this study is in accordance with Ausubel meaningful learning theory which states that the use of interactive multimedia can provide more meaningful and effective learning and help students understand concepts (Ardiani & Agung, 2022; Tamam & Fikriyah, 2024).

CONCLUSION

This study aims to develop student worksheet assisted by the Stellarium website through the framework of design-thinking on the topic of the solar system Findings of the research indicate that

the validation of the student worksheet reachs the overall percentage of 91.9% which means it is included in the "very good" category, showing that the student worksheet that has been developed is worthy of being tested in schools with improvements according to the suggestions and input given. However, this student worksheet has not been carried out until the trial, due to limited time, so it is necessary to conduct a trial process to measure the improvement of students' conceptual understanding, increase of interest in learning and development of 21st century skills.

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