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THE USE OF SMARTHPHONES TO BUILD CONCEPTUAL UNDERSTANDING OF ELEMENTARY SCHOOL STUDENTS

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ABSTRACT

Most elementary school students have difficulty understanding the concept of the human respiratory system. This happens because their science study tends to be rote learning. To overcome this, teachers use smartphones because all students have smartphones and their smartphones have various features that can help students learn. The purpose of this research is to analyze the influence of smartphone use on elementary students' understanding of concepts in learning activities. This research uses a Quasi-experimental method. The research design used is the nonequivalent control group design type. The sample consists of 21 students who carried out their learning activities using smartphones and the other 22 students who carried out their learning activities without using smartphones. Research data was collected using a multiple-choice test consisting of 48 questions focusing on learning materials about the human respiratory system. The results of this research indicate that there are significant differences in students' scores regarding conceptual understanding tests after they learned the human respiratory system materials by using smartphones. This is because camera features available on smartphones help students to take pictures and record so that students can be directly involved in the learning activity and can observe again and again the experimental activities they carried out. Thus, it can be concluded that learning activities using smartphones on the human respiratory system can improve students' understanding of concepts. This research contributes to the quality of learning so that schools can apply smartphone use to other subject matter. In addition, future researchers can conduct similar research with different research materials and focus, for example improving communication skills.

Keywords: *Smartphones, Building Understanding Of Concepts, Elementary School Students*

1. INTRODUCTION

Natural science (commonly referred to as "science") learning focuses on how facts, concepts, or principles are obtained and applies scientific methods and attitudes in everyday life [1]. Science learning is given to students so that students can understand and master the concept of nature in their everyday life [2]. Students are considered to understand a concept if they can explain something using their sentences without changing the meaning. Science, known as IPA (Ilmu Pengetahuan Alam) in the Indonesian context, refers to processes and products. Science is called a process because it is a way of thinking and working to understand nature. Science refers to a product because it is a collection of knowledge produced by the process [3].

Most students consider that science is a difficult subject to understand because it is related to invisible processes that are too slow, too small, or sometimes too large to be observed easily [4]. Research conducted by Wishart [5] showed that most science learning is related to understanding invisible processes, too small, or too large to be easily observed, so students think that science is a difficult subject to understand. Students had difficulty understanding the respiratory system because their perspectives and analysis conflicted beyond the range of their everyday experiences [6]. Furthermore, one of the difficult science materials to understand is the respiratory system.

The concepts of the respiratory system are important for students to understand because their application is closely related to their everyday life. However, some students experience difficulties in understanding the concepts. It is difficult for students to understand the respiratory system because it is a complex system [7]. The respiratory system, both the

organs that make up the respiratory system in the body cavity and the processes that occur in the respiratory system, is material that cannot be seen directly [8] because is abstract in nature. Therefore, students have difficulty understanding it [9], [10]. The material of human respiratory system is considered a difficult material because it is a complex material [11]. Based on the results of the research conducted [12] in terms of the level of difficulty, the human respiratory system material is the 22nd level material out of 30 levels of material that is considered difficult.

Students' difficulty in understanding the concept of the respiratory system can impede their success in learning and cause several learning problems. Consequently, they can reduce students' interest in learning. This is reinforced by the results of the 2018 Program for International Student Assessment (PISA) national survey. The diagnostic survey reported that Indonesia is ranked 72 out of 78 countries. Indonesian schools have not been able to prepare students to master analytical ability because students are not familiar with HOTS (Higher Order Thinking Skill) questions in their everyday class assessments. Therefore, students are not motivated in understanding concepts [13]. Furthermore, the results of the Trends in International Mathematics and Science Study (TIMMS) conducted in grade IV of elementary schools showed that Indonesia is ranked 44th out of 49 countries. Based on TIMMS research results, Indonesian students can work on questions, but they lack the depth of understanding. This is because most science learning in Indonesian schools tends to be rote learning [14].

Teachers can take advantage of technology to overcome such a problematic situation. Using smartphones during teaching-learning activities can be one alternative because all students have smartphones. Smartphones are handheld computers that can be used to improve many aspects including education. Mobile technology will make learning more accessible and appropriate for students to use in classes [15]. Smartphones can easily connect to the internet and store large amounts of data which can be accessed from anywhere and anytime. Besides, the content on smartphones can be easily distributed to other people on various media. Smartphones' small size makes them easier to carry so that they can be used to respond to situations, ideas, and needs wherever they are.

Smartphones have facilities in the form of features that have computing and communication capabilities. The features on smartphones can be used to assist learning activities, especially to help understand the concept of the human respiratory system. One of the available features is a camera which can be used to create photos and videos. Smartphones have high-quality cameras and recording devices. Cameras on smartphones can be used to capture images related to learning materials during teaching-learning activities. Cameras on smartphones can also support experimental activities in classes so that it becomes easier and more efficient for students to conduct experiments [16]. Pictures taken by smartphone cameras during learning activities when conducting experiments can be useful for students because they can provide notes whose results can be seen repeatedly so that students can observe any changes in experimental activities gradually. Images taken from the experimental results via smartphone cameras can be sent to other friends so that all students will have the same images to observe [17]. Using digital cameras in classrooms allows students to capture images to record their observations [18]–[20]. The smartphone's versatility is promising to transform the nature of educational content into the nature of learning itself [21].

Based on the aforementioned explanation, research focusing on using smartphones to build students' conceptual understanding of the learning material on the human respiratory system was carried out.

2. RESEARCH METHODS

This study uses a quantitative approach. Quantitative research requires researchers to explain how certain variables affect other variables [22]. The method implemented in this study is the quasi-experimental method. The research design used is a nonequivalent control group design. In this study, there were two groups to be studied. First, the group that received treatment, i.e.: using smartphones during their learning activities. The second group is the control one that did not use smartphones during their learning activities.

Table 1: The Research Design of Nonequivalent Control Group research

Treatment Group	O1	X	O2
Control Group	O3		O4

Description:
O1 : The pretest for experimental class
O2 : The post-test for the experimental class
O3 : The pretest for control class
O4 : The post-test for control class
X : The treatment given to the experimental group

This research was conducted at SD Al Hikmah (Al Hikmah Elementary School) Surabaya. The research population is the fifth graders of the 2021/2022 academic year. The research sample was taken by purposive sampling, namely the fifth-grade students who had the following criteria: having a smartphone, being able to operate a smartphone, and having an initial pretest and posttest understanding of concepts. The number of samples in this study was 43 students. In addition, the students in class A used smartphones during their teaching-learning process, while the students in class B did not use smartphones during their teaching-learning process.

In this research, the instrument used is a test, that is, the initial concept understanding test (pretest) and the final concept understanding test (posttest). The concept understanding test given is in the form of multiple-choice tests with 48 questions. The analysis of instrument testing was conducted before it was distributed to the students to determine its feasibility in terms of validity, discriminatory power, and level of difficulty. The trial of this instrument was carried out on fifth-grade students who had studied the material on the human respiratory system. After the test instrument was completely analyzed and tested, the next step is to analyze the data from the trial results. Based on the test results of the conceptual understanding test instrument, there were 48 valid multiple-choice questions. besides, they had good discriminating power. In terms of the level of difficulty, four questions belong to easy, 39 questions belong to moderate, and 5 questions belong to difficult ones.

Data collection techniques were conducted by giving a concept understanding test to the students. In processing the data, the results of the pretest and post-test were analyzed. After that, the data processing was conducted and assisted with the SPSS 16 (Statistical Product and Service Solution) program. While the data analysis techniques used in this study are as follows:

A normality test was carried out. The normality test is used to find out whether the data used is normally distributed or not. This study used the Shapiro-Wilk normality test. This is done because the number of samples used is less than 50. Then, a homogeneity test was carried out. The purpose of the homogeneity test is to find out the similarity level of the data variance from a population. After that, an independent sample t-test was carried out to find out the average difference in conceptual understanding ability between the two classes (experimental and control). The basis for decision-making in the independent sample t-test is as follows.

a) If the significance value (Sig.) is < 0.05, it indicates that there is an average difference between research subjects.
b) If the significance value (Sig.) is > 0.05, it indicates that there is no average difference between research subjects.

3. RESULTS AND DISCUSSION

3.1 Student Understanding of Concepts

Analysis of students' understanding of concepts in this activity is related to understanding the concept of materials of the human respiratory system. The students' understanding of concepts is carried out by conducting tests through questions on the understanding of breathing, the human respiratory system, functions of the organs that make up the human respiratory system, the mechanism of breathing in humans, the factors that affect the respiratory frequency, human respiratory volume, diseases of the respiratory system, and the effects of pollution air from cigarette smoke on the respiratory system and how to prevent it. The following is the score of students' conceptual understanding tests at SDN Al Hikmah before and after learning using digital smartphone technology.

Table 2: The Score Analysis of Understanding Concept

Data types		Pretest		Posttest	
Groups		Experimental	Control	Experimental	Control
N		21	22	21	22
Mean		40,10	37,32	77,95	59,55
Standard Deviation		6,355	7,403	11,448	11,955
Normality test (Shapiro-Wilk)	Significant	0,52	0,073	0,693	0,191
	Description	Normal	Normal		Normal
Homogeneity test (Levene's test)	Significant	0,394		0,955	
	Description	Homogenous		Homogenous	
T-test	Significant	0,195		0,000	
	Description	Insignificant		Insignificant	

Table 2 shows the different pre-test test scores. P-value > α = 0.05 indicates that there is no significant difference between students' understanding of the concepts in the experimental class and the control class. This occurs because the research subject is the students of SDN Al Hikmah which has an international class program (ICP). The

result showed that the initial conditions of the students in the experimental class and the control class had the same concept understanding abilities. This ICP class implements two curricula, i.e.: the Cambridge curriculum and the international curriculum. After the treatment was performed in the experimental class, the score for calculating the different test data was obtained. The score of the post-test is p-value $<\alpha = 0.05$. It means that there is a significant difference between the scores of students' conceptual understanding tests after learning using digital smartphone technology on the human respiratory system.

The significant difference in the experimental class shows that learning activities using digital smartphone technology on the subject of the human respiratory system can effectively improve students' understanding of concepts. Understanding of these concepts can be awakened through the use of applications available on smartphones. This is in line with the study results conducted by [23] which showed that the use of smartphones to study can increase students' involvement and motivation in learning [24]. Besides, it can also increase students' achievement [25]. In addition, the use of smartphones during the teaching-learning process makes learning activities easier and more effective [26], [27]. This is because students can access smartphones and use their useful features anytime and anywhere.

From the first meeting to the fifth meeting every week, students do a practicum on the human respiratory system because they will understand the concepts of the human respiratory system by doing a practicum. Practicum activities can train students to become skillful in solving problems. It is in line with the theories they have learned in classes. The practicum is carried out using smartphones by utilizing camera features on the smartphones in the form of photos and videos. Smartphones are used as measuring tools for measurement as well. The measurement devices are used for experimenting and learning [24].

Smartphone cameras used to take pictures aim to facilitate the teaching-learning process and understanding of concepts. It can also help students examine changes in the outer structure of things studied in terms of color changes and capture images so that students can identify observations, analyze contextual problems, and do exploration. Photo cameras help students observe changes in their environment [28]. Data taken through digital images can make the relationship between experimental variables more concrete. Thus, the use of smartphone cameras enables students to understand abstract concepts that are often taught in science.

In addition, smartphone cameras are used to record videos to analyze every movement in an experiment. Smartphone cameras also allow students to record video or audio and take pictures of the teachers' explanations from the board or screen [29], [30], revise video recording scores [31], record certain objects, what is being done, and what can be seen and heard wherever they are. Besides, smartphone cameras can help students run interactive surveys, tests, and experiments via touch screens and wireless connections to screens, headsets, nearby screens, biosensors, and other peripherals [32]. Smartphones are an important tool because they facilitate various kinds of calculations and measurements, reducing data acquisition, and processing time [26].

Students use the features available on smartphones for practicum activities. These features can help students to learn actively. Gonzalez et al. [24] state that smartphones that are used as an experimental tool can foster students' motivation, interest, and learning achievement. Besides, it can also increase students' conceptual understanding [29]. Utilizing smartphone technology in the teaching-learning process can overcome practicum problems that cannot be done in conventional laboratories, can also increase student independence in learning [27], and help the process of problem-solving [33].

The benefit of using smartphones as a practicum tool is not in the ability to make more accurate measurements compared to traditional methods but in the ability to carry out practicum and associate experimental procedures by analyzing measurement data with only one device [29]. Students can learn human respiratory system materials with a simple observation so that students can make more critical thoughts to differentiate or convince their knowledge. When students take an active role in their learning and see how the concepts affect their lives, they become more engaged with the subjects and their learning scores improve significantly [24]. It is in line with the statement that the use of smartphones not only helps students improve their understanding of the material in learning biology, but also mathematics and electronics [34]. The camera features on smartphones trigger students to learn more contextually. Besides, students can record their practicum scores by using smartphone cameras so that each student can provide ideas and opinions in criticizing biological problems [35]. Using smartphones in the teaching-learning process can build students' competence in a dynamic way

[36]. Taking pictures taken by students through the camera on their smartphones can create their knowledge. Furthermore, students are encouraged to use smartphones to capture their laboratory pictures. It is proven that students who take and share their pictures are more involved and engaged in learning processes.

3.2 Master of Indicator Problems of Respiratory System Material

The calculation of the increase in score is carried out on the test data for each learning indicator. This is done to find out how far the increase in mastery of concepts that occurs in each learning indicator in the material on the human respiratory system. The score for calculating the increase in score for each indicator can be seen in Table 3 below.

Table 3: The Score Analysis of Understanding Concept

Subtopic	Scores		Increase
	Pretest	Post-test	
Definition of breathing	49	82	33
Human respiratory apparatus	48	90,5	42,5
Functions of the organs that make up the human respiratory system	37	63	26
Breathing mechanism in humans	32	71,9	39,9
Factors affecting the respiratory frequency	26,4	77,7	51,3
Human respiratory volume	38	72,6	34,6
Diseases of the respiratory system	46,24	66,95	20,71
The effect of air pollution from cigarette smoke on the respiratory system and how to prevent it	57,1	96,9	39,8

Table 3 shows that the increase in pretest and posttest scores occurs. There are indicators whose post-test scores are less than 75, namely the function of the organs of the human respiratory system with a post-test score of 63, diseases of the respiratory system with a post-test score of 66.95, the respiratory mechanism in humans with a post-test score of 71.9, and human respiratory volume with a posttest score of 72. This happens because, in the five learning meetings conducted, students always carried out practicum activities assisted by Student Worksheets or students' worksheets. Students' score was less than 75 for 4 indicators because they did not carry out the practicum activities. The students' worksheet the students did was students' worksheet 1. It is about observing the respiratory process exhaust score by using a mirror and observing substances released when breathing using lime sediment. Students' worksheet 2 deals with knowing the number of breaths in humans with changes in position and activity changes. Students' worksheet 3 focuses on observing breathing in creatures by using an artificial respirometer, and students' worksheet 4 emphasizes proving the cause of respiratory disorders by using insect repellent and cotton.

Through the four students' worksheets, students were directed to build concepts with the practicum scores they did. Practicum scores are documented either in the form of taking pictures with a photo camera or taking videos by recording them using smartphone cameras. Such an activity aims to help students to be directly involved and be able to observe their observation scores repeatedly. The four indicators whose posttest scores were less than 75 were due to the absence of students' worksheets. Therefore, students were unable to observe their observation scores repeatedly. The findings are in line with the statement that students needed to repeatedly carry out activities to achieve a good understanding of the lungs and the respiratory system because one of the materials that students consider difficult is the material of the human respiratory system [37]. This is due to students' relatively low cognitive learning scores [11]. The human respiratory system is a difficult biological concept. One of which is the concept of respiratory mechanisms because this material is abstract in nature and relates to everyday life found in human organs. Therefore, studying the working systems of the human body is abstract in nature [9] and complex [38]. The respiratory system consists of concepts that are both concrete and abstract. Abstract concepts are considered difficult by students because they discuss the course of a complex process and it is not easy for students to imagine how the process occurs or is microscopic [39].

Studies showed that students' attempts to understand concepts may be incomplete or incorrect. However, students need opportunities to apply what they know and get feedback to increase their interest [40]. One part of the difficulty in understanding complex concepts can be related to the way these concepts are introduced to students.

The function of the organs that make up the human respiratory system is difficult to understand

for several reasons. One of which is the absence of students' worksheets to help students understand the concept of the organ functions that make up the human respiratory system. Students' worksheets can be used to help students do a practicum in understanding concepts.

Bakri et al. [41] stated that experts use worksheets to do practicum activities in teaching concepts. The use of students' worksheets can assist teachers in developing and implementing the learning process in classes [42]. The absence of students' worksheets for the concept of the function of the organs making up the human respiratory system makes it difficult for students to understand the concept, so students learn by memorizing the learning materials without proper understanding even though students' worksheets can be used in the learning process.

The students' worksheets are expected to enable students to study independently [43]. Rote learning makes students less interested in understanding the concepts. The function of the organs that make up the human respiratory system is a concept whose explanation cannot be related to everyday life. Therefore, to make learning effective, the materials must be taught by connecting certain topics with students' everyday life [44]. Good learning occurs when teachers can build students' conceptual understanding through the activities and materials provided because students do not directly observe and experience materials on the human respiratory system which has complex system characteristics [45]. Then, students tend to focus more on the structure of the human respiratory system instead of focusing on the function and behavior of the system, so students have difficulty understanding the learning materials.

Regarding the material for diseases of the respiratory system, the posttest score is 66.95 which is less than 75. This was also due to the absence of students' worksheets in this material. As a result, students learn more to memorize the materials instead of understanding the concepts. It is in line with the aforementioned explanation stating that rote learning or learning certain materials through memorizing makes students less interested in understanding the concept. Students had to memorize a lot of material in a short-limited time. In addition, it is also due to the lack of connection between what is taught in class and students' daily life.

Arista and Kuswanto [27] stated that many students said that science lessons or teachers cannot help their students relate what they have learned in class and their daily life. This shows that in biology lessons, teachers only talk and transfer theoretical or abstract knowledge without giving examples from students' everyday life. In other words, students cannot understand why they learn certain topics or concepts in science because they cannot relate the materials to their real life. Teachers' lack of understanding of the relationship between teaching materials in classes and students' daily life makes students feel hard to learn science. This causes students to lose their motivation to learn science and finally it creates students' negative attitudes toward the learning materials.

Regarding the material on the mechanism of breathing in humans, the posttest score is 71.9 which is less than 75. It happens due to the absence of students' worksheets. Besides, the material is abstract in nature, so students find it difficult to understand. The material is related to the functions of the organs that make up the human respiratory system. It is hard for the students to understand the mechanism of breathing in humans because they tend to understand the structure of the respiratory system organs without understanding their functions. This can be seen from the result of the post-test score on the function of the organs making up the human respiratory system which records the lowest score, that is, 63.

In the learning materials related to human respiratory volume, the posttest score is 72. This is also because of the absence of students' worksheets. The learning materials related to human respiratory volume are abstract in nature. It is very difficult for students to understand the materials if they learn them through rote learning. The research conducted by Firdaus et al. [46] on the concept of respiratory volume shows similar results. Students achieved the lowest scores regarding the materials related to human respiratory volume because they still did not understand what the volume capacity was for each respiratory volume. Teachers should give a chance for students to do observation during their learning of the materials because teaching science needs to use visual materials and tools to help students retain biological knowledge for a long time. As a result, students will be able to remember the knowledge they have learned more easily. Teaching science with visual materials can give words more concrete meaning, show relationships between ideas explicitly, provide useful communication channels, strong verbal messages and images that are easy to remember in students' minds, and make lessons more interesting for students.

In a learning activity, understanding the concept is the most important part of learning. There are many reasons why students experience difficulties in

learning the organizational concept level of science and its abstract concept level as well. Those make science learning materials difficult to understand. Overloaded learning materials, the abstract and interdisciplinary nature of science concepts, and difficulties with textbooks are other factors that hinder students from understanding science learning easily. The nature of science itself and its teaching methods are one of the causes of difficulties in learning science [47]. According to Putri et al. [39] in their research, studying abstract concepts as well as microscopic and submicroscopic representation skills are needed in various formats so that students can understand abstract concepts more easily. In addition, representation abilities can be improved by implementing technology in learning media.

Using smartphones as a learning medium provides more in-depth learning opportunities for students because by using smartphones, students can develop learning through searching for information on the internet. They can also train their skills in carrying out practicums due to the principle of mobility possessed by smartphones. The use of smartphones can reduce difficulties and assist teachers in learning so that the delivery of concepts is more meaningful and can increase understanding of concepts, thereby creating a quality learning process [48].

In addition to the data above, this study also provides information about the advantages and disadvantages of the results obtained. The strength of this research is the functioning of the use of smartphones in learning. The choice of the quasi-experimental method helps to obtain data about differences in students' understanding of concepts after using smartphones. Smartphones as media have a real impact on the activeness of students so that they are able to master the material well. Various features in the camera help students to be able to take pictures of the experiment's students are doing. Students can observe the results or findings of experiments repeatedly so that students' understanding of concepts increases.

On the other hand, this research also has limitations. These limitations include the limited research sample which was only attended by 43 students or only two schools. This study only compares one independent or influencing variable (smartphone use) with learning without a smartphone. Future research will be better if the use of independent variables is not just one. This means that other researchers can add other media such as multimedia as a comparison from smartphones. The end result is expected to lead to a more effective use of media between smartphones and multimedia towards understanding concepts. Future researchers are expected to do so in the future.

5. CONCLUSION

The use of smartphones in learning activities can help students understand concepts more easily. The features available on smartphones such as a camera are very helpful because students can learn contextually and record the results of experiments, they have carried out in learning activities. The results of the recordings made can be played repeatedly to be observed until students understand the activities that have been carried out.

Students will always have great access to smartphones. Therefore, it is recommended that further research be used to utilize existing features on smartphones in education. In addition, future researchers can also conduct similar research with different research materials and focus, for example improving communication skills. This research also contributes to the quality of learning so that schools can apply smartphone use to other subject matter. Furthermore, it is hoped that the teaching-learning process in elementary schools will develop satisfactorily.

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