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THE USE OF SMARTPHONES IN PHYSIC LEARNING ON SOUND WAVES

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ABSTRACT

The role of education is very important to prepare students who have knowledge and skills in using technology. Physics learning in the 21st century requires teachers to make technology an efficient and innovative learning medium. One technology that is often used by students is a smartphone. Smartphones are a technology that can be used to motivate and motivate students' curiosity to learn. The purpose of this study is to see the use of smartphones in learning physics, especially sound wave material. This type of research is descriptive qualitative research. Research data were collected through questionnaires and interview sheets. Questionnaires are distributed using a rating scale. Price data is processed using a proportion technique. The results of this research are that on average students in five public senior high schools already have a smartphone. Smartphones have been used in learning. However, the use of smartphones is still limited. Smartphones have not been used as learning media in sound wave experiment activities. In addition, smartphones are more often used by students to play social media than studying. This shows that the use of smartphones by teachers and students has not been carried out optimally in learning physics, especially sound wave material.

Keywords: sound waves, technology, smartphone, sound analyzer basic, frequency sound generator

I. INTRODUCTION

Education has an important role in preparing students to have knowledge and skills, especially in using technology. Through education, students are guided to have innovations, be able to use technology and use information media wisely, and collaborate to survive by using the skills they have [1]. In this era, mastery of science and technology is a reference for solving educational challenges in the future [2]. In essence, education is an effort to prepare students to apply the principles of science and technology in shaping students to become fully human beings [3].

In the 21st century skills are needed when students enter the world of work. Companies and society will see how a person works, their skills in using technology, and establishing good communication with other people. Students must have skills in using technology to solve problems quickly and precisely. The use of technology helps make jobs that are difficult for humans easy. Therefore, when someone enters the work environment, knowledge must be supported by skills. So, it is necessary for the teacher's role to guide students to have knowledge and skills in using technology to ease human work and save time.

In this era, mastery of science and technology becomes a reference in solving future educational challenges. In essence, education is an effort to prepare students to apply the principles of science and technology in shaping students into complete humans. Education must be able to prepare human resources capable of being competitive with the global community [4]. Education is very important to produce graduates who master science and technology so that students become graduates who are competitive, innovative, creative, and skilled to survive and compete in the era of the Industrial Revolution 5.0. In the era of Industrial Revolution 5.0, students must have soft skills and hard skills to be able to compete with international workers. So, in learning activities, educators must be able to combine technology with lesson material. It is hoped that by integrating technology into learning, students will have experience and skills in using technology. Through the experience that students gain during learning activities, students will be proficient in using technology in everyday life.

The use of technology as a learning medium is one of the innovative steps to improve the quality of education in Indonesia so that it can compete at the global level [5]. Physics learning in the 21st century cannot be separated from technological developments. The demands of the 21st century for learning are the integration

of the use of technology in the field of education to improve students' skills [6]. Technology is very important in learning because students in the 21st century grow and develop when technology develops rapidly. This can be seen in society, almost every child uses a smartphone as a form of technology. Children enjoy using smartphones to play, learn, and communicate. This is supported by the expert opinion that children of school age currently spend more time with smartphones because smartphones are considered interesting [7]. Another opinion states that children nowadays spend more time with their respective smartphones [8]. Based on the explanation above, technology is currently a tool that is close to students and a necessity for students.

It is hoped that the use of technology can create liberating learning for students. This is supported by Ki Hadjar Dewantara's idea that education must pay attention to the nature of nature and the nature of the times. The nature of the times pays attention to developments in the times that are appropriate to students. Currently, students are in the technological age. In this era, learning must facilitate students to be able to live and work and have technological skills to achieve a decent life and livelihood.

One lesson that requires technology in its application is physics learning. Many technologies apply physics concepts to them. Therefore, learning physics is expected to be able to make students have skills in using technology and utilizing technology to master physics concepts. This is supported by the expert opinion that physics learning should provide space for students to think critically about the application of physics in everyday life which is realized through technology [9]. Through the use of technology as a learning medium, students can apply physics learning in everyday life. The use of technology can be the right solution to solving problems that arise in physics learning and problems in students' lives. The existence of technology makes it easier for students to carry out learning activities and directly apply the material studied.

In the 21st century technology has become a tool that is close to students. Technology has become a major necessity and lifestyle for students. One technology that is close to students is smartphones. Almost every student has a smartphone. Smartphones can be used well in learning if students have the competence to operate them. Using smartphones makes learning easier because students don't need to look for tools or buy tools to support learning activities. Apart from that, smartphones allow students to study wherever and whenever they want. This makes learning more flexible for students because students can access learning without having to carry heavy books wherever students go. This is supported by the expert opinion that smartphones make it comfortable and easy for students to learn material content [10]. Another opinion explains that learning can become something more real and interesting for students when using technology [11]. Smartphones can also change traditional learning to be more interesting and interactive [12]. Based on the explanation above, students are required to be proficient in using technology as a learning medium. This is supported by [13] that the use of technology can increase competence to form creative, collaborative, and competitive human resources. Technology used as a learning medium makes it easier for teachers and students to convey information, manage information, and carry out different experiences [14]. So as a teacher, it is necessary to train students to be proficient in using technology.

The reality is that there are still many students who misuse smartphone functions. Smartphones are widely used as an entertainment tool by students. Many students lose track of time when playing on smartphones. Some forget to study, forget to help their parents, and some even forget to eat, because they are too busy playing on their smartphones. Some students stay up late playing games on their smartphones so that they are sleepy at school when participating in learning activities. This opinion is supported by relevant research that people who play online games on smartphones spend excessive time playing online games, sacrificing sleep, eating, or other important tasks. Excessive use of smartphones will cause several side effects, including the radiation produced by smartphones which will disrupt body health. The World Health Organization (WHO) suggests that signal radiation from smartphones can cause brain cancer.

In the physics learning process, experimental activities are needed to explain physical phenomena. This is supported by relevant research that carrying out practical work in the field of physics is very important. It is important to support learning activities, emphasize physics concepts, and practice skills. Physics is a science that develops through observational steps consisting of; (1) formulating the problem; (2) drawing hypotheses; (3) conducting experiments to test hypotheses; and (4) drawing conclusions based on experimental activities [15]. Experiments are teaching and learning activities that provide opportunities for students to conduct experiments, test theories, and apply theories in the laboratory or outside the laboratory [16]. Through experimentation, students will experience an increase in both knowledge and skills. So in learning physics, experimental activities are needed that give students time to discover their knowledge.

One material that requires experimental activities is sound waves. Sound waves have many applications in everyday life that can only be properly understood through real experiments. However, the fact is that physics

learning at school does not encourage students to understand in depth the application of sound waves. In fact, the material of sound waves is material that must be understood through experiments. Through experiments, students are guided to discover their own concepts and knowledge through scientific activities. The rarity of experiments carried out causes a lack of student motivation and interest in studying sound waves. Students who do not carry out experiments feel that sound waves are not needed to solve problems in everyday life. In fact, in the field, there are many phenomena related to sound waves, but students do not yet know that these phenomena can be overcome with the concept of sound waves.

One of the factors that caused no experimental activities to be carried out at the five state high schools was that the high school physics KIT was not yet complete for investigating sound wave material and was limited in quantity. This is supported by research [17] which shows that an incomplete physics KIT is a reason for not carrying out experiments. The incomplete Physics KIT makes teachers carry out learning activities about sound waves using lecture, discussion, question and answer methods. This means that the availability of equipment is very important to support the implementation of experiments. Therefore, it is necessary to have technology that is close to students and can be used as a learning medium in sound wave experimental activities. One technology that can be utilized is a smartphone. Smartphones can be used without having to bother looking for and buying new experimental equipment.

In physics learning, smartphones can be used as the main medium for conducting experiments. Experiments can be carried out with the help of software installed on smartphones. Software is the primary tool for measuring. One of the software that can be used during the experiment is Sound Analyzer Basic 1.10.2 and Frequency Sound Generator 2.6. This software can be used for experiments on sound wave materials.

This research aims to see the extent to which students use smartphones in learning physics, especially sound waves. This research data can be a reference for teachers, lecturers, and technology developers to create and develop electronic teaching materials, technology-based learning media, interactive multimedia, and smartphone-based experiment sets to make it easier for students to carry out experiments. This is supported by relevant research that teachers, lecturers, and technology developers have a very important role in creating ideas, innovations, or ideas for utilizing technology as a learning medium [14]. This research can also be a reference for creating innovation in making technology-based teaching materials. Teaching materials are a very important support in learning activities. In accordance with relevant research, teaching materials include tools that have an important role in the learning process [18]. Teaching materials can make it easier for teachers and students to achieve learning goals. Apart from that, this research data can be a guide for teachers to determine students' use of smartphones. Do smartphones have a negative impact and how can teachers overcome the negative impacts of smartphones? Through this research, teachers can find the right solution to overcome the problem of using smartphones by using smartphones as a learning medium. The results of research development can help students in carrying out learning activities.

II. METHOD

This type of research is qualitative descriptive research. Qualitative research methods are research based on interpretive philosophy or postpositivism to examine the condition of natural objects with the researcher as the key instrument [19]. Qualitative descriptive research focuses on answering research questions about how an experience or event occurs which is studied in depth to find patterns in the event [20]. Qualitative research uses data collection techniques carried out in a triangulated manner, namely a combination of observation, interviews, and documentation [19]. Researchers and data sources are key instruments in this research. This research is descriptive in nature with the data obtained in the form of words and images [19]. Facts that occur in the field are understood by looking at actions, conditions, and situations which are then described in the form of words [21]. The advantage of this qualitative research is the flexibility of the researcher's style in describing the research flow with an open research problem [22].

In this research, the subjects used were students at five state high schools. Meanwhile, the object that is the target of the research is the use of smartphones by students as a learning medium for physics subjects in high school, especially sound waves. Sources of information in this research were obtained from teachers and students at five state high schools. Data collection techniques in this research used interview and questionnaire techniques. Interviews are data collection techniques carried out by researchers by conducting questions and answers with sources. Questions and answers are carried out to obtain information in the form of data needed to support research. In this research, the interviews conducted were qualitative interviews. Qualitative interviews provide freedom for researchers to ask questions according to their needs without being bound by previously prepared questions [19]. A questionnaire or questionnaire is a data collection technique carried out by

researchers with several questions or written statements given to respondents to answer [19]. The use of questionnaires was carried out by researchers considering that the number of respondents was quite large and spread across several places. The data collection technique was carried out by distributing questionnaires to 207 students and 7 high school physics teachers. Researchers also conducted interviews with 7 high school teachers to obtain additional information and observe the availability of high school physics KITs, especially material on sound waves.

The research procedure consists of the preparation stage, implementation stage, and completion stage. The preparation stage is carried out by designing and making questionnaires and interview instruments. The implementation stage was carried out by collecting data through interview instrument sheets, questionnaire instrument sheets, and high school physics KIT observations. Questionnaires distributed to students and teachers use a rating scale. Teachers and students as respondents will answer yes or no. This data then becomes a guide to describe the facts that occur at school. The final stage is the completion stage. The data that has been obtained through questionnaires and interviews is then processed. At this stage, researchers select, summarize, and focus data on important things that support research. After processing, conclusions can be drawn and a research report can be made.

The instruments in this research used questionnaires and interview sheets. The questionnaires distributed consisted of a smartphone usage questionnaire filled in by students and a smartphone usage questionnaire filled in by the teacher. The data obtained will be processed using percentage techniques [23]. In processing the data, researchers used the Microsoft Excel application so that the data obtained was more accurate and completed quickly. The equation using the percentage technique is:

$$Value = \frac{Scor\ obtained}{Total\ Score} \times 100\% \qquad (1)$$

After obtaining the percentage value, the value will be displayed in the form of a bar chart and table. The purpose of the data is presented in the form of tables and diagrams so that the data is easier to understand. Analysis of the use of smartphones was carried out to raise problems in the physics learning process, especially in the material of sound waves. This analysis was also carried out to see how students use smartphones. The data obtained can illustrate whether the smartphone has been used appropriately by students or not. This problem is the basis for further research in developing products that use smartphones for physics learning so that misuse of smartphones outside of learning can be overcome.

III. RESULTS AND DISCUSSION

The results of this study are information data on the use of smartphones by students and teachers in learning physics, especially sound wave material. The following are the results of a smartphone use questionnaire research conducted by students at five state high schools, which can be seen in the image below.

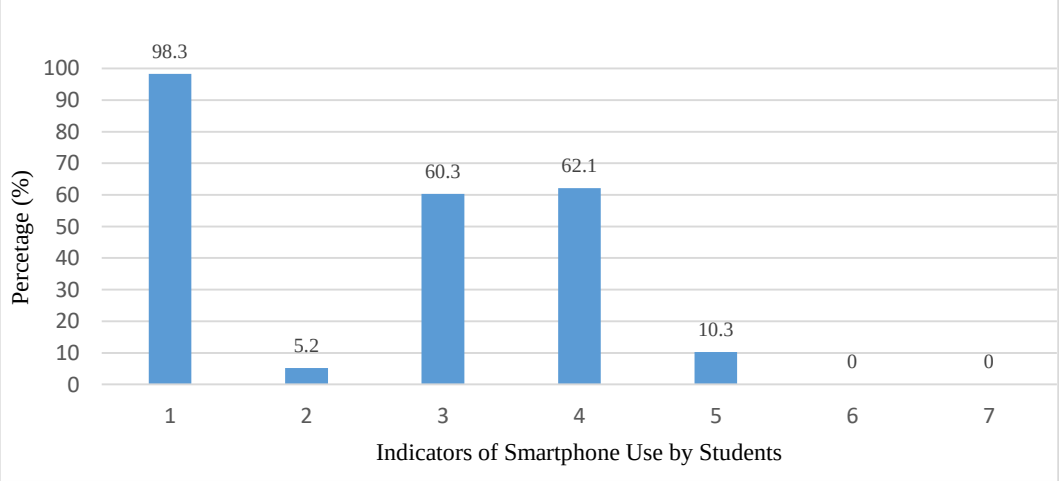

Fig.1 Percentage of Use Percentage of Smartphone Usage In Senior High School A

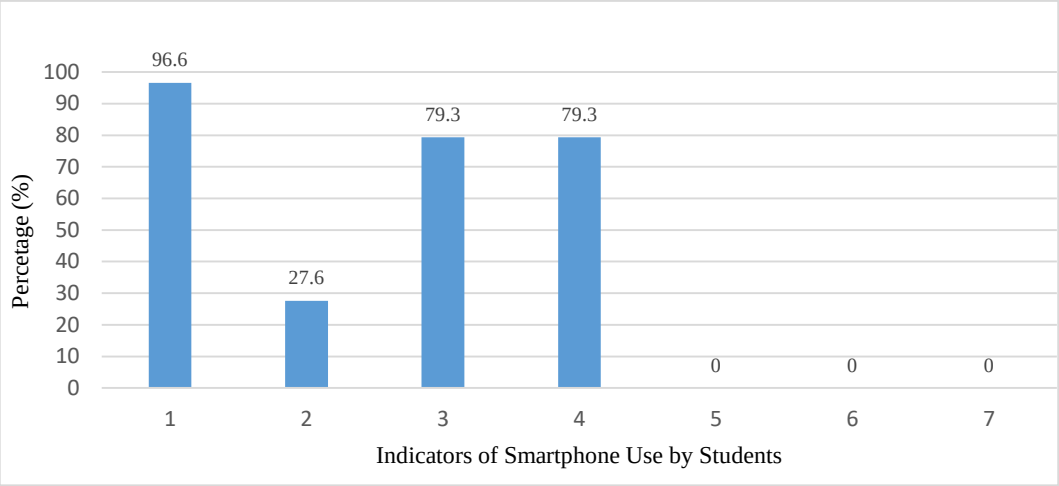

Fig.2 Percentage of Use Percentage of Smartphone Usage In Senior High School B

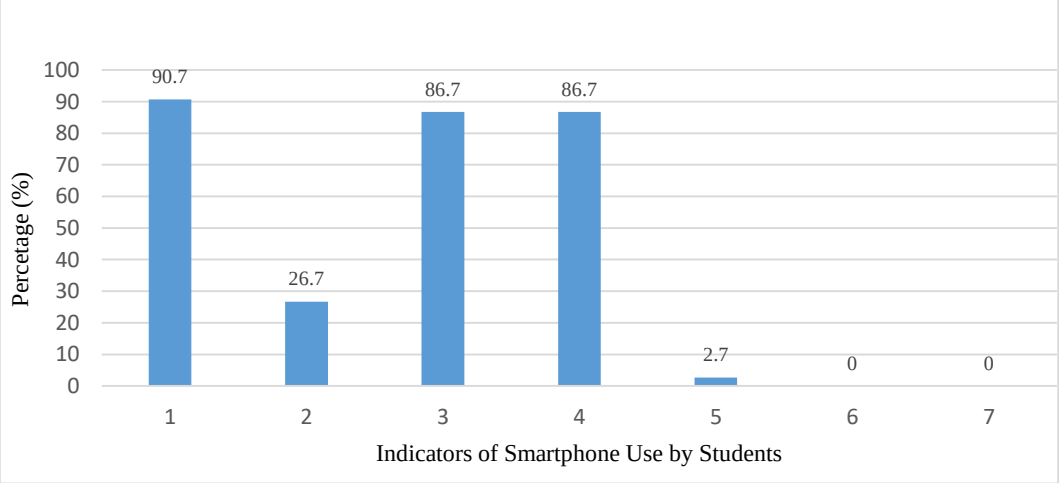

Fig.3 Percentage of Use Percentage of Smartphone Usage In Senior High School C

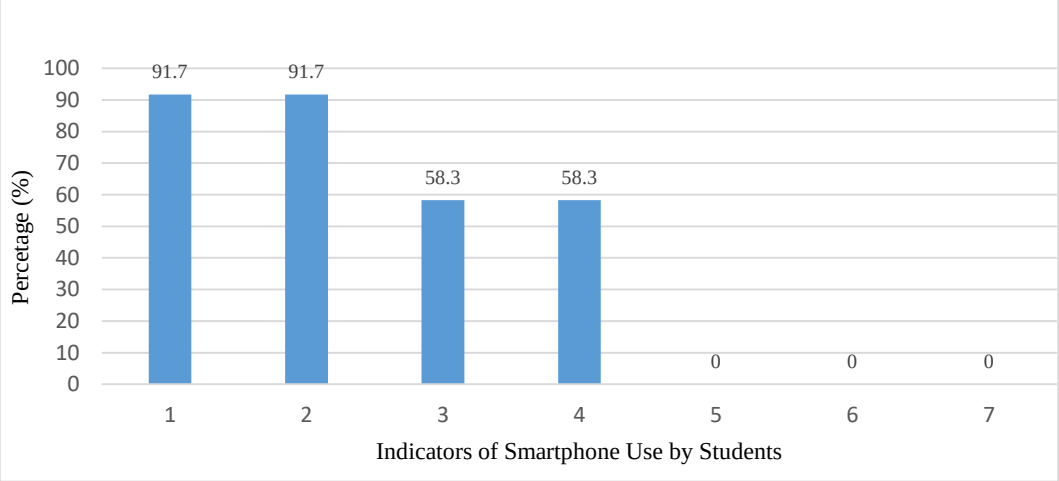

Fig.4 Percentage of Use Percentage of Smartphone Usage In Senior High School D

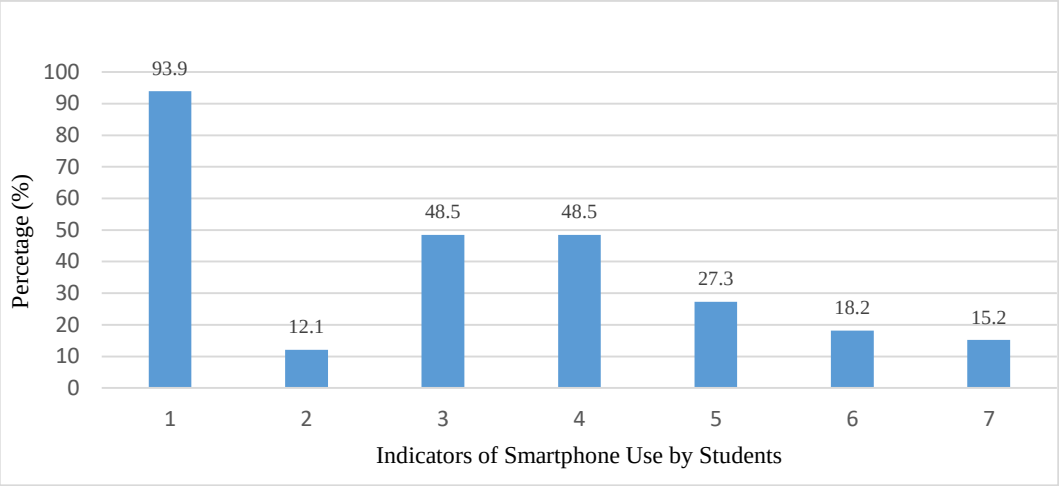

Fig.5 Percentage of Use Percentage of Smartphone Usage In Senior High School E

Information:
1. I use a smartphone to study
2. I use my smartphone more to play games than study
3. I use my smartphone more often to play social media than study
4. I studied sound waves using a smartphone
5. I studied sound waves using a smartphone
6. I have Sound Analyzer Basic 1.0.2 software
7. I use the Sound Analyzer Basic 1.10.2 software for a sound wave experiment

Based on smartphone usage questionnaire data, information was obtained that the average student already has a smartphone. This means that smartphones are a technology that is close to students in the 21st century. This is supported by relevant research that smartphones have become commonplace and are needed by students today [24]. Another opinion states that the average person already has a smartphone and cannot be separated from smartphones because smartphones have become a technology that is closely related to everyday life [25]. Therefore, smartphones are very suitable as technology-based physics learning media because almost every student has a smartphone. Apart from that, students do not need to specifically learn how to use smartphones because students are used to using smartphones in everyday life. Based on the data obtained, it is known that the advantage of using smartphones as a learning medium is that students and teachers do not need to specifically prepare or buy technology for physics learning media. This will save time and money spent on providing learning media. This statement is supported by relevant research that technology can make it easier for students to achieve learning goals in a shorter time and at a lower cost [26]. The data obtained in this research can be a basis for teachers to consider smartphones as a flexible learning medium in physics subjects.

Questionnaire data shows that more than 60% of smartphones have been used for studying in SMA A, SMA C, and SMA E. However, the use of smartphones for learning is only 41.4% in SMA B and 8.3% in SMA D. This shows There are still several high schools whose students do not use smartphones to study. This means that the use of smartphones as a technology that can be used as a learning medium has not been used optimally. If smartphones are used optimally, smartphones can answer the challenges teachers encounter, such as limited experimental equipment, lack of student motivation to learn, and students' lack of understanding of concepts.

Questionnaire data shows that smartphones have been used for learning by students at 3 public high schools. Other research has also been conducted that smartphones have been used in learning [27]. Students already use smartphones to watch physics learning videos, search for learning materials on Google, and discuss via WhatsApp. This shows that the use of smartphones is still limited to learning physics. This is supported by the expert opinion that schools have not utilized technology such as smartphones and effective applications [28]. Smartphones can be used as a means for students to explore through experiments and physics games to improve critical thinking skills and evaluate learning. Through smartphones, students can test hypotheses in experiments without fear of breaking or breaking the equipment. Damage to experimental equipment can be minimized because equipment settings are carried out using software on a smartphone. Apart from that, the use of smartphones as a learning medium can facilitate the limited number of tools. So, every student can try directly and discover concepts through experimentation. The use of smartphones can minimize students who cannot try experimental activities because they lack equipment.

The results of the questionnaire show that the use of smartphones for playing games can be overcome by students. However, questionnaire data shows that students have not been able to allocate their time well to playing on social media. Students use social media more often than studying. Social media is used as a means of expression for students and a means of communication. Students who are busy communicating on social media will lose track of time and ignore their study obligations. Students' study time is reduced because students are busy playing on social media. In accordance with relevant research, students' learning achievement decreases because they cannot divide their time playing social media with studying [16]. Most students enjoy making videos and dancing on the TikTok and Instagram applications. This will result in students lacking concentration in learning because students feel playing on social media is more fun than studying at school. Other research states that students who often use smartphones are less focused on learning [25]. Students who are used to playing on social media will find learning monotonous and boring if it is done traditionally using the lecture method. This is a challenge for future teachers and researchers to create learning products that can attract students' interest and curiosity. Student curiosity is the key for students to start learning.

The solution that can be taken to overcome the inappropriate use of smartphones is to create an innovative use of technology that invites students to seek their own knowledge, explore, and try new things according to their abilities. In accordance with Ki Hadjar Dewantara's thoughts as teachers, we must pay attention to the nature of the times. Students at this time will find it interesting and have an interest in learning if learning uses technology. So that teachers can realize learning that supports students, teachers must encourage students to use smartphones in learning. Teachers can use various applications to become virtual laboratories for students to try new things in their thinking. Students can formulate hypotheses without having to be afraid of making mistakes and damaging the equipment. This will guide students to independently solve their problems in learning. If students are used to solving problems independently, then students will be used to solving problems that arise in their lives.

Teacher questionnaire data can be seen in Figure 6.

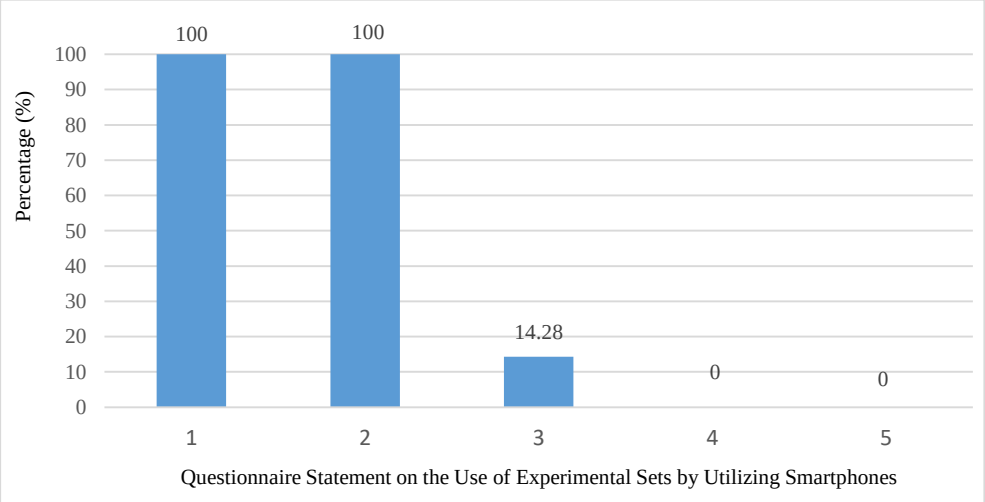

Fig. 6. Percentage of Use of Experimental Sets by Utilizing Smartphones

Information:

1. The teacher has used a smartphone as a learning medium for sound wave material
2. The teacher has never conducted experiments on sound wave material using a smartphone
3. The teacher recognizes software sound analyzer basic 1.10.2
4. The teacher has a software sound analyzer basic 1.10.2
5. The teacher used software sound analyzer basic 1.10.2 to conduct sound wave experiments

The use of smartphones as a learning medium in experimental activities has never been done. Learning carried out in high school is still teacher-centered and relies on rote memorization, so physics learning does not yet link real life and technology [2]. The teaching process carried out by teachers is still less interesting so students are less motivated to study physics [29]. This causes the learning process carried out to not have a significant impact on education [30].

The results of interviews at one of the schools showed that experimental activities on sound wave material were not carried out due to limited experimental sets. However, basic competency in sound wave material requires carrying out experiments. Not carrying out experiments makes students feel that physics material is

abstract material that is difficult to understand. The many formulas, concepts, and calculations that students have to understand make students think that physics is material that is difficult to understand and boring [29]. Students who think that the material is difficult will tend to dislike the subject. As a result, student learning outcomes will be low [31]. Students' difficulties in understanding physics concepts are caused by students who are less trained in solving physics problems [26]. Problems in physics can be solved through experiments. Experiments will answer student problems. One of the student problems is that students feel that physics material is abstract. Experiments will make abstract physical material more real through direct experimental activities. Apart from that, experiments will provide meaningful learning experiences for students because students experience and observe physical phenomena directly.

One solution so that experiments can take place even though experimental equipment in schools is limited is using smartphones. This is supported by relevant research that the use of technology can be a solution when experimental equipment is incomplete [26]. Smartphones can be used as learning media in experimental activities. In sound wave material, teachers and students can use the Sound Analyzer Basic 1.10.2 and Frequency Sound Generator 2.6 software. This smartphone application can help teachers and students measure sound intensity levels, frequencies, and sound sources. So experimental activities can still take place using a smartphone.

However, questionnaire data shows that the average student in five public high schools does not know the Sound Analyzer Basic 1.10.2 software and does not have the Sound Analyzer Basic 1.10.2 software. Sound Analyzer Basic 1.10.2 software has never been used for sound wave experiments. This is supported by questionnaire data distributed to teachers. Questionnaire data shows that 85.72% of teachers do not know the Sound Analyzer Basic 1.10.2 software. Teachers who don't have Sound Analyzer Basic 1.10.2 software 100%. Teachers who have not used Sound Analyzer Basic 1.10.2 software in sound wave experiments are 100%. This shows that physics learning in schools has not utilized the potential of technology to the maximum. The use of smartphones has not been used as a learning medium in experimental activities.

Even though teachers must be able to utilize technology in teaching physics. In accordance with relevant research education is dynamic and must keep pace with developments over time [32,33]. Teachers should be able to guide students in using smartphones in physics learning. In accordance with the role of the teacher which is a function of the success of the educational mission to improve the quality of education in schools [34]. Teachers have an important role in achieving learning goals so teachers are required to be able to utilize information and communication technology in learning activities [4]. The teacher's role is to organize and direct students in using smartphones and improve students' skills and competencies. One of the basic competencies that students must achieve in the field of sound waves is Basic Competency 3.10 applying the concepts and principles of sound and light waves in the field of technology. This shows that if technology is not utilized in learning, it means that basic competencies are not achieved.

This research can see the ability of teachers and students to use smartphones in physics learning so that an evaluation can be carried out on the use of technology by teachers and students. Based on the demands of the 2013 curriculum, competency in using technology in learning is one of the skills that students must master. Technological developments require students to develop their potential which includes skills in using technology, mastery of knowledge, and innovation in learning. This means that the knowledge possessed by students must be supported by skills in using technology.

This research data can be used as a reference for developing smartphone-based interactive and multimedia teaching materials. Smartphones are simple tools for students to use because smartphones are small and easy to carry anywhere. Smartphones are tools that are easy to carry and can be used to search for information [35]. Smartphone use is also not limited by time. Students can study sound wave material both during class hours and outside school hours. In accordance with relevant research, Android-based learning is expected to make it easier for students to carry out learning according to their abilities wherever and whenever [36].

The use of smartphones as a learning medium makes it easy for students to access information. The learning process becomes easier because students can look for various expert opinions, research and theories as comparisons to draw conclusions. The conclusions and data obtained will be more accurate. Apart from that, smartphones can make student work easier and improve student academic results. All student learning styles such as visual, audio, kinesthetic can be facilitated using smartphones. This is what makes smartphones able to improve student learning outcomes [37].

This research also provides a basis for teachers to overcome the problem of inappropriate smartphone use by students. Teachers can motivate students to use smartphones as a good learning medium for students [37]. It is hoped that this research can become evaluation material for teachers to guide students in using smartphones from something less useful to something more useful. Smartphones can be an efficient technology for learning if used correctly. This statement is supported by expert opinion that smartphones are an effective tool for teaching and improving student learning achievement [38].

IV. CONCLUSION

Smartphones are a technology that can be used as learning media to support learning activities. Smartphones can be an interesting and fun learning medium for students because smartphones are a technology that is close to students. Currently, smartphones offer a variety of applications that can enable students to learn independently anywhere, both at school and at home. Applications on smartphones support students in carrying out theoretical and experimental learning. Experiments are facilitated with a virtual laboratory by smartphone. So the limitations of tools and materials for conducting experiments can be overcome.

The use of smartphones will guide students to be active in learning. This is because the use of smartphones is in accordance with the nature of the times among high school students today. In accordance with Ki Hadjar Dewantara's principle that education should be carried out in accordance with the nature of nature and the nature of the times. Adapting learning to the nature of the times will create learning that is in favor of students. Students will feel that learning is not something boring but an interesting and enjoyable activity.

The use of smartphones in learning has been carried out. However, based on the research that has been carried out, it can be concluded that the use of smartphones in learning physics, especially sound wave material, has not been implemented optimally in five state high schools. Research shows that the average student already has a smartphone. Smartphones have been used in learning, but smartphone use is still limited to viewing learning videos and searching for learning materials on Google and YouTube. The use of smartphones as a learning medium in sound wave experimental activities has never been carried out by teachers and students.

The use of smartphones among students at five state high schools is still inappropriate. Students at five state high schools on average spend a lot of time using smartphones to play on social media. As a result, students are less focused on studying because they spend a lot of time using smartphones. Apart from that, excessive use of smartphones can harm your health. So that smartphones can be used wisely, teachers must guide students to use smartphones in learning. Teachers can use smartphones as a learning medium so that students can focus on learning and use smartphones wisely.

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