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Validity and Practicality of Student Worksheet Integrated by Sound Wave Experiment Set Using Smartphone with Sound Analyzer Basic 1.10.2 and Frequency Generator 2.6 Software

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Abstract

The sound wave experiment in class XI high school physics learning did not go according to the planned mandate of the 2013 curriculum. Based on observations in five high schools, high school physics KITs are not yet complete and in numbers limited physics KIT. Based on the problems that occur in schools, there is a need for alternative media so that experimental activities can be carried out. Therefore, worksheets are needed that can guide students in carrying out sound wave experimental activities. This research uses a smartphone installed with Sound Analyzer Basic 1.10.2 software to measure the frequency and intensity level of sound as well as the Sound Generator 2.6 frequency as a sound source. The type of research used is research and development refers to the ADDIE model. Instrument of validity and practicality using a Likert scale. Validity results are calculated using the Aiken (1985) formula which is said to be valid if the value ranges between 0.87-1.00. Practicality results are calculated using a percentage technique according to Riduwan (2014) which is said to be practical if the value is 61%-80% and very practical 81%-100%. Students worksheets created are valid with an average value of content validity of 0.91, presentation validity of 0.92, and graphic validity of 0.88. Students worksheets created are practical with an average value of practicality according to students for ease of 87%, attractiveness of 87%, benefits of 85%, and an average value according to teachers for ease of 83%, attractiveness of 76%, benefits 79%.

Keywords: validity, practicality, student worksheet, Sound Analyzer Basic 1.10.2, Frequency Sound Generator 2.6

INTRODUCTION

In the era of the industrial revolution 4.0 students must have knowledge supported by skills. The skills demanded in this century are skills in using technology. This statement is supported by Pratama (2018) that technology plays an important role in education. Technology plays a significant role in supporting the teaching and learning process (Machmud, 2018).

To prepare students who are skilled in using technology, the government has made adjustments to the curriculum (Sari et al., 2019). Curriculum adjustments are made by implementing the 2013 curriculum. The 2013 curriculum requires students to have competence in utilizing technology to solve

problems. This statement is supported by Astutik et al. (2020) that high school graduates are expected to have the competence to solve problems and apply them in life. The importance of competence in using technology is supported by Wijaya et al. (2016) who that the important role of education is to prepare students who are innovative and skilled in using technology to work and survive.

One technology that can meet the demands of the 2013 curriculum is a smartphone. Smartphones have become a technology that is often used by children and adolescents (Gui et al., 2023). This statement is supported by Machmud (2018) that smartphones are familiar to students and become an integral part of students. The results of interviews with teachers and students in five public high schools show that the use of smartphones for learning has been carried out. However, smartphones are only used to watch learning videos on YouTube, collect assignments on WhatsApp, and search for material on Google. This is as long as the use of a smartphone is administrative. Smartphones have not been used optimally as learning media to improve student skills.

The use of smartphones that are not maximal in learning causes several problems. The results of the interviews show that students use smartphones more often outside of learning. Relevant research shows that smartphones are more often used for social media (Nayak, 2018; Sobon et al., 2019; Ardiansyah & Nana, 2020; Simanjuntak et al., 2018). This causes addiction for users, so users can spend more time with smartphones (Ge et al., 2023; Nayak, 2018). As a result, student time is wasted and time for learning is reduced. Therefore it is necessary to have an evaluation carried out by the teacher. Teachers must be able to guide students to use smartphones as fun learning media.

One of the materials that can utilize a smartphone as a learning medium to achieve basic competence is sound waves. Basic competence in sound wave material requires students to be able to apply the concept of sound waves in technology and conduct experiments. Smartphones are a technology that can be used as a sound wave experiment set.

Observations at school show that sound wave experiments have never been carried out. The cause of the non-implementation of the experiment was the incomplete sound wave experimental equipment at school. This statement is supported by Purwasih et al. (2022) that the incomplete high school physics KIT was the reason the experiment was not carried out. This is supported by the research of Wirda et al. (2015) that teachers teach natural sciences using the lecture method and rarely do experiments. Even though experimental activities are the main key to achieving basic competence.

The implementation of experiments is very important because the application of sound waves is often found in daily life. In addition, the concept of sound waves can only be properly understood if experiments are carried out. Experimental activities will lead students to find concepts and principles by the basic competencies to be achieved (Usmeldi, 2016). Through experiments, students actively build their concepts and develop their skills (Nugraha et al., 2017). Experiments increase students' science process skills because they involve students directly in investigating and proving experiments (Nugraha et al., 2018; Salamah & Mursal, 2017). This statement is supported by Siswato (2023) that students' skills will increase if learning is based on scientific processes such as making observations, conducting experiments, and drawing conclusions. Based on the explanation above, experiments are very important in learning physics (Safarati et al., 2022; Yulianci et al., 2019; Nurfadilah et al., 2019).

A set of sound wave experiments is needed to support the implementation of the experiment. A smartphone-based sound wave experiment set with installed Sound Analyzer Basic 1.10.2 and Frequency Sound Generator 2.6 software has been developed. This experimental set can be used as an alternative medium to support sound wave experiments. Investigations that can be carried out using this experimental set include deflected sound waves, sound resonance, the Doppler effect, and sound intensity levels.

The advantages of using smartphone with Sound Analyzer Basic 1.10.2 and Frequency Sound Generator 2.6 software installed as learning media in experiments are: (1) both software is easy to install on smartphones; (2) both software have a small memory of 1.9 MB; (3) both software can be freely downloaded; (4) both software can be used without an internet network.

The advantages of using Sound Analyzer Basic 1.10.2 software are: (1) this software can accurately measure the frequency and intensity level of sound; (2) frequency range and sound intensity level can be adjusted; (3) Sound Analyzer Basic 1.10.2 software can measure more than one sound source frequency; (4) the number of frequencies of the sound source to be measured can be adjusted; (5) the results of frequency measurements and sound intensity levels can be stored. The advantages of using

the Frequency Sound Generator 2.6 software are: (1) the frequency of the sound source can be adjusted; (2) the volume of the sound source can be adjusted; (3) Frequency Sound Generator 2.6 software can display sound waveforms (4) sound waveforms can be selected. The sound waveforms that can be selected in the Frequency Sound Generator 2.6 software are sine, square, sawtooth, and triangle.

So that students can use smartphones as learning media in sound wave experiments, student worksheets are needed. Student worksheets are needed to guide students in carrying out sound wave experiments. Student worksheets integrated with smartphone-based sound wave experiment sets installed with Sound Analyzer Basic 1.10.2 software and Frequency Sound Generator 2.6 software have been developed. Experimental worksheets are expected to improve students' experimental abilities and competencies (Widayanti et al., 2018).

The advantage of this student worksheet is that it has kept up with the times by integrating technology into experimental activities. This is supported by (Maulidiya & Mercuriani, 2023) that technology or electronic media must be integrated into student worksheets to support learning. In addition, this student worksheet has facilitated students to work in groups so that students' collaboration and communication skills can increase. Learning activities on student worksheets provide opportunities for students to express opinions and exchange ideas. This happens because students do experiments in groups. Learning activities in groups allow students to share knowledge (Erina & Kuswanto, 2015).

This student worksheet has an important role in making learning centered on students. Student-centered learning is very important in learning activities (Desnita, 2019). This student worksheet guides students to directly prove the hypothesis made through experimentation. The process that students go through in the experiment makes the knowledge gained by students more durable in the minds of students. This is supported according to Darmawan et al. (2013) that the experiment trains students to carry out scientific activities directly so that the knowledge gained by students is easy to remember and long-lasting.

If the student worksheets are not developed, it will be difficult for the teacher to guide active students in conducting experiments. Students who are not active are caused by theoretical learning. This results in an imbalance in the mastery of knowledge and skills of students. Even though the implementation of experiments is very important to balance the soft skills and hard skills of students (Ramadhani et al., 2019). Another impact is not developing student worksheets, namely not achieving learning objectives in sound wave material. This is due to the absence of teaching materials that facilitate students to conduct experiments by utilizing the equipment around students. Even though student worksheets have a role in helping teachers deliver material and achieve learning objectives (Sari et al., 2019). In addition, student evaluation will be difficult because there are no structured teaching materials that facilitate learning evaluation. The importance of student worksheets is supported by Kahar (2021) that student worksheets can facilitate learning evaluation.

The student worksheet in this research has gone through several tests. Two of the tests that have been carried out are validity and practicality tests. The validity test was carried out by five physics lecturers at Universitas Negeri Padang. Through expert validity, it can be seen that product deficiencies are the basis for product improvement. According to the validators, these student worksheets have met the valid category.

The validity test aims to prove scientifically that student worksheet is suitable for use as teaching materials on sound waves. The important role of the validity test is as a critical assessment. The purpose of the assessment is to strengthen research trust and credibility (Fitzpatrick, 2019). The result of the validity test is in the form of a quality product by the needs of teachers and students to achieve learning objectives.

The product that does not go through a validity test will make teachers hesitate in using them as learning media. This is because the product made has not been scientifically tested to achieve learning objectives. This is supported by Terwee et al. (2018) that the product produced can be used in learning after being tested scientifically, not just the opinion of researchers. Based on the important role of validity and the consequences if it is not carried out, it is recommended that every product development go through the validity test stage.

The practicality test of student worksheet has been carried out at SMAN 2 Padang Panjang by physics teachers and students in small groups. The practicality test results show that the students' worksheets meet the practical category. The purpose of the practicality test is to see whether the student

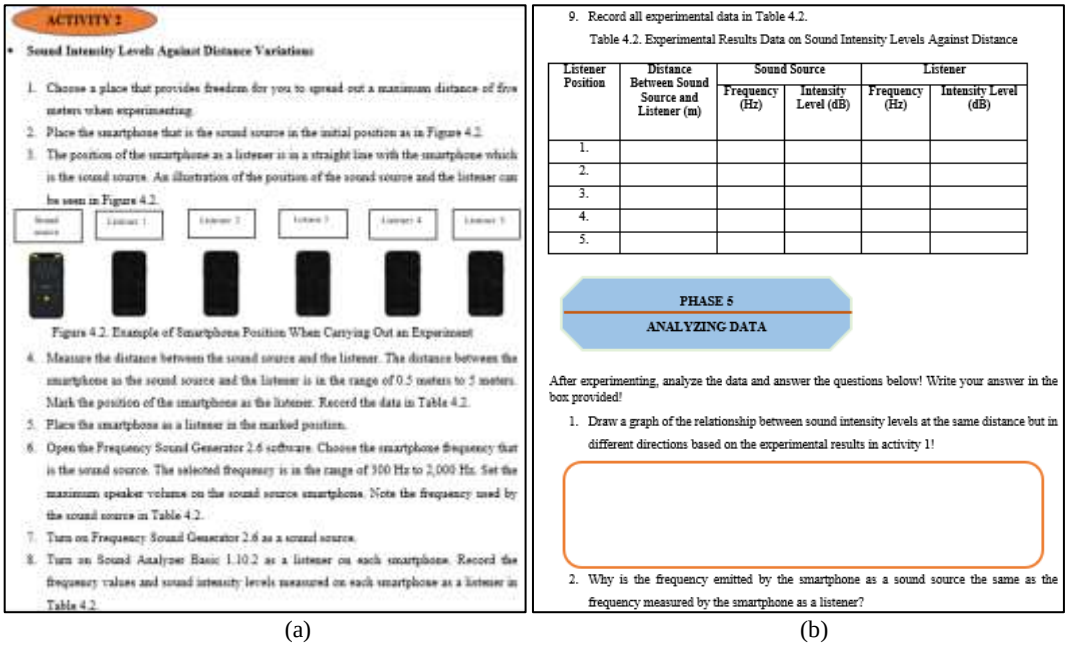
worksheet is easy to use and efficient (Sugiyono, 2013). Practicality tests were carried out on teachers and students to see assessments from two points of view. This is needed because the use of student worksheet is used by teachers and students. So the criticisms and suggestions obtained will be taken into consideration for making practical student worksheet.

If the practicality test is not carried out, then the application of student worksheet will find several problems in class. These problems can be in the form of technical problems that cause time inefficiencies and products that are difficult for students to use. This happens because those who use the product are not physicists or researchers, but teachers and students.

Based on the problems that have been described and the importance of making student worksheet on sound wave material, researchers are interested in doing this research. The results of this research are validity and practicality tests which show that student worksheet is feasible to be tested on a large scale in the real field. This article was written to convey the results of the practicality and validity test of the student worksheet integrated by sound wave experiment set using smartphone with software Sound Analyzer Basic 1.10.2 and Frequency Generator 2.6 software.

METHODS

This article conveys certain parts of the research stages. This research aims to develop student worksheets that are integrated with sound wave experimental devices using smartphones installed with Sound Analyzer Basic 1.10.2 and Frequency Generator 2.6 software. This student worksheet facilitates diffraction of sound waves experiments which are carried out using one smartphone as a sound source and several other smartphones as listeners. In this experiment, students prove the diffraction of sound waves. In the sound resonance sub-material, experiments were carried out using a sound resonance tube. In this experiment, one smartphone will act as a sound source and another smartphone will act as a listener. Students will investigate sound resonance events by measuring the level of sound intensity heard on a smartphone as a listener. After that, students will look for the speed of sound through experiments. In the Doppler effect sub-material, students will carry out experiments using cars toys. The smartphone as a sound source will be placed in toy car 1 and the smartphone as a listener will be placed in toy car 2. Students will analyze changes in frequency when the sound source moves away from the listener and vice versa. In the sound intensity level sub-material, students will vary the distance between the smartphone as the sound source and the smartphone as the listener. Then, students will analyze the relationship between distance and the intensity level of the sound heard. Photo One of the experimental activities for sound intensity levels can be seen in FIGURE 1.



(a) (b)

FIGURE 1. (a) Example of Experimental Activities for Sound Intensity Levels, (b) Analyzing Data

This research applies the Research and Development method concerning the ADDIE model. The Research and Development method aims to create a new product or develop an existing product (Sugiyono, 2013). The ADDIE model has stages namely analysis, design, development, implementation, and evaluation (Branch, 2009). The ADDIE model serves as a very appropriate guiding framework for development research that produces an educational product and other learning resources (Branch, 2009).

This research uses the ADDIE model according to Branch (2009) where validity and practicality tests enter the development stage. The product that has been made are validated by 5 physics lecturers at Universitas Negeri Padang are experts in their fields. The components of product validity that are assessed are content validity (Almanasreh et al., 2019), construct validity, and graphical validityThe content validity criteria assessed were 24 items. The construct validity criteria assessed were 6 items. The graphical validity criteria were 5 items. The range of values from the validators, teachers, and students uses the Likert scale (Sugiyono, 2019). The Likert scale can be seen in TABLE 1.

TABLE 1. Likert Scale

Likert Scale	Value
1	Very less
2	Less
3	Good
4	Very Good

The validity coefficient is calculated by Aiken's V formula (Aiken, 1985). The equation validity as follows:

$$V = \frac{\sum s}{[n\,(c-1)]} \quad (1)$$

$$s = r - l_o$$

Information:

l_o = the lowest value of validity assessment
c = the highest value of validity assessment
r = the score given by the assessor
n = number of validators
s = the number given by the assessor minus the lowest rating score
$\sum s$ = sum of s

Student worksheet is assessed by 5 validators with 4 categories according to Aiken (1985) student worksheet is said to be valid if a validity value of 0.87–1.00. Product validity criteria can be seen in TABLE 2. The validation instrument grid sheet can be seen in TABLE 3.

TABLE 2. Product Validity Criteria

Criteria	Value
0.00-0.86	Invalid
0.87-1.00	Valid

TABLE 3. The Validation Instrument Grid Sheet

Validation Component	Indicator	Statement Number
Contents	Suitability	1,2,3,4,5,6,7,8,9,10
	Guiding Active Learners in Learning	11,12,13,14
	Accuracy	15,16,17,18,19,20
Serving	Instruction	1,2
	Table of contents	3
	Student worksheet structure	4
	Motivating Students	5
	Interaction	6
Graphics	The sentence used does not have a double meaning	1,2
	Use of fonts, types and use of letters	3,4,5,6,7

After receiving criticism and suggestions from the validators, revisions were made to produce a quality product. The product that is declared valid is then tested for practicality. The practicality test was carried out to see the practicality of using student worksheet. The practicality test component consists of components of easiness, attractiveness, and benefits. Examples of the practicality of grid instruments can be seen in TABLE 4.

TABLE 4. The Teacher's Practicality Instrument Grid Sheet

Practicality Component	Indicator	Statement Number
Convenience	Instruction	1,2,3
	Language	4
	Student worksheets help students achieve Basic Competencies, Competency Achievement Indicators, and Learning Objectives	5,6,7
	Sound wave material	8,9
	Learning Activities	10,11,12,13
	Experimental steps	14,15
	Helping teachers improve students' knowledge	16
	Helping teachers guide students to do experiments	17
	Helping teachers in evaluating students' knowledge	18
Attractiveness	Cover	1
	Student worksheet content display	2
	Font, size and spacing	3
	Layout	4,5
	Color	6
	Stimulate students' curiosity	7
Benerfit	Teacher's Guide	1
	Meet the demands of the 2013 Curriculum	2
	Creating learner-centered learning	3
	Motivate students	4
	Train students' skills using tools	5
	Train students to identify scientific opinions	6
	Train students to assess scientific information	7
	Train students to discover the concept of sound waves	8
	Train students to make graphs	9
	Train students to read and interpret data	10
	Train students to analyze questions that present quantitative data	11
	Improve the ability of students to make conclusions	12

The practicality test was carried out by 3 teachers and 30 students at SMAN 2 Padang Panjang. The components assessed in the practicality of student worksheet is easiness, attractiveness, and benefits (Sukardi, 2012). The value obtained is then calculated using the percentage technique according to Riduwan (2014) as follows:

$$\text{Score} = \frac{score\ earned}{total\ score} \times 100\% \quad (2)$$

Student worksheet can be said to be practical if the practicality value reaches 61% -80% and student worksheet is said to be very practical if they reach 81% -100% (Riduwan, 2014). The table of practicality criteria for student worksheet can be seen in TABLE 5. Student worksheet that is valid and practical means that student worksheet is feasible to be tested on a large scale in the real field.

TABLE 5. Practicality Criteria

Value	Citeria
0% - 21%	Very impractical
21% - 40%	Not practical
41% - 60%	Practical enough
61% - 80%	Practical
81% - 100%	Very Practical

RESULTS AND DISCUSSION

Researchers conducted curriculum analysis, needs analysis, and potential smartphone use analysis before creating student worksheets. The results of the curriculum analysis show that basic competency in sound wave materials requires experimental activities and links them to technology. However, the facts in the field were found to be that sound wave experiments had never been carried out due to limited equipment. This causes students to be less critical of contextual problems around students. In fact, learning activities influence students' critical thinking skills (Shcheglova et al., 2019). Therefore, experiments are very important to carry out.

Experimental activities require teaching materials that facilitate students carrying out investigations and experiments. However, based on the needs analysis, it shows that there are no teaching materials that facilitate sound wave experiments and utilize technology. Therefore, there is a need for technology as a learning medium for carrying out experimental activities. Researchers took data on the use of smartphones as technology close to students to facilitate experimental activities. This is because the average student already has a smartphone so it is not difficult for students to find equipment.

Based on the results of the analysis, the researcher developed a student worksheet that was integrated with a sound wave experimental device using a smartphone with Sound Analyzer Basic 1.10.2 and Frequency Generator 2.6 software which tested its validity and practicality. At the design stage, researchers design learning objectives and experimental activities that will be carried out in student worksheets. The student worksheet developed consists of four experimental activities. First, the experimental results of the diffraction of sound waves, lead students to prove the diffraction of sound waves in everyday life. Second, the results of sound resonance experiments guide students to investigate the speed of sound propagation, characteristics of resonance events, and solve problems found due to resonance, such as installing window glass loosely. Third, the results of the Doppler effect experiment guide students to study frequency changes in the Doppler effect phenomenon and understand the concept of the Doppler effect in everyday life, such as in ambulances. Fourth, the results of the effects experiment. Third, the results of the sound intensity level experiment guide students to investigate the relationship between sound intensity levels and distance and apply the concept of sound intensity levels in everyday life. Examples of learning activities in student worksheet can be seen in FIGURE 2.

The next stage is to carry out validity and practicality tests. Validation is carried out to validate the content, presentation and graphics on students' worksheets. The results of the validity test of students' work papers can be seen FIGURE 3. Based on the results of the content validity, construct validity, and graphic validity tests, it was found that each validity component item met the valid category. Content validity is carried out to ensure the accuracy of the sound wave material and to describe the learning content and learning objectives (Sirait et al., 2023). This is supported by Ginting et al. (2023) that an instrument is said to be valid if it can measure what it wants to measure.

The indicators measured in content validity consist of 24 indicators. Indicators of content validity measure whether students' worksheets can achieve basic competencies and learning objectives, test whether the material presented on students' worksheets follows physics concepts, and test experimental activities to prove and analyze the application of sound waves.

The average value of the content validity component is 0.91. This shows that the resulting worksheet meets the valid category according to physicists. The content validity carried out consisted of 24 indicators that met the valid category for each indicator. The validation results show that the material presented in the student worksheet is suitable for achieving basic competencies 3.10 and 4.10, indicators of competency achievement, and learning objectives in sound wave material. Student worksheets can achieve basic competency by presenting sound wave experiments following the demands of the 2013 curriculum. Through student worksheets, learning objectives will be achieved because the sound wave experiments presented lead students to actively study, analyze, and discover the concept of sound waves. This is supported by relevant research that content validity is said to be valid if learning materials and activities can achieve basic competencies (Usmeldi, 2016).

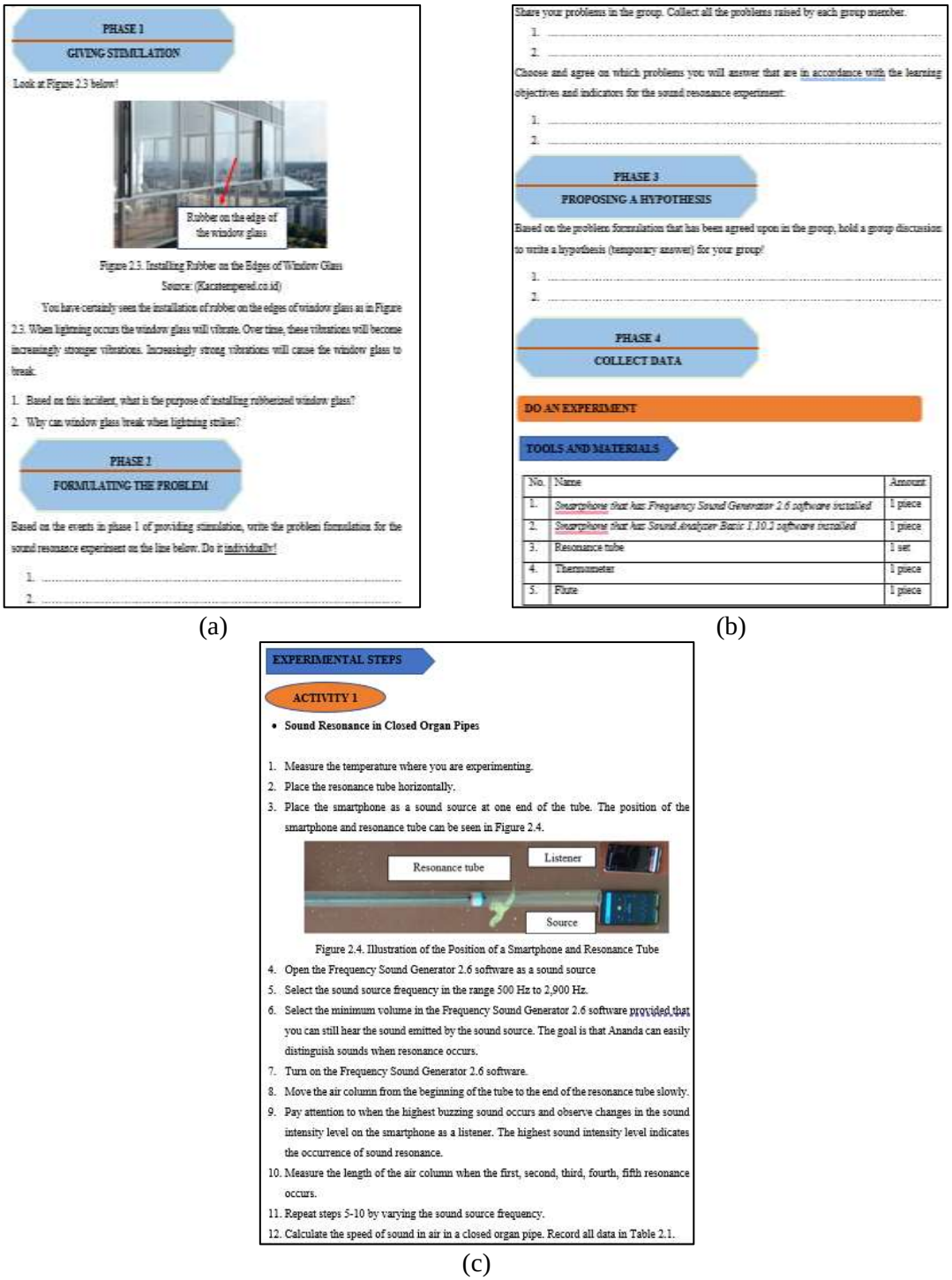


FIGURE 2. (a) Phase 1 Giving Stimulation and Phase 2 Formulating the Problem, (b) Phase 3 Proposing a Hypothesis and Phase 4 Collect Data, (c) Experimental Steps

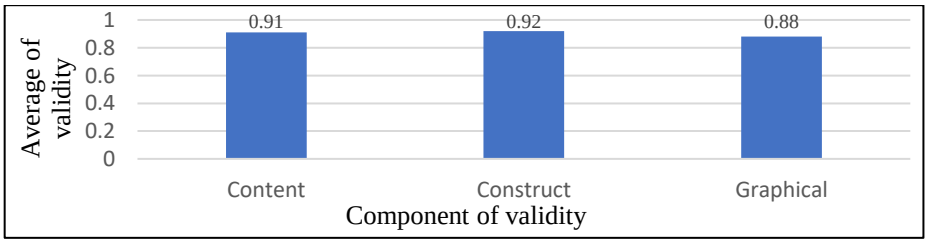


FIGURE 3. Average of student worksheet validity

The evaluation in the student worksheet follows the concept of sound waves. The evaluation section presents questions on the analysis of sound wave phenomena in everyday life and how to apply the concept to solve problems. Questions that present contextual problems are very important for students. This is supported by Yanez et al. (2024) that reinforcement and application questions can evaluate students' understanding of lesson material and evaluate students' ability to apply their knowledge in everyday life.

The content validity results show that the student worksheet encourages students to work in groups and express opinions. This can be seen from the activities on the student worksheets which guide students to work in small groups. Collaboration in groups can be seen from how students provide tools, carry out experiments, analyze data, and make conclusions. Collaboration is very important in academic achievement and effective learning because students can share knowledge and skills in groups (Radhumbu, 2024). This student worksheet will guide trained students to express opinions so that students can solve problems correctly. This is in accordance with the main aim of education to produce individuals who can solve problems, and are innovative and creative (Rauber et al., 2023).

Expert lecturers also test experimental activities on the sub-material that diffraction of sound. The validity results show that the experimental activities have facilitated students to prove and discover the concept that diffraction of sound. Student worksheets have facilitated sound resonance experimental activities to determine the speed of sound propagation in air. This experiment will guide students to understand the conditions for resonance to occur, to interpret the relationship between frequency and the length of the air column in the pipe, as well as the characteristics of sound resonance. Through direct experience from experiments, enjoyable learning can be realized. In accordance with relevant research, physics learning is based on understanding concepts through an active and fun learning process which can be realized through experimental activities (Khairunnisa et al., 2018).

This student worksheet facilitates students carrying out experiments on the Doppler effect when the listener and sound source move. Students will directly experience the phenomenon of sound changes and examine frequency changes that can be observed via smartphone. This student worksheet is considered valid because it presents Doppler effect events that students often encounter in everyday life. Through contextual learning, this student worksheet can help students master concepts. Mastery of concepts is very important for transferring students' knowledge in applying physics knowledge to real life (Mills, 2016). This is supported by Banda & Nzabahimana (2021) that the application of physics concepts in real life is an important component to trigger innovative skills.

The second component is construct validity. Based on the validity that has been carried out, the average value of the validity of the dish is 0.92 in the valid category. The validity of the presentation consists of 6 indicators that are tested. Student worksheets are said to be valid because they contain instructions for using the software so that students can understand how to use the software and organize what they want to measure. This student worksheet contains study instructions to make it easier for students to carry out experiments. The table of contents presented provides information about learning activities. The validity of presentation on the student worksheet is valid because in its preparation it takes into account the components that must be present in the teaching materials according to the 2008 Ministry of National Education teaching material development guidelines. If the student worksheet does not have one of the components, the student will have difficulty finding knowledge, improving skills, and achieving learning goals. When validating the presentation, the expert lecturer pays attention to the learning activities in the students' worksheets. Presentation validation can be said to be valid because the activities on the students' worksheets have triggered students' curiosity and triggered interactions. Curiosity is very important for students to have so that students are motivated to carry out experiments and make learning fun. Learning will feel fun because students carry out experiments from their hearts out of curiosity and without coercion. In accordance with relevant research, construct validity in teaching materials is very important to attract students' interest in learning, thereby arousing students' curiosity. According to Desnita et al. (2021) good teaching materials can increase the desire to learn and are easy for students to understand. Through learning activities on student worksheets, interactions arise between students who investigate concepts and teachers who guide students to carry out experiments. According to the statement by Khairunnisa et al. (2018) good student worksheets allow for interaction between teachers and students.

The third component is graphic validity. Based on the validity that has been carried out, an average graphic validity value of 0.88 is obtained in the valid category. Graphic validation on student worksheets consists of 7 indicators. This student worksheet is said to be valid because the type and size of the letters can be read clearly. The writing in students' worksheets is very important so that students can read clearly and not guess what they are reading. Expert lecturers assess the cover and layout of students' worksheets. Student worksheets are valid because the layout is neatly arranged, making it easier for students to find material or learning activities to be carried out. In accordance with relevant research, the use of proportional fonts, picture illustrations, and color combinations in teaching materials can attract students' attention (Fadhilah et al., 2020). The worksheets used bright colors to attract students' interest in using the worksheets. Color and graphics have a role in adding an impression of realism so that they can stimulate students to learn and help students understand the material (Rahim et al., 2020). This student worksheet is valid because it presents pictures to make it easier for students to understand the material and carry out experimental activities. So students will not be confused about how to position tools and materials when conducting experiments. Pictures help students understand the material more easily. If pictures are not presented, students may have misconceptions about imagining abstract things they have never encountered. In accordance with relevant research, the display of colors or images can strengthen students' memory and make it easier for students to understand the material (Alfiyah et al., 2016).

The highest validation results on student worksheets lie in the presentation validation component. This means that students' worksheets have been prepared with clear instructions and learning activities have attracted students' attention to investigate the phenomenon of sound waves. This is supported by Mattoasi (2019) that learning media functions to make the learning process more interesting and clear for students. Meanwhile, the lowest validation results were in the graphical validation component. Graphics validation received the lowest score because in preparing worksheets students need knowledge of the right layout, attractive design, and the right color combination. Researchers have not mastered the theory of combining colors and layout very well. If researchers create student worksheets with a theoretical understanding of graphics, students will be immediately motivated to understand the material without being prompted. This is supported by Aima & Rahima (2020) that worksheets that attract students' attention stimulate students to learn.

Student worksheet in this research went through a practicality test stage to see how practical the use of the LKS was. Practicality testing was carried out in small groups. The practicality test of the LKS was carried out at SMAN 2 Padang Panjang by distributing practical instruments to 3 physics teachers and 30 students. Based on the results of the practicality test carried out by the teacher, it is known that each item of practicality convenience, attractiveness, and benefits meets the practical category. The results of the practicality test assessed by the teachers can be seen in FIGURE 4. The results of the practicality test assessed by the students can be seen in FIGURE 5.

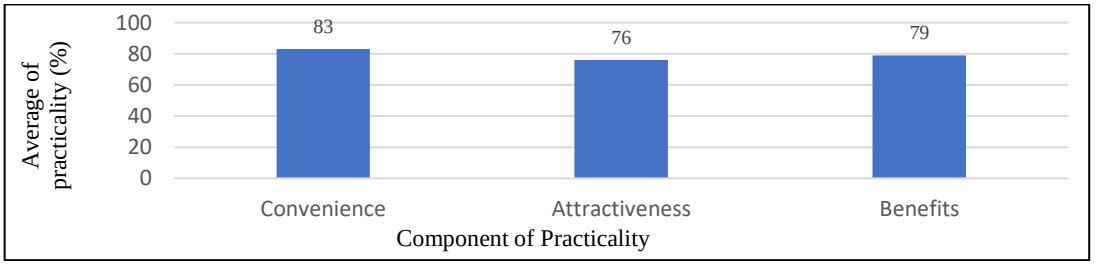


FIGURE 4 Average Practicality Test Results by the Teachers

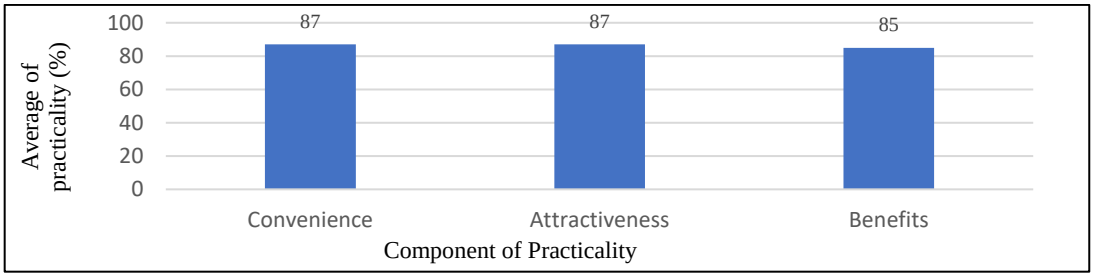


FIGURE 5. Average Practicality Test Results by the Students

The results of the practicality test show that the average value of the convenience component assessed by teachers is 83% in the practical category. Meanwhile, the average practicality value of the convenience component assessed by students was 87% in the very practical category. This means that this student worksheet is easy for students and teachers to use because it contains clear instructions and learning steps that can be understood. This student worksheet is said to be practical because the language used is easy to understand and does not create double meanings that make it difficult for students to understand. This is supported by Sukardi (2012) that considering student worksheets is said to be practical if the student worksheets provide ease of use. This student worksheet can direct students to master the concept of sound waves. This is in accordance with the definition of student worksheets, namely teaching materials that can direct students in learning activities and guide students so they can learn practically (Rahayuningsih, 2018; Rahmawati & Wulandari, 2020). Using this student worksheet can make it easier for students to achieve learning goals. By using this student worksheet, it is easier for students to overcome sound wave problems because the application examples given are often encountered by students in everyday life. This student worksheet is said to be practical because it is structured systematically so that it makes it easier for students to understand the concept of sound waves from the activities of providing stimulation, formulating problems, proposing hypotheses, collecting data, analyzing data, and reporting experimental results. Teaching materials that are arranged sequentially can make it easier for students to learn (Magdalena et al., 2020).

The second component assessed in the practicality test is attractiveness. Based on the results of the practicality test, the average practicality score for the attractiveness component assessed by teachers was 76% in the practical category. The average practicality value of the attractiveness component assessed by students was 87% in the very practical category. This means that the student worksheets that have been created attract students' curiosity to study sound wave material. Innovations in materials alone are the right steps to foster students' interest in learning (Rahim et al., 2020). The practicality results show practicality because the appearance of students' worksheets is arranged with picture illustrations, frames with bright color combinations, and writing with balanced proportions. Pictures can convey messages and become an interesting communication medium so that students will easily understand the material. This attraction is an important ingredient in practicality tests because interested students will be serious about discovering concepts and understanding the material. This is supported by relevant research that interesting teaching materials can create meaning in students so that students do not easily forget the lesson material (Magdalena et al., 2020).

The third component assessed in the practicality test is benefit. Based on the results of the practicality test, it is known that the average value of the practicality of the benefit components assessed by teachers is 79% in the practical category. The average practicality value of the benefit component assessed by students is 85% in the very practical category. This student worksheet is said to be practical because it helps students discover the concept of sound waves through experimentation. Students who discover concepts through experimentation can help students achieve learning goals. This is supported by Prastowo (2019) that the benefits of teaching materials are creating interesting learning, fostering learning motivation, and making it easier for students to study each learning indicator. This student worksheet is said to be practical because learning is student-centered so students are more active in learning. Students who are active in learning can practice good attitudes and skills in drawing hypotheses, analyzing data, and drawing conclusions. Data from experiments can help teachers assess whether students can interpret the data correctly (Yanez et al., 2024).

The implications of this student worksheet can facilitate sound wave experiments so that students can seek their own knowledge and practice their skills directly. The contextual problems presented in student worksheets will guide students to be critical in solving sound wave problems through experiments using smartphones. This is supported by Major et al. (2021) that technology in education enables effective and critical learning thereby providing ease of understanding. This student worksheet can make it easier for students to understand abstract concepts in physics material. So teachers and students can achieve the expected learning goals.

Referring to the results and discussions that have been presented, show that the students' worksheet integrated with the smartphone-based sound wave experiment set with Sound Analyzer Basic 1.10.2 software and Sound Frequency Generator 2.6 software installed meets the valid and practical category. This means that student worksheets that are integrated with sound wave experimental devices using smartphones with Sound Analyzer Basic 1.10.2 software and Frequency Generator 2.6 software have been deemed suitable for testing on a large scale in the real field.

CONCLUSION

Student worksheets integrated with smartphone-based sound wave experiment sets installed with Sound Analyzer Basic 1.10.2 software and Sound Frequency Generator 2.6 software have met the valid category with an average value of content validation of 0.91, presentation validity of 0.92, and graphic validity of 0.88. The student worksheet integrated with the smartphone-based sound wave experiment set with Sound Analyzer Basic 1.10.2 software and Sound Generator Frequency 2.6 software has fulfilled the practical category. The average practicality score by teachers for the convenience component was 83%, attractiveness 76%, and usefulness 79%. The average practicality score by students for the convenience component was 87%, attractiveness 87%, and benefits 85%.

Based on the research results, it shows that the importance of learning media such as student worksheets in learning activities is to facilitate students to study, analyze and draw conclusions in seeking their own knowledge. These student worksheets have an important role in helping teachers and students to achieve learning goals. The results of the research show that students' worksheets are practical to use because they use smartphones as technology that is close to students. This smartphone has an important role as a medium in experiments so that students can investigate sound wave phenomena and analyze changes in frequency and changes in sound intensity levels. Smartphones will make it easier for students to understand sound wave events because students not only hear but can see the results of measuring changes in frequency and changes in sound intensity levels.

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