



## LIVEWORKSHEET-BASED STUDENT WORKSHEET FOR SENIOR HIGH SCHOOL IN PHYSICS LEARNING

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### ABSTRACT

Physics learning should be equipped with technology-assisted student worksheets following the demands of the 2013 curriculum and contain steps in the scientific approach. This study aimed to produce electronic student worksheets based on liveworksheets on sound waves. This research is development research using the ADDIE model, which consists of analysis, design, development, implementation, and evaluation. This research was conducted in a school in Salimpaung. Data collection is based on product validation and trial results. The data analysis technique used is descriptive statistics. The validation results of the three validators who rated it gave an average score of 87.4% in the "highly valid" category. The result of the product trial by 25 students achieved an average score of 91% with the criteria of "very practical." Student understanding seems to increase after using electronic student worksheets. Thus, the products developed are easy and interesting to use in learning physics and can increase student understanding. It is suggested that future researchers develop electronic student worksheets on different materials.

## LEMBAR KERJA SISWA BERBASIS *LIVEWORKSHEET* UNTUK PEMBELAJARAN FISIKA TINGKAT SMA

### ABSTRAK

#### Kata Kunci:

Kurikulum 2013  
 Lembar kerja siswa elektronik  
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 Lembar kerja berbantuan teknologi

Pembelajaran fisika seharusnya dilengkapi dengan lembar kerja siswa berbantuan teknologi dan sesuai dengan tuntutan kurikulum 2013 serta memuat langkah-langkah pendekatan saintifik. Tujuan penelitian ini yaitu untuk menghasilkan lembar kerja siswa elektronik berbasis *liveworksheet* pada materi gelombang bunyi. Penelitian ini merupakan penelitian pengembangan dengan menggunakan model ADDIE yang terdiri dari *analyze*, *design*, *development*, *implementation*, dan *evaluation*. Penelitian ini dilakukan di salah satu sekolah di Salimpaung. Pengumpulan data didasarkan pada hasil validasi dan uji coba produk. Teknik analisis data yang digunakan adalah statistik deskriptif. Hasil validasi dari 3 validator yang menilai memberikan skor rata-rata sebesar 87,4% dengan kategori "sangat valid". Hasil uji produk oleh 25 siswa mencapai nilai rata-rata 91% dengan kriteria "sangat praktis". Pemahaman siswa terlihat meningkat setelah menggunakan lembar kerja siswa elektronik. Dengan demikian, produk yang dikembangkan mudah dan menarik digunakan dalam pembelajaran fisika, serta mampu meningkatkan pemahaman siswa. Disarankan kepada peneliti selanjutnya untuk mengembangkan lembar kerja siswa elektronik pada materi yang berbeda.

## 1. INTRODUCTION

The development of the times cannot be avoided in this life. Today, the advancement of science, information, and communication technology is felt rapidly [1], [2]. Advances in information and communication technology should be followed by the ability of humans to utilize these technologies in everyday life [3]-[5]. The development of technology that impacts human civilization is also felt in the world of education [3], [6]. Previously, learning activities could only be carried out if educators were face-to-face with students in class. This technological development shifts conventional face-to-face learning to more open learning [7]. Technology may help students succeed in their studies [8]. Face-to-face activities no longer seem necessary due to technological assistance [9], [10].

Technology and education that is innovative are topics covered in the 2013 curriculum. In the present day, everyone must work together to improve and spread education in the classroom. Curriculum 2013 can potentially improve the quality of education by accelerating the advancement of knowledge and technology. This curriculum is developed based on challenges in the world of education, both internal and external, so educational goals can be realized [6], [11]. Learners have a significant role in implementing the 2013 curriculum, and the concept of thinking has changed to student-centered [11]. Learning activities using a scientific approach can support the implementation of the 2013 curriculum because learning activities are student-centered [8]. The learning procedure in the 2013 curriculum emphasizes an active, interactive, and fun learning process [12]. To support the learning process, students should be equipped with good teaching materials in compliance with the requirements of the 2013 curriculum and contain the steps of the scientific approach [12], [13]. Thanks to the scientific approach, students will gain knowledge and comprehension of employing a scientific learning method [14]. Using the scientific process in learning can help students solve problems, make decisions, and strengthen their understanding [15]. Students learn more and better when given opportunities to make and evaluate their decisions [16].

The quality of instructional materials influences students' grasp of the subject matter. Student worksheets are one of the instructional resources that are utilized [17]. Worksheets are suggestions to help and facilitate learning activities [18]. Learner worksheets are one of the suggestions for learning activities that can facilitate learning activities and help students understand the material being studied [2], [5]. Students can actively participate in the learning process using student worksheets [17]. Student worksheets significantly impact learning since they may make students more engaged in their studies, and their use in learning can help teachers direct students to find concepts through their activities [13], [19]. The student worksheets will generally contain the title, to be attained are core competences and fundamental competencies, tools and materials if there are learning activities that require tools and materials, brief information, work steps, and work step assessments [20]. Teaching materials in the form of student worksheets presented to students should utilize technology because as technology develops, the teaching materials used must also be developed [21], [11].

Based on the initial study experience at SMAN 1 Salimpaung, physics learning at the school still tends to use the lecture learning method, rarely uses electronic student worksheets, and learning outcomes are still low. Students also have a low interest in learning physics, and students' interest in physics content is low compared to, for example, biology and chemistry content [22]. The outcomes of an interview with a teacher at SMAN 1 Salimpaung indicate that students frequently perceive physics learning as difficult. For students to comprehend the subject matter, the teacher typically explains the material in front of the class and discusses questions pertinent to the related material. Furthermore,

according to a questionnaire examining student demands for electronic student worksheets-based liveworksheets, some students still find physics challenging. The electronic student worksheets used have not fully met the criteria for good electronic student worksheets and have not implemented the steps of the scientific approach in them. A good student worksheet is a student worksheet that has been validated based on the validator's assessment and declared valid [12].

The ideal student worksheets are student worksheets that are made following the learning model used during learning so that these student worksheets will be effective, successful, and meaningful [23]. Making student worksheets can involve the latest technology so that student worksheets are attractive and practical to use online and offline. One website that can be used to make student worksheets more interesting is liveworksheet [21], [24]. The benefit of using this free service, which Google provides, is that it enables teachers to turn printed worksheets into electronic worksheets, also known as electronic student worksheets [25]. Electronic student worksheets are computer-aided media originally in printed form converted into electronic form. In it, there are pictures, animations, and videos that are more effective so that students do not feel bored [10], [26]. Liveworksheet-based electronic student worksheets can contain video, images, and audio while automatically correcting [4]. Online worksheets allow students to work on them and transmit their responses to the teacher. Thus learning activities are more interesting, interactive, arouse student interest, and save teacher time and save paper usage [4], [27], [28]. The difference between electronic student worksheets and printed student worksheets is that electronic student worksheets are given in an interactive format with a specific operating system that permits immediate response, and the look is more appealing since audio, video, and animation may be incorporated. The printed student worksheets cannot do this since it is easily torn and damaged. The look is also less appealing because the graphics utilized are two-dimensional images that are less beautiful, less lifelike, and cannot produce a reciprocal reaction for students [29].

Previous research has been undertaken in 2021. The findings indicated a percentage of electronic student worksheets quality of 95.94% in the highly valid category. The n-gain value of 0.723 indicates that electronic student worksheets can increase critical thinking abilities in the high category. The very good category is represented by the average student response rate of 93.88% [30]. This is in line with other research with the results obtained from this study, namely, the student worksheets developed are very feasible with an overall expert validator assessment percentage of 92.56% obtained from the material expert assessment of 89.71% and media experts of 95.40%. In addition, students' responses to the interactive student worksheets developed were also very interesting, obtained from the assessment of students on a limited scale trial of 85.30% and the assessment of students on a field trial of 85.47% [24].

The findings of this study served as the author's reference for developing a liveworksheet-based electronic student worksheets. Recognizing the relevance of this liveworksheet-assisted electronic student worksheets in the physics learning process and supporting learning in line with the needs of the 2013 curriculum, liveworksheet-based electronic student worksheets in physics learning are required. These electronic student worksheets include scientific method processes, including observing, thinking, asking, attempting, and presenting that can help students build their knowledge [31]. These electronic student worksheets also include assessment as a standard for meeting learning objectives. Aside from that, after conducting a literature review on liveworksheet-based electronic student worksheets, there are still many electronic student worksheets that do not meet the criteria for good and feasible electronic student worksheets, so researchers

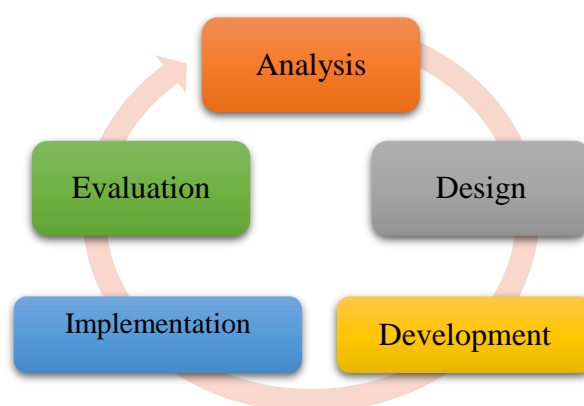
are interested in developing liveworksheet-based electronic student worksheets, particularly on sound wave material. As a result, this research aims to create a liveworksheet-based electronic student worksheet that is legitimate, practical, and enhances student understanding. Because electronic student worksheets may be accessible by communication technologies connected to the internet, it is envisaged that they can be utilized anywhere and at any time to enhance the physics learning process.

Research on the development of electronic student worksheets has been carried out, including; the development of electronic student worksheets with Flip PDF professional [2], the development of android-based electronic student worksheets [3], liveworksheet-based electronic student worksheets to increase learning motivation [4], development of electronic student worksheets with liveworksheets media on circle material [13], but no research develops worksheet-based electronic student worksheets in physics lessons. These electronic student worksheets are focused on sound wave material, which has not been done in previous studies.

The purpose of this research is to develop worksheet-based electronic student worksheets on sound wave material, electronic student worksheets can be accessed easily, and worksheet-based learning becomes more effective and efficient because it can provide direct feedback. In addition, electronic student worksheets are also interesting because they can contain interactive simulations and graphics.

## 2. METHOD

The type of research conducted is research that will produce products in the form of liveworksheet-based electronic student worksheets for sound waves material. The model used in making these electronic student worksheets is the ADDIE design model, one of the more generic design models developed by Reiser and Mollenda in the 1990s. This design model consists of 5 steps, namely: 1) Analysis, 2) Design, 3) Development, 4) Implementation, and 5) Evaluations [32]. ADDIE is a process for creating effective learning resources. Creating products using the ADDIE process is one of the most effective tools [32]. The research model has five stages of development illustrated in Figure 1.



**Figure 1.** Schematic of the ADDIE Model

Two instruments were utilized in this study's data gathering to gather information. The instruments are validity sheets by experts and practicality sheets that students will fill in. This data is collected to see the implementation of liveworksheet-based electronic student worksheets. The validation instrument aims to determine the accuracy of the components of the liveworksheet-based electronic student worksheets. The validation components used include five aspects, namely, content criteria, presentation criteria,

language criteria, graphic criteria, and software utilization. These five aspects are translated into several indicators to make it easier to analyze the advantages and disadvantages of the products that have been made.

The assessment instrument uses a Likert scale with a score of 1-4. The gathered data will be examined using quantitative descriptive analysis, which will be shown as scores and percentages using the following rating scale [33], [34].

**Table 1.** Criteria for Scoring Validation Answers

No	Score	Criteria
1	4	Excellent
2	3	High
3	2	Low
4	1	Poor

Using the following formula, the validity value is determined [35].

$$\text{Validity Value} = \frac{\text{score obtained}}{\text{maxscore}} \times 100\% \quad (1)$$

As a last step, check Table 2 to summarize the computation findings depending on several aspects [35].

**Table 2.** Validity Criteria (Modified)

No	Percentage Rate (%)	Interpretation
1	0% - 20%	Highly invalid
2	21% - 40%	Invalid
3	41% - 60%	Moderately valid
4	61% - 80%	Valid
5	81% - 100%	Highly valid

Then for the product trial, a response questionnaire is given to students with the same scoring criteria as the validity activities, and the assessment obtained from students is calculated as the average value based on the data obtained and then converted to a statement to determine the practicality of the electronic student worksheets that have been made. The criteria for practicality assessment can be seen in Table 3 [35].

**Table 3.** Practicality Criteria (Modified)

No	Percentage Rate (%)	Interpretation
1	0% - 20%	Not practical
2	21% - 40%	Less practical
3	41% - 60%	Moderately practical
4	61% - 80%	Practical
5	81% - 100%	Very Practical

The data analysis approach utilized in this study is descriptive statistical data analysis, in which the findings of validation and the feasibility of employing liveworksheet-based electronic student worksheets are described in tables or graphs. This study assesses the validity and practicality of using liveworksheet-based electronic student worksheets for physics learning on sound wave material for the eleventh-grade senior high school students. Data from the validity and practicality tests are presented in graphical form. Statistics are used to evaluate the validity and applicability of the findings. The validity score is calculated by adding the validator scores, dividing by the total number of validator scores, and multiplying the result of the division by 100%.

### 3. RESULTS AND DISCUSSION

Based on the research of making liveworksheet-based electronic student worksheets for sound waves material that has been carried out, two research findings can be derived based on the study goals. The initial research outcome is the validation result of electronic student worksheets based on liveworksheet. The second research finding is the applicability of using a liveworksheet-based electronic student worksheets for sound waves content for senior high school students in the eleventh grade. The items created are explained in the research technique according to the research stages, which will be explained further below.

#### 3.1 Needs Analysis

Electronic student worksheets require assessment using an interview technique with instructors and questionnaires administered to students. According to the interview results, students still find physics studies challenging. As a result, teachers are more likely to explain the content in front of the class and address questions related to the material being studied. According to the questionnaire, students want technology-assisted worksheets that can engage students to participate in learning activities and boost their grasp of the topic covered. Students appreciate electronic student worksheets that include videos, graphics, audio, and various interactive exercises.

Curriculum analysis focuses on the curriculum's qualities, specifically the 2013 curriculum. Following that, the basic competencies will be analyzed in line with the appropriate criteria and those employed in schools where researchers undertake research to develop indicators of learning accomplishment and learning objectives. For material analysis, researchers determine the key material that must be included in the electronic student worksheets, have relevant material, and methodically reorganize it.

#### 3.2 Product Design

The design stage is responsible for creating an initial design of electronic student worksheets. The researcher creates a content design in the form of a framework of learning materials with core skills and fundamental competencies that are updated in the 2013 curricular syllabus at this stage. Choosing the format for creating electronic student worksheets aims to develop the design, methodologies, learning resources, and animations utilized in electronic student worksheets. Using Microsoft Word and PDF applications, create a display design. Finally, transform the electronic student worksheets from PDF to include animation, video, audio, and picture elements.

The first outcome of this study is a liveworksheet-based electronic student worksheets design, which refers to the design of teaching materials from the Ministry of Education and includes components like title/identity, learning instructions, core competency/basic competencies, supporting information, material summary, tasks or work steps, and assessment in the form of evaluation and using a scientific approach. After students open the electronic student worksheets link sent by the teacher, students can fill in the identity on the cover and read the competencies to be achieved in learning and read the instructions for filling out the electronic student worksheets to be used. The prepared electronic student worksheets conform to the instructions for creating electronic student worksheets provided by the Ministry of National Education in 2010 and are modified to the planned product requirements. This electronic student worksheet contains pictures, videos, power points, experiments with virtual labs, various activities, and evaluation questions that are adjusted to the learning objectives. Overall, the development of this electronic student worksheet employs a scientific approach with live worksheets designed

to be as appealing as possible to boost students' grasp of physics, particularly sound wave material.

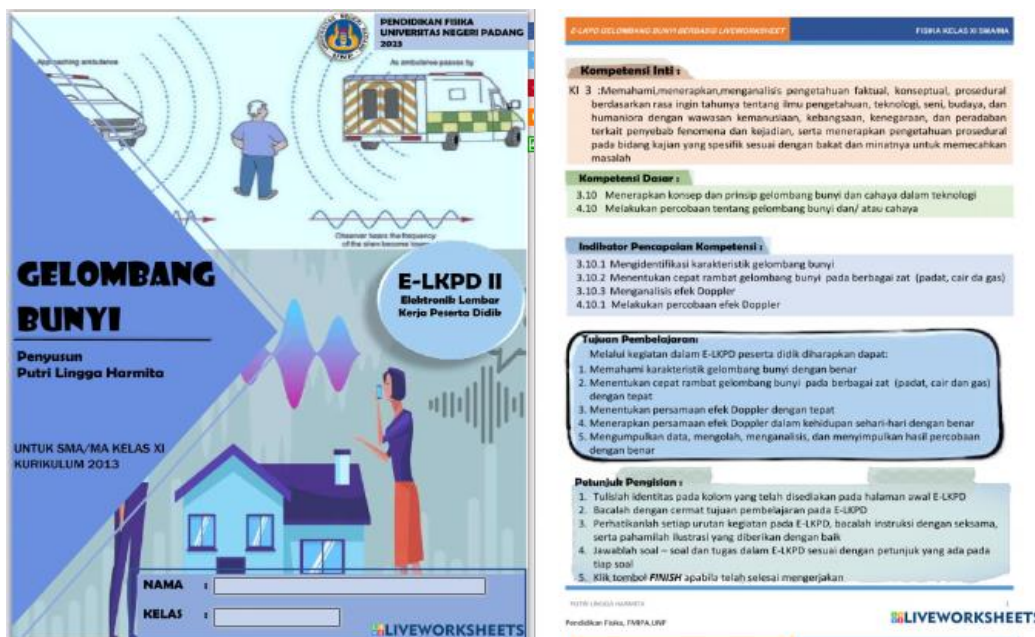


Figure 2. The Display of the Electronic Student Worksheets Cover and the First Page

The liveworksheet service has certain drawbacks, including that worksheets can only upload up to 9 pages. Furthermore, once students have completed working on the electronic student worksheets, the outcomes are in the form of grades and answer corrections. Students cannot read discussions about issues that cannot be answered or whose responses are incorrect. Following that, the product may be validated. If there is a modification, the electronic student worksheets are amended in Word form first, then uploaded back to the liveworksheet and revised on the site.

### 3.3 Validation Result

The development stage attempts to generate and validate the completed electronic student worksheet products. Following that, the product is changed depending on feedback from the validator. Validation of products by specialists utilizing validation sheets created by researchers. The second result of this research is the validity of the liveworksheet-based electronic student worksheets. Before product validation is carried out, it is necessary to determine the instrument that will be used as a measuring tool for product validity. The validator, which in this case is the supervisor, validates the instrument before it is used. After the instrument is declared valid, product validation can be carried out. The validation was conducted by three specialists, mostly physics lecturers from the Faculty of Mathematics and Natural Sciences at Padang State University. Product validation aims to determine the feasibility and quality of the liveworksheet-based electronic student worksheets that have been made. The product validation assessment consists of 5 aspects, namely content criteria, presentation criteria, language criteria, graphical criteria, and software utilization. The validity of these five aspects is in the range of 81-100%. In other words, all electronic student worksheets are highly valid and suitable for use in the physics learning process [36]. The aspects are translated into indicators to make it easier to analyze the advantages and disadvantages of the products made. The average plot results for all validation test components can be seen in Figure 3.

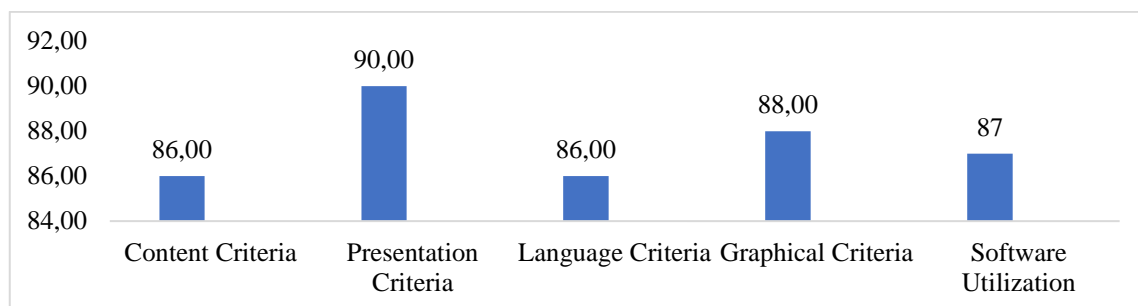


Figure 3. The Overall Average Value of the Validity Aspects

The first validation aspect assessed was the content criteria. The value of the content criteria is in the range of 81-100. The validation scores of the six indicators on the content criteria are presented in Table 4. The average score for the content criteria is 86, with a highly valid category, based on the value of the seven indicators, so the electronic student worksheets are according to the student worksheets requirements that students utilize [36].

Table 4. The Validity Value on the Feasibility Aspects

No	Content Criteria	Score
1	Sound wave material is compatible with the 2013 curriculum	92
2	The suitability of sound wave material with core competencies, basic competencies, and learning objectives to be achieved	83
3	Physics equations and symbols used are appropriate	75
4	The images and videos displayed are in harmony with the material	92
5	The material presented does not cause multiple interpretations from students	83
6	Videos quoted from other people's work include references/sources	92
Average		86

The second validation aspect is the presentation criteria. The range of values obtained is in the range of 81-100. The validation scores of the seven indicators on the presentation criteria are presented in Table 5. Based on the values of the seven indicators, the average value for the presentation criteria is 90, with a highly valid category. The electronic student worksheets have been prepared following the planned learning steps [36].

Table 5. The Validity Value on the Presentation Aspects

No	Presentation Aspects	Score
1	The cover presented presents the content of the electronic student worksheets	92
2	The liveworksheet-based electronic student worksheets have a complete structure	100
3	The liveworksheet-based electronic student worksheets has clear activity objectives	83
4	The liveworksheet-based electronic student worksheets has organized systematics	100
5	The variety of activities presented in the liveworksheet-based electronic student worksheets can arouse students' interest in learning	92
6	The presentation of the liveworksheet-based electronic student worksheets leads students to find concepts and equations	83
7	The presentation of the evaluation on the liveworksheet-based electronic student worksheets can reveal the progress of student understanding	83
Average		90

According to the expert, the third aspect of validity is the language criteria. The value of the language criteria is in the range of 81%-100%. The validation scores of the seven indicators on the language criteria are presented in Table 6. Based on the value of the seven indicators on the linguistic criteria, the average value is 86, with a highly valid category



where the language contained in the electronic student worksheets conforms with Indonesian linguistic conventions and follows students' level of thinking [36].

**Table 6.** The Validity Value of the Language Aspect

No	Language Aspect	Score
1	Electronic student worksheets writing uses Indonesian language according to the students' level of thinking	83
2	Electronic student worksheets writing uses good and correct Indonesian language	83
3	Electronic student worksheets uses terms that are appropriate and easy for students to understand	92
4	Electronic student worksheets use simple sentences and is easy for students to understand	92
5	Electronic student worksheets uses terms/labels/symbols consistently	83
6	The terms used in electronic student worksheets are following the agreed technical terms of science	83
7	Presentation of the evaluation on the liveworksheet-based electronic student worksheets can reveal the progress of students' understanding	83
Average		86

According to experts, the fourth aspect of validity is the criterion of grammar. The value of grammatical criteria is in the range of 81%-100%. The validation scores of the five indicators on the grammatical criteria are presented in Table 7. Based on these five indicators, the average value for the graphic criteria is 88, with a highly valid category. The graphical plot of the validation results for the graphic criteria can be seen in Table 7.

**Table 7.** The Validity Value on Graphic Aspects

No	Graphic Aspects	Score
1	The use of fonts that facilitate reading	92
2	Electronic student worksheets have an attractive cover	83
3	Liveworksheet-based electronic student worksheets have a background match with the color of the text	92
4	Electronic student worksheets based on liveworksheet has a harmonious layout of text, images, and tables	92
5	Terms, formulas, and symbols are clearly stated	83
Average		88

The last validity aspect, according to experts, is software utilization. The value in the software utilization aspect is in the range of 81%-100%. The validation scores of the five indicators on the software utilization criteria are presented in Table 8. Based on the value of the five indicators, the average value for the software utilization component is 87, which has a highly valid category, which indicates that the electronic student worksheets look consistent with accepted standards and accepted norms. Illustrations, content size, and electronic student worksheets are proportional [36].

**Table 8.** The Validity Value of the Software Utilization Aspect

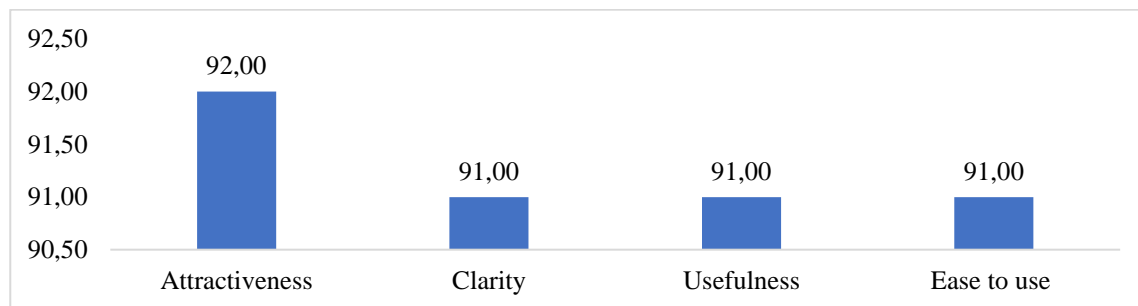
No	Software Utilization Aspect	Score
1	Electronic student worksheets have utilized liveworksheet and Microsoft Word in the design process	100
2	Microsoft Word application can design electronic student worksheets well	83
3	Electronic student worksheets has utilized liveworksheet in providing a variety of activities in electronic student worksheets	92
4	In the liveworksheet-based electronic student worksheets there is interactivity in each stage of learning and evaluation	67
5	The liveworksheet-based electronic student worksheets has utilized a virtual laboratory in sound wave experimental activities	92
Average		87

Several suggestions have been accumulated, including writing in electronic student worksheets. There are still many mistakes in both symbols and equations. Evaluation questions are still not following the learning objectives. Learning objectives must be adjusted to the indicators of competency achievement, questions on problem identification are less directing students to find physics concepts, and the addition of data analysis after conducting experimental activities. The follow-up to the suggestions given by the expert is to revise the electronic student worksheets based on liveworksheet that has been made. Improvements were made to improve the exercises and evaluation questions following the learning objectives, improve questions on problem identification to better encourage students to find physics concepts, improve learning objectives, and improve equations and symbols that are still less precise. The existence of suggestions and improvements in the making of these electronic student worksheets makes the resulting product better and can be used in supporting the procedure for learning physics.

Using the data analysis in Figure 3, the highest value is in the presentation criteria, which is 90, which is in the highly valid category. In contrast, the lowest value is in the content and language criteria, with a value of 86 which is in the highly valid category. The average value of the five components is 86, 90, 86, 88, and 87. After withdrawing, the average value of all components is in the highly valid category, with a value of 87,4. According to the validator, liveworksheet-based electronic student worksheets can be valid if they meet the criteria of good or very good on the components of liveworksheet-based electronic student worksheets and in accordance with learning indicators [12]. The results of the validity test of the liveworksheet-based electronic student worksheets are declared valid and can be used in physics learning.

**3.4 Practicality Result**

In this research, the implementation stage involves students assessing the product's usability. At this point, students complete a practicality instrument, including remarks regarding the usefulness of using liveworksheet-based electronic student worksheets in learning. The third outcome of this research is the result of the field trial to see the practicality of the liveworksheet-based electronic student worksheets. A questionnaire that the eleventh-grade grade students completed is used to evaluate practicality. The practicality test was conducted to see the ease and practicality of the liveworksheet-based electronic student worksheets for sound wave material for the eleventh-grade senior high school students. Data was obtained from questionnaires completed by students who have used liveworksheet-based electronic student worksheets. The components of practicality contained in the instrument are attractiveness, clarity, usefulness, and ease to use. Each component has several assessment indicators related to student responses to the liveworksheet-based electronic worksheet. The results of the average value plot for each component can be seen in Figure 4.



**Figure 4.** The Overall Average Value on the Practical Aspects

The first practicality component assessed was attractiveness. The value of the content criteria is in the range of 81%-100%. Based on the value of the six indicators in the attractiveness component, the average value for each indicator is 92, with a very good category. The second practicality component assessed is clarity. The range of values obtained is in the range of 81%-100%. Considering the worth of the six indicators in the attractiveness component, the average value for each indicator is 92, with a very good category. The third component of practicality assessed by students is the usefulness criteria. The value of the usefulness criteria is in the range of 81%-100%. The lowest score is 88, obtained on the electronic student worksheets indicator that can help students study in compliance with the requirements of the 2013 curriculum, and on the indicator that can motivate students in learning. The highest score is 93 on the indicator that can increase students' independence in learning. Based on the scores of the six indicators on the linguistic criteria, the average score was 91, with a very practical category. The last component of practicality assessed is the ease of access. The value of the software utilization component is in the range of 81%-100%. The lowest score was 88 on the indicator of simple electronic student worksheets presentation to facilitate students in its use and on the indicator that students can use electronic student worksheets anywhere. The highest score is 92, obtained from the indicator that electronic student worksheets can save time and be efficiently used in learning. Electronic student worksheets can be used at any time. Based on the value of the six indicators, the average value for the ease of access component is 91, with a very practical category.

The practicality value on each indicator is obtained in the range of 81%-100%. The highest value is in the attractiveness component, 92, which is included in the practical category. The other three components, clarity, usefulness, and ease of access, have a value of 91, which falls under the extremely practical category. After averaging, every element has a value of 91 and falls within the extremely practical group. So, it is concluded that the liveworksheet-based electronic student worksheets for sound wave material for eleventh-grade senior high school students are highly practical. This product can optimize the online and offline learning process [13], [26].

The findings demonstrated that the liveworksheet-based electronic student worksheets were extremely valid and practical to use in physics instruction and that students could utilize them independently [37], [30]. This finding is consistent with the findings of previous studies that electronic student worksheets based on liveworksheet are very supportive of the learning process, easy to use by anyone, and can be accessed on all electronic communication devices connected to the internet [30]. These electronic student worksheets can help teachers learn and motivate students to expand their knowledge and explore learning materials to develop their knowledge [27], [37]. This is under other research that compiling electronic student worksheets arranged with attractive media such as images, simulations, audio, video, and virtual labs can make students more enthusiastic and prove effective for improving student skills [18], [25]-[10]. Joyful learning could attract the students' engagement, making them more absorbed in the activities and evoking intrinsic motivation to make them like learning and keep studying even outside of class [38]. Students are very happy with learning activities that include technological developments [8], [37].

The results of this study imply that teachers can become facilitators and guide students to be more active in the learning process. Following the nature of the 2013 curriculum, student-centered learning, students are more independent and active in the learning process. Liveworksheet-based electronic student worksheets Teachers may maximize learning activities by promoting student-centered learning [21]. Following the

nature of the 2013 curriculum learning, students must be more active. So that with these electronic student worksheets, students become more active, independent, and excited in developing their knowledge of physics learning [27], [26].

### 3.5 Evaluation

The evaluation step is a procedure that must be completed to assess an object's worth, price, and benefits. Assessment is classified into two types based on its intended use: formative assessment and summative evaluation. Formative evaluation is a type of assessment employed in this study to enhance product quality, as was done throughout the development stage, namely the electronic student worksheets product validity activity. The idea of formative assessment is product trials and adjustments. In contrast, summative evaluation is used to continuously acquire data or information about the product's worth and advantages. The summative evaluation in this study was a practical test of the product on 25 students from SMAN 1 Salimpaung. The evaluation of electronic student worksheets product development is acquired through expert validation findings and the implementation of products into learning activities to identify the advantages of electronic student worksheets developed.

## 4. CONCLUSION

Considering the findings of the performed research, it is obtained that the liveworksheet-based electronic student worksheets on sound wave material can be categorized as highly valid with an average percentage value of the validity test results of 87.4%. Second, according to students, the practicality value of the liveworksheet-based electronic student worksheets is in the extremely practical category, with a percentage of the average value of the practicality test results of 91%. Researchers also suggest that teachers can utilize liveworksheet-based electronic student worksheets as additional teaching materials to support learning following the 2013 Curriculum, which requires the implementation of active, varied and effective, and fun learning. In addition, other researchers can also conduct research to ascertain the level of effectiveness of liveworksheet-based teaching materials that have been made.

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