

Feasibility of PBL (Problem Based Learning)-based Sound Wave Electronic Student Worksheet for High School Students Using the Liveworksheet Application

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Abstract: Digital teaching materials are one of the alternative solutions in the learning process in the era of digitalization 4.0. One of the digital teaching materials that can be developed in digital form is student worksheet. In addition to digital teaching materials, the selection and use of learning models is also important in supporting the learning process in schools. One of the learning models that can be used is the PBL (*Problem Based Learning*) learning model. This study aims to describe the feasibility of PBL-based sound wave electronic student worksheet digital teaching materials using the Liveworksheet application for high school students. This type of research is research and development (R&D) using the ADDIE model. The test subjects were students of class XI MIPA PC (Prima Cendekia) Senior High School of 3 Mataram. Data collection techniques through observation and distribution of questionnaires. The data obtained were analyzed qualitatively and quantitatively using quantitative descriptive statistics. The results showed that the PBL-based sound wave electronic student worksheet that had been developed obtained an assessment score from expert validation of 0.86 (very valid) with 90.6% reliability (reliable) and practitioner validation of 0.83 (very valid) with 95.55% reliability (reliable). Based on these results, it can be concluded that the PBL-based sound wave electronic student worksheet is proven valid so that it is suitable for use in the learning process in schools.

Keywords: ADDIE Model; Electronic student worksheet; Sound Waves; PBL Learning Model.

Introduction

The COVID-19 pandemic has had a very broad impact on human life, especially education (Agung, 2020; Pantan, F., & Benjamin 2020; Joharudin et al., 2020). It was noted that starting March 2020, the Indonesian government through the ministry of education and culture announced to study from home (Kurniawan, 2020; Siregar & Jubba 2020; Sanjaya, 2020). This policy has an impact on nearly tens of millions of students in Indonesia from elementary to tertiary levels who no longer study as usual in the classroom (Rokhani, 2020; Erni et al., 2020). This situation certainly makes the government and education observers work hard so that

the Indonesian people still get a decent education and do not lag behind other countries. The Indonesian government provides a study quota for all students in Indonesia while studying from home. Some applications that are used to study from home include zoom meetings, google classroom, WhatsApp, etc. (Pakpahan & Fitriani 2020; Maulah, S., & Ummah, 2020; Satriah, L et al., 2020). However, the facts on the ground show that some students are not used to using the application, so they have difficulty learning from home. Students are accustomed to learning to use printed textbooks directly so that when online-based learning is carried out they do not understand the material well at all (Wardani, A., & Ayriza, Y. 2020; Sabiq, 2020). This is certainly a challenge

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for educators to present interesting and accessible learning media and teaching materials for students during a pandemic.

Learning activities in Indonesia apply the revised 2013 curriculum which makes students as learning centers or Student Centered Learning and teachers or educators as facilitators in learning (Jayawardana & Gita, 2020; Zakaria, M. P. 2021). Realizing the active involvement of students in learning is not an easy thing. As a solution to the impact of the Covid-19 pandemic, educators are required to be able to design teaching materials and learning media as innovations by utilizing online media (Parlindungan et al., 2020; Jaelani et al., 2020; Solviana, 2020). As an effort to realize the active involvement of students in the learning process, especially in physics subjects, we need an appropriate media and teaching materials that can meet the needs of students, especially during the Covid-19 pandemic (Gusty et al., 2020; Najuah et al., 2020; Maemunawati, S., & Alif, M. 2020). The process of adapting new learning habits after the Covid-19 pandemic, one of the things needed for the learning process is the existence of online teaching materials using interesting and easily accessible media for students (Alperi, 2020; Anugrahana, A 2020). To realize interesting learning, it is necessary to develop digital teaching materials packaged in online learning media in the form of Electronic student worksheet. Student worksheet is one of the teaching materials that can be used and supports the teaching and learning process (Prastowo, 2014). Student worksheet are known as printed teaching materials, in their development the student worksheet can be presented in electronic form not only presenting material, but also equipped with videos and interesting pictures that can improve or strengthen participants' understanding students in studying the material presented (Alhikmah, 2021; Wahyuni et al., 2021).

The development of this electronic student worksheet can use various IT applications, one of which is using the Liveworksheet application which is available for free on Google. This application can be accessed by educators and students online so as to facilitate learning. Research conducted by Prabowo, A (2021) using a live student worksheet application can improve student learning outcomes. The results of research by Widiyani, A., & Pramudiani, P. (2021) concluded that the development of electronic student worksheet using a live student worksheet application can be used as a means to facilitate students in understanding learning materials.

Learning physics, especially sound waves, in addition to using appropriate media and teaching materials, also requires learning models that are in accordance with the conditions of students' needs. One alternative learning model that can be used is Problem

Based Learning or PBL. PBL is a learning model that uses real-world problems as a context for students to learn how to think and solve problems, and can gain essential knowledge and concepts from subjects (Setyorini et al., 2011; Cahyani et al., 2017; Maryati, 2018). Thus, students are easier to learn and are expected to master the important concepts presented in learning physics. Based on the description above, it is important to conduct research on the feasibility of digital teaching materials as online learning media in the form of PBL-based sound wave electronic student worksheet using the Liveworksheet application for high school students. The purpose of developing this electronic student worksheet is to improve the critical thinking skills of high school students.

Method

The type of research used is research and development. According to Sugiyono (2012) research and development is research that is used to produce certain products, and test the feasibility of the products developed. The research development model used is the ADDIE model. The ADDIE model is a simple and easy to learn development design model. Development with the ADDIE model includes: 1) Analysis, 2) Design, 3) Development, 4) Implementation, and 5) Evaluation.

The analysis phase aims to analyze information related to conditions in the field so that it can become a stronger basis for developing research products. At this stage, 3 analyzes are carried out, namely: 1) Learner Readiness, 2) Material Characteristics, and 3) Learning Resources Characteristics. The planning stage (design) aims to make plans related to research products. There are several components planned at this stage, which are related to the design of the electronic student worksheet that will be developed. The development phase aims to develop the product. Development consists of initial product draft development, expert validation and practitioner validation. The development of product drafts includes learning materials, learning models and the final display of the product and is developed using a live student worksheet application that is available for free on Google so that it is digitally based. The product draft that has been developed will then be validated by experts and practitioners. Each stage of development will continue to be revised and refined.

The feasibility test of the product developed was assessed using expert validation questionnaires and practitioner validation. The types of data used in this research are qualitative data and quantitative data. Qualitative data obtained from the results of the validator in the form of suggestions, comments and input as material for improvement of the developed product. Quantitative data obtained from the results of

expert validators using a Likert scale of 1 to 5, 1 = very poor, 2 = not good, 3 = quite good, 4 = good, 5 = very good. The results of practitioner validation use a Likert scale of 1 to 4, 1 = not good, 2 = quite good, 3 = good, 4 = very good. Product validation results are calculated using the following formula 1.

$$Validation\ score = \frac{Total\ score\ obtained}{Maximum\ score} \quad (1)$$

The validation results from the assessment obtained are then converted to the product validity criteria as presented in Table 1.

Table 1. Product Validity Results Criteria

Scoring Results	Validity Level
0.81-1.00	Very Valid
0.61-0.80	Valid
0.41-0.60	Quite valid
0.21-0.40	Less Valid
0.00-0.20	Invalid

(Azwar, 2013)

Furthermore, the reliability test of this study used the Borich method known as the Percentage Agreement (PA). This means that the percentage of agreement between the values is a percentage of the suitability of the values between the first assessment and the second assessment. The instrument is said to be reliable if the percentage value of the agreement is more or equal to 75%. The following formula for Percentage Agreement as follows:

$$PA = \left(1 - \frac{A-B}{A+B}\right) \times 100\% \quad (2)$$

Keterangan:

PA : Percentage Agreement

A : Greater rater score

B : Lower rater score

The next stage of implementation (Implementation) aims to determine the response of students to the product being developed. At this stage, a limited trial will be conducted on students of class XI MIPA PC Senior High School of 3 Mataram. This PBL-based electronic student worksheet is accessed using an online live student worksheet application using the cellphone of each student by first logging in using the "students access" menu in the application. Finally, in the evaluation stage, evaluation in the ADDIE model can be carried out at every stage, so it is very flexible when it comes to making improvements to the product to be developed. In this study, evaluation only consisted of formative evaluation. Formative evaluation aims to assess a product in terms of the format and validity of the product, so that this evaluation is carried out repeatedly to produce a good product.

Result and Discussion

Development of Electronic student worksheet using the Liveworksheet application

The product produced in this study is a PBL-based electronic student worksheet using a live student worksheet application. The Liveworksheet application can be accessed for free using the link <https://www.Liveworksheets.com/>. This application provides two menu options, namely teachers access and students access.

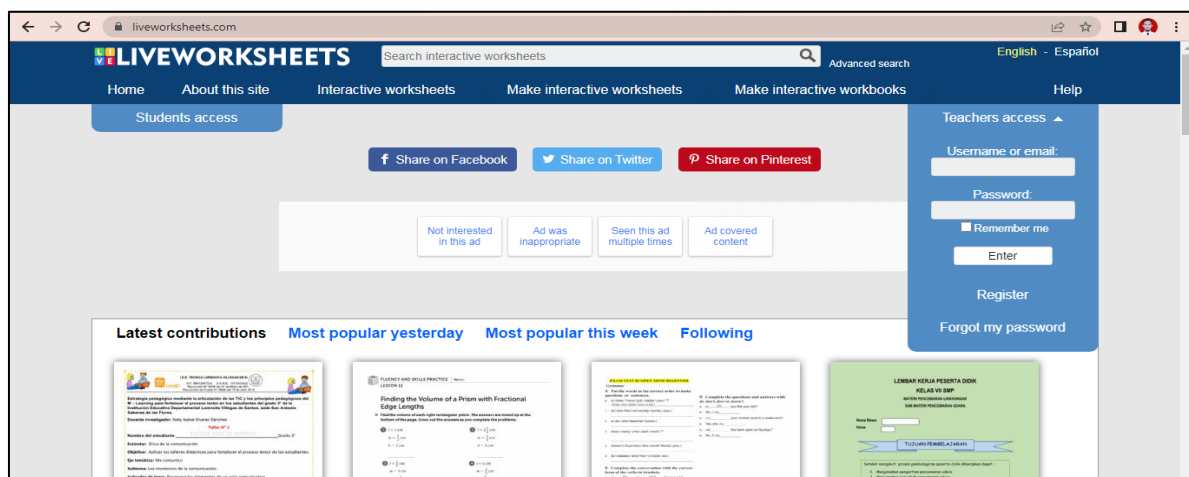


Figure 1. Liveworksheet application start menu

Students can access products that have been made by teachers or educators by logging in as student access. Products that have been made by teachers can be

accessed at any time as long as there is an internet network, so that students can open and learn whenever they have time. This electronic student worksheet is very

well used in classroom learning with limited study time because it can be accessed repeatedly according to the needs of students and teachers. Teachers can add

materials or assignments according to learning needs. However, the drawback is that students and teachers cannot access this electronic student worksheet offline.

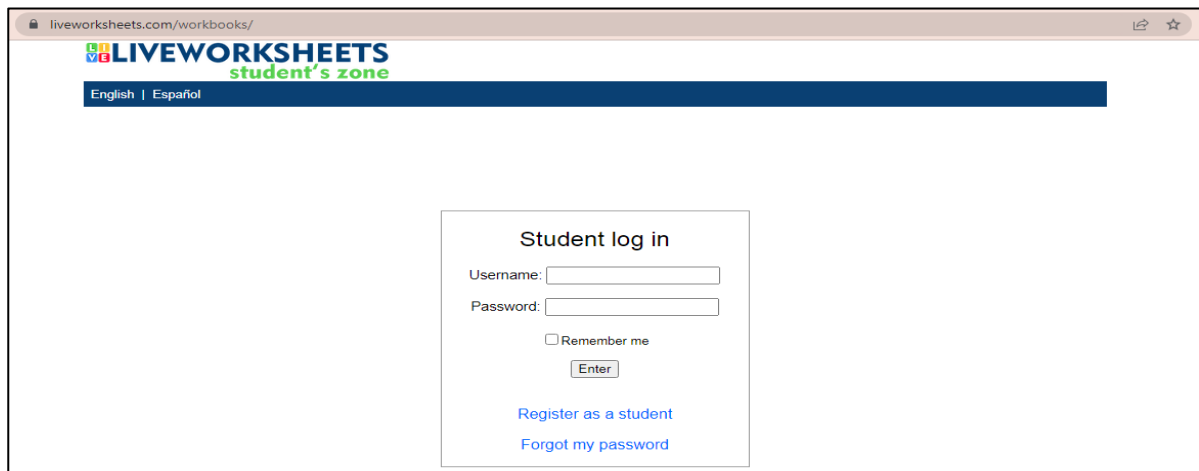


Figure 2. Students log in as students

Sound wave electronic student worksheet display results

The electronic student worksheet product that has been developed can be seen in Figure 3. Figure 3 is

the development stage of the ADDIE model which contains cover displays, pretests, posttests and a summary of sound wave material.

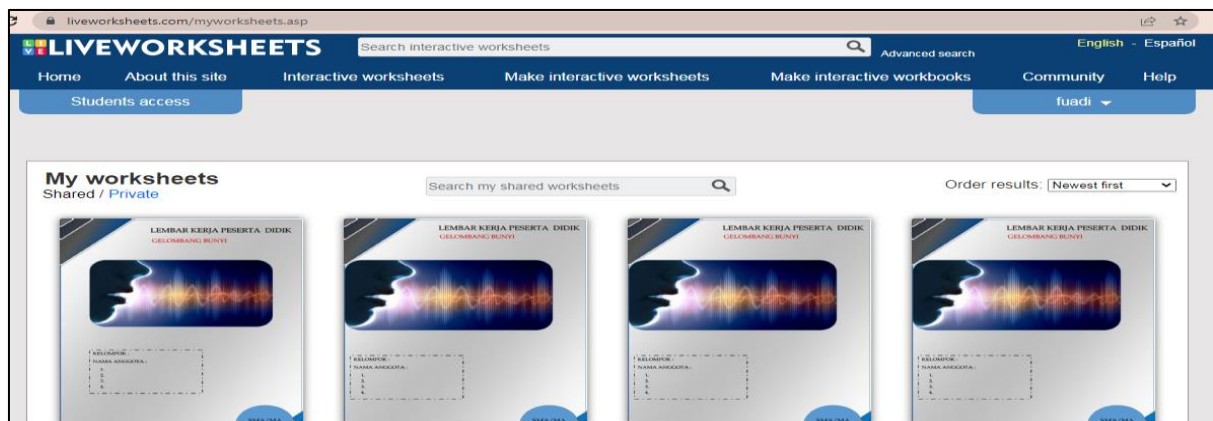


Figure 3. Display of electronic student worksheet before revision

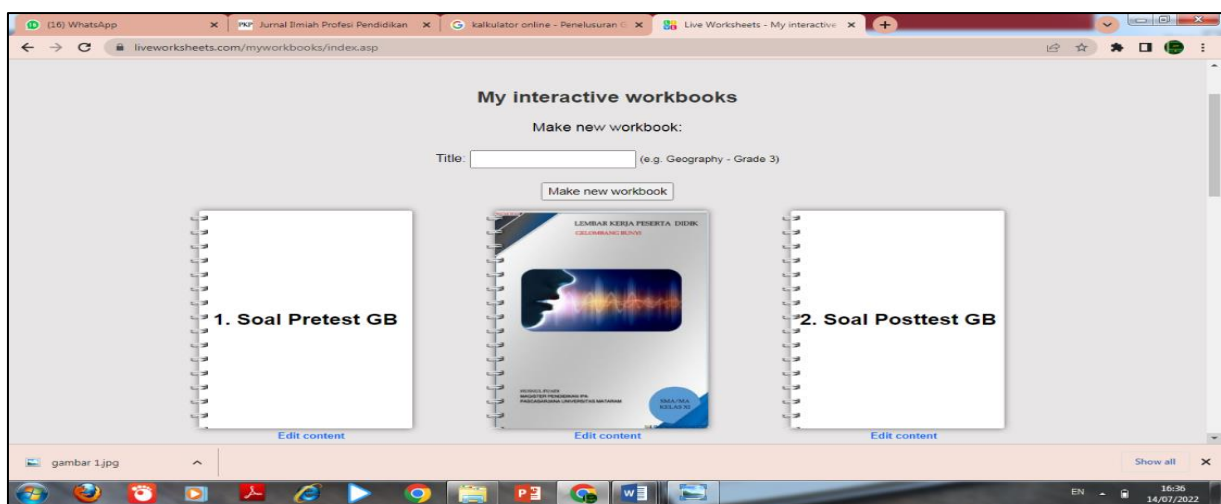


Figure 4. Display of electronic student worksheet after revision

PBL-based Sound Wave Electronics Student Worksheet

The developed electronic student worksheet is combined with the PBL learning model on sound wave material. The PBL stages developed in this product include; a) Reviewing and presenting problems, b) Developing strategies, c) Implementing strategies, and d) Discussing and evaluating results. The following are the stages of the PBL model developed in the sound wave electronic student worksheet.

a. Reviewing and presenting problems

At this stage, contextual problems related to everyday life are presented on the sound wave material. Students are stimulated to understand the subject matter based on what they experience in real life. An example of a question given is "Have you ever whispered in your friend's ear? When you whisper into your friend's ear, why do your hands clench into a funnel? What does that have to do with the sound waves that come out of your mouth? This section also presents several supporting questions related to the material being studied.

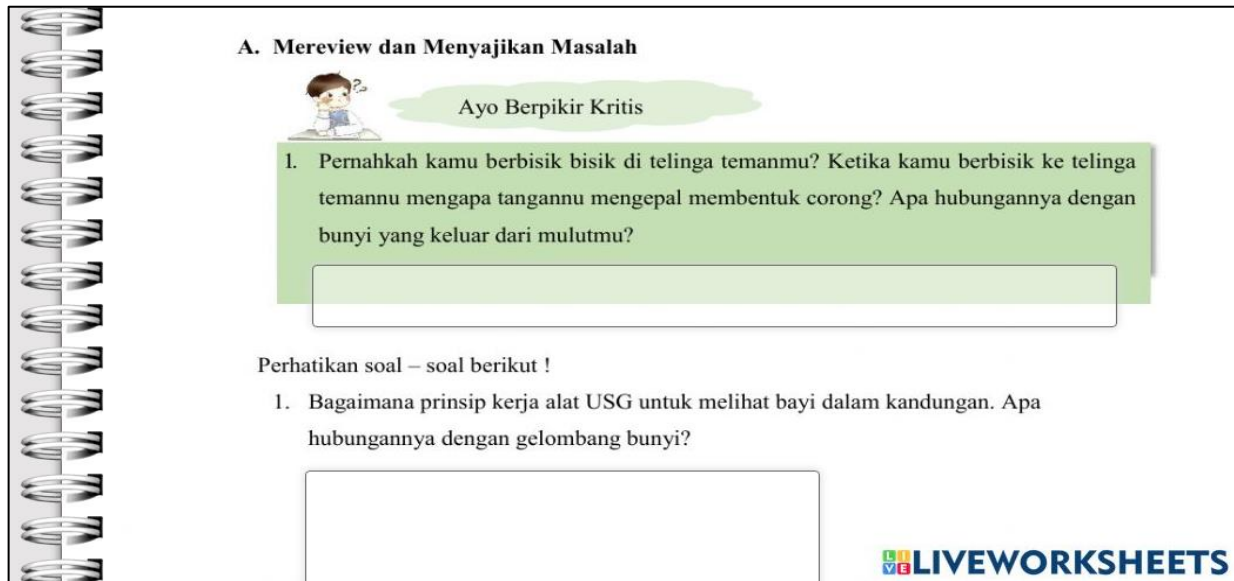


Figure 5. The stage of reviewing and presenting the problem

b. Strategize

At this stage students are expected to be able to respond to the questions posed in stage 1 by

conducting simple experiments in small groups that have been formed by students according to their respective groups.

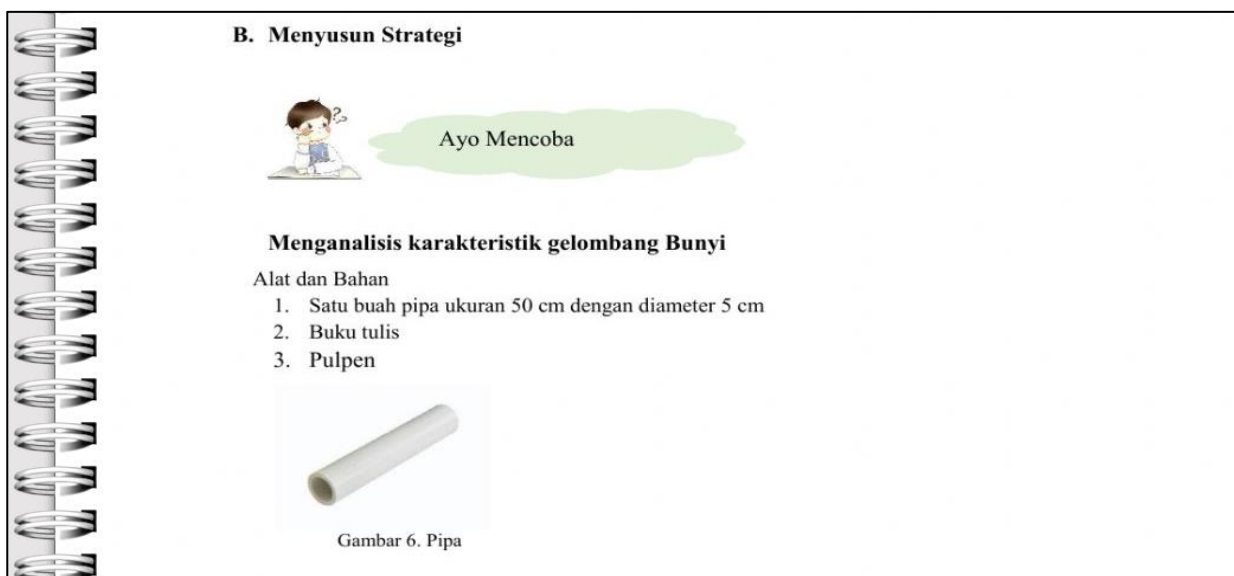


Figure 6. Stages of Strategy

c. Implementing strategy

At this stage, students look for actual and valid references through learning videos that have been provided on electronic student worksheet or through

other sources. After that, students are expected to be able to write answers on the sheets that have been provided based on the results of each group's discussion.

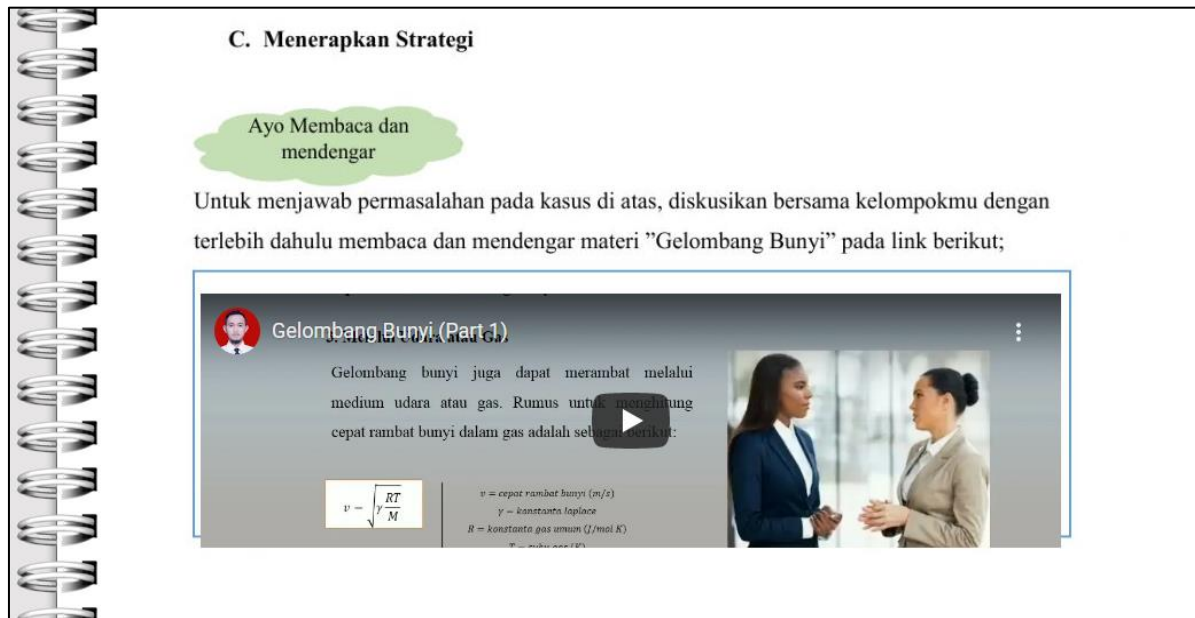


Figure 7. Stages of implementing the strategy

d. Discuss and evaluate the results

At this stage students re-evaluate the results of group discussions and then present them in front of the

class so that there is interaction between each group to find solutions to the problems posed. Educators or teachers as directors and facilitators.

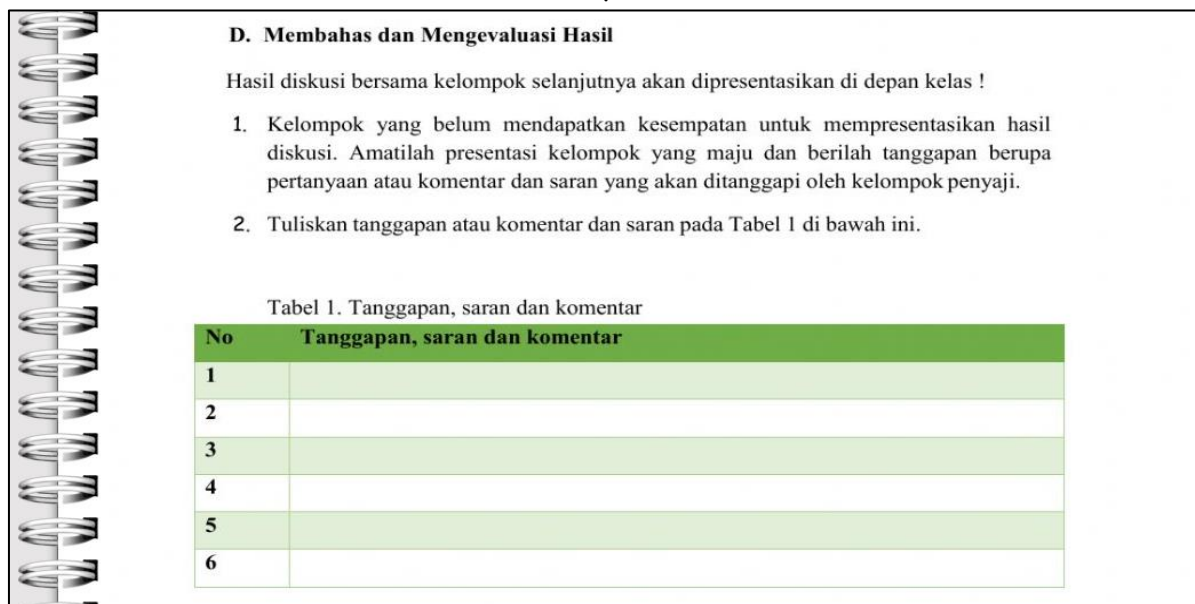


Figure 8. Stages of discussing and evaluating results

In the final stage of this product, students conduct an independent test based on the questions that have been

prepared at the end of the meeting as an evaluation of the learning that has been carried out.

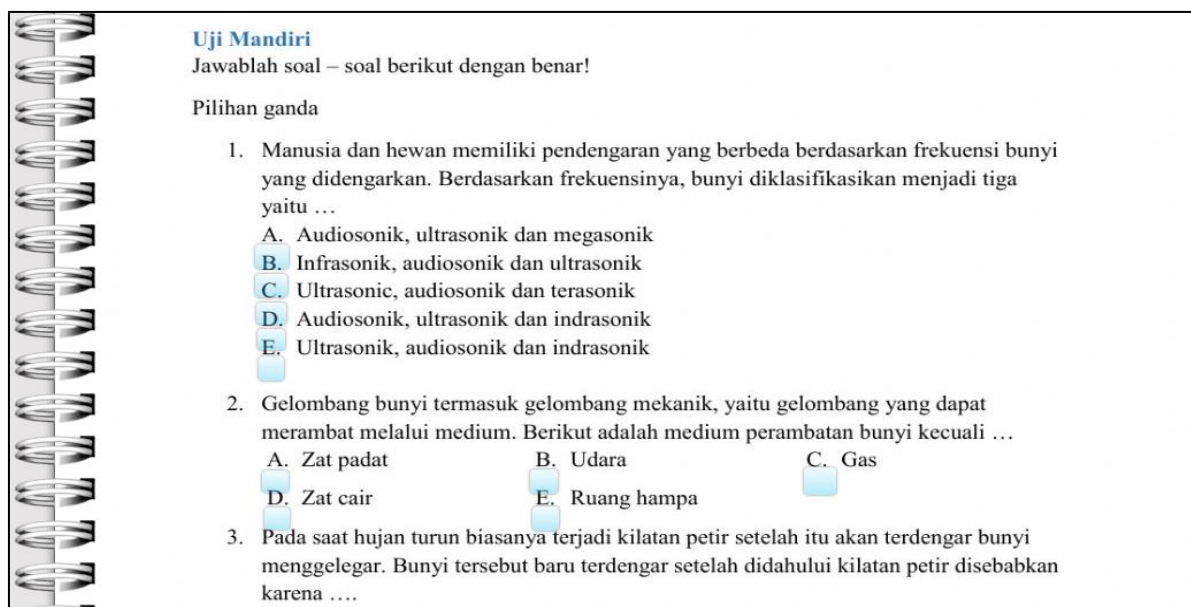


Figure 9. Self-test session

Expert validation results

Expert validation aims to validate PBL-based electronic student worksheet products that have been developed. This validation was carried out by three lecturers from the Physics Education Study Program, FKIP University of Mataram. Aspects that are validated

include the quality of content and purpose, format of writing and images, language use, display quality, product correlation with the dependent variable and product instructional quality. The results of this validation can be seen in Tables 2, 3 and 4 below.

Table 2. Expert Validation Result Data on Electronic Student Worksheet

Aspect	Validity			Average	Criteria
	V1	V2	V3		
Content quality and purpose	0.96	0.90	0.70	0.85	Very valid
Writing and drawing format	1.00	0.92	0.72	0.88	Very valid
Language use	0.88	0.96	0.72	0.85	Very valid
Display quality	1.00	0.94	0.74	0.89	Very valid
Product correlation with dependent variable	0.92	0.92	0.66	0.83	Very valid
Instructional quality	0.96	0.94	0.72	0.87	Very valid
Average				0.87	Very valid

Table 3. Data from expert validation of product support learning devices

Instrument	Validity			Average	Criteria
	V1	V2	V3		
Syllabus	0.96	0.90	0.72	0.86	Very valid
RPP	0.92	0.92	0.71	0.85	Very valid
Study Results Test	0.96	0.92	0.70	0.86	Very valid
Critical Thinking Skills Test	1.00	0.92	0.70	0.87	Very valid
Average				0.86	Very valid

Table 4. Results of product reliability analysis and supporting learning tools

Instrument	Percentage Agreement (%)			PA _{average}	Category
	PA ₁₂	PA ₁₃	PA ₂₃		
Electronic student worksheet	99	88	87	91.3%	Reliable
Syllabus	97	86	89	90.6%	Reliable
RPP	100	88	88	92.0%	Reliable
Study Results Test	98	85	87	90.0%	Reliable
Critical Thinking Skills Test	96	83	87	88.6%	Reliable

Based on the results of expert validation in Tables 2, 3 and 4, it can be concluded that the PBL-based sound wave electronic student worksheet product is in a very valid and reliable category so that it is suitable for use in the physics learning process for class XI MIPA PC Senior High School of 3 Mataram

Practitioner Validation Results

The results of the validation of practitioners, teachers or educators are intended to obtain an

assessment from the teacher regarding the PBL-based sound wave electronic student worksheet that will be used in the classroom. This practitioner validation was carried out by three physics teachers at Senior High School of 3 Mataram. Aspects assessed include appearance, convenience, content and language used. The results of this validation can be seen in Tables 5, 6 and 7.

Table 5. Data from Practitioner Validation on PBL-based sound wave electronic student worksheets

Aspect	Validity			Average	Category
	V1	V2	V3		
Appearance	0.75	1.00	0.87	0.87	Very valid
Convenience	0.75	0.87	0.87	0.83	Very valid
Content	0.75	0.75	0.75	0.75	Valid
Language	0.87	1.00	1.00	0.95	Very valid
Average				0.85	Very valid

Table 6. Data on the results of the validation of product-supporting learning device practitioners

Instrument	Validity			Average	Criteria
	V1	V2	V3		
Syllabus	0.89	0.89	0.78	0.85	Very valid
RPP	0.82	0.82	0.82	0.82	Very valid
Critical Thinking Skills Test	0.80	0.75	0.90	0.81	Very valid
Average				0.82	Very valid

Table 7. Results of product reliability analysis and supporting learning tools

Instrumen	Percentage Agreement (%)			PA _{rata-rata}	Kategori
	PA ₁₂	PA ₁₃	PA ₂₃		
Electronict student worksheet	94	95	99	96.0%	Reliable
Syllabus	100	94	94	96.0%	Reliable
RPP	100	100	100	100%	Reliable
Critical Thinking Skills Test	97	95	91	94.3%	Reliable

The product validation stage is the stage of assessing the feasibility of the product design being developed. This validation was carried out by three expert lecturers as expert validators and three physics teachers as practitioner validators. The product developed is a PBL-based sound wave electronic student worksheet and its supporting learning devices. Product feasibility is assessed based on product construction, content and language. This assessment includes the validation of the electronic student worksheet, syllabus, lesson plans, and evaluation instruments. Suggestions and inputs from validators are the main basis for correcting and revising products so that products that are feasible and can be used in learning (Makhrus et al., 2020). Learning products and devices are said to be feasible if they meet content and construct validity (Rochmad, 2012).

The results of the validation of experts and practitioners can be stated that the product developed is valid and reliable so that it is suitable for use in the

learning process in the classroom. The recapitulation of the validation results on the PBL-based sound wave electronic student worksheet includes the quality of the content and objectives, the format of writing and pictures, the use of language, the quality of the display, the correlation of the product with the given variables, and the quality of instruction. The average validation result of each of these aspects is 85% and is included in the very valid category so that it is suitable for use in learning. The electronic student worksheet that has been developed has gone through a revision stage according to expert advice. The revision or evaluation of the validator has been carried out according to the direction of the supervisor. The use of student worksheets with the live worksheet application trains students to be able to think critically and creatively in dealing with problems and finding better solutions (Noprinda & Soleh, 2019). Through problem-based student worksheets, students are able to think complexly in solving material, draw conclusions, analyze and build

relationships by involving the most basic mental activities (Nadifatnisa & Sari, 2019; Noprinda & Soleh, 2019). Problem-based student worksheets can also facilitate students in practicing higher-order thinking skills (Muzayyanah et al., 2020; Purwasi & Fitriyana, 2020).

Conclusion

PBL-based sound wave electronic student worksheet are online-based digital teaching materials developed using the Liveworksheet application containing sound wave materials and using the PBL learning model. This electronic student worksheet can be accessed for free by students using an Android-based smartphone. The learning stages in this electronic student worksheet follow the PBL learning model with the steps of reviewing and presenting problems, setting strategies, implementing strategies and discussing and evaluating results. This electronic student worksheet is declared valid and reliable based on the results of expert and practitioner validation so that it is suitable for use in physics learning for class XI MIPA PC Senior High School of 3 Mataram.

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