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Development of Electronic Student Worksheets Based on the Science, Environment, Technology, and Society Learning Model on Sound and Light Waves Topic

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ABSTRACT

The study aimed to (1) Describe the development of Electronic Student Worksheet (ESW) based on the SETS model on sound and light waves topic. (2) Describe the level of validity of ESW based on Science, Environment, Technology, and Society (SETS) learning model on sound and light waves topic. (3) Dercribe the level of practicality of ESW on SETS learning model on sound and light waves topic. The research used Research and Development (R&D) with the ADDIE model. The research population consisted of 6 classes of the 11th-grade mathematics and science program (MSP) in madrasah (Islamic school) at Tasikmalaya with a total of 211 students, and a sample of 138 students was taken using the cluster random sampling technique. The validation of material experts consisted of three aspects, namely the content, the language, and the presentation. The validation of media experts consisted of three aspects of assessment, namely the display, the format, and the interactivity aspect. The validation of learning experts consisted of two aspects of assessment, namely presentatio and the SETS syntax. The ESW that was created is the latest innovation that combines Ophysics virtual laboratory technology with ESW Google Sites, especially the author designed ESW on sound waves and light topic for physics learning.

Keywords: Electronic student worksheet (ESW), Light Waves. SETS, and Sound

INTRODUCTION

The Information and Communication Technology (ICT) in the education sector can provide solutions to several problems that arise in physics learning (Ariyansah & Sulistyowati, 2021). The use of technology in education is currently increasingly innovative, effective, and efficient in physics learning (Rizal et al., 2024). The use of learning technology is one form of implementing the Regulation of the Minister of Education and Culture of the Republic of Indonesia No. 22 of 2016 concerning the Standards for Elementary and Secondary Education Processes, which stated that the learning process uses models, strategies, approaches, and methods that refer to interactive characteristics, motivate students to participate actively, and are contextual (Sudan, 2018). One way that can be done to make the physics learning more interactive is by developing student learning tools that are oriented towards a learning model with a virtual practical method (Mubarokiyah et al., 2024). One of the learning tools that can be developed is the Student Worksheet. Student worksheets are a form of learning media

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used to support the learning process, both on an individual and group scale, and they contain materials, practice questions, learning videos, and other activities (Trisnani et al., 2021).

Based on a preliminary study conducted by the author in 11th-grade mathematics and science program at one high school in Tasikmalaya, the author obtained that physics learning in the classroom is still predominantly using a conventional approach. Physics learning still uses teaching materials in the form of printed books and conventional worksheets, but there are still some limitations to the material presented and the models applied. The use of ICT has potential that needs to be developed as one of the solutions to solving problems as well as for the advancement and innovation of education. Therefore, student worksheets need to be used in physics learning and integrated with ICT (Rizal & Ramelan, 2024; Sulistyaningsih et al., 2022).

Physics learning with the practical method in high school is still rarely implemented because the physics laboratory room is still integrated with the biology and chemistry laboratory rooms. One of the benefits of the development of ICT is that it is a learning medium in the form of virtual media or interactive multimedia. Several studies have proven that the use of virtual laboratories in physics learning has proven to be quite effective (Santos & Prudente, 2022). This virtual laboratory will be an alternative to overcoming problems where practical tools are not available, or students cannot access the physics laboratory room at school so that students can study physics material well. This condition is in line with the percentage of questionnaire results that 81,8% of students tend to be more interested in doing practical work in physics learning.

Based on the interview results, it was also found that one of the physics materials that require practical activities is sound and light waves. The schools do not yet have the right media or practical tools for the material. Sound waves are a material that is quite difficult for students to understand because the sound waves generated by the sound source in sound waves are relatively difficult to see or describe directly, so a simulator is needed that can provide an overview of the sound waves. Learning on the material of sound and light waves can use a learning model that allows learning not only to be limited to paper but also involves accurate understanding by seeing, understanding, discussing, and finding real solutions that are relevant to everyday life.

The learning model that is in line with efforts to improve 21st-century skills and is able to encourage 21st-century skills in students is the Science, Environment, Technology, and Society (SETS) learning model (Khoirunnisaa' & Fahmi, 2023). This model has five syntaxes, namely the invitation, exploration, solution, application, and concept consolidation stages. According to Fauzi (2019), some of the advantages of the SETS model are that it equips students with the ability to solve problems using scientific, environmental, technological, and societal reasoning in an integral manner both inside and outside the classroom.

Sarjono (2020) stated that the use of the SETS learning model has a positive impact on student learning outcomes. The implementation of science learning with the SETS approach shows an increase in the learning outcomes of class X students. SETS-based science learning not only improves learning outcomes but also increases student participation in every learning activity. The purpose of learning with the SETS model is to provide steps to connect student knowledge with science, the environment, technology, and society (Khomariah, 2021). The study only focused on one class level, namely class X in high school. The difference with this study is the development of Electronic Student Worksheets (ESW) aimed at class XI mathematics and science programs on the material of sound and light waves, with the hope

that they can be an innovation in the approach and method of learning in schools.

Based on the description above, the author proposes a study entitled "Development of Electronic Student Worksheets (ESW) Based on the SETS Model on Sound and Light Waves". The development of this product was designed with the Google Site application. This development contains 7 ESWs with resonance topic, sound intensity and sound intensity levels, closed organ pipes, doppler effects, light reflection on concave mirrors, interference on slits, and light diffraction, where each meeting consists of: 1) ESW Cover, 2) Subject identity, 3) Learning Competencies, Competency Indicators, and Learning Objectives, 4) Supporting information, 5) Learning syntax, 6) Virtual laboratory, 7) Learning videos, and 8) Five questions in each meeting. This ESW can be accessed via smartphone, laptop, or computer through the link provided, allowing students to use it anytime and anywhere. Therefore, with an attractive appearance, virtual laboratory, videos, and a variety of questions that stimulate thinking, it is expected to increase students' enthusiasm and motivation to learn. The results of this study can be an alternative solution for educators in developing effective learning media that are in accordance with technological developments. Thus, the physics learning process can be more innovative, creative, effective, and enjoyable of ESW based on the Science, Environment, Technology, and Society (SETS) model on sound and light wave material. It hopes to be an alternative solution for educators in developing effective learning media that is in accordance with technological developments. Thus, the physics learning process can be more innovative, creative, effective, and enjoyable. The objectives of the study were to (1) Describe the development of ESW based on the SETS model on sound and light waves topic. (2) Describe the level of validity of ESW based on Science, Environment, Technology, and Society (SETS) learning model on the topic of sound and light waves. (3) Dercribe the level of practicality of ESW on SETS learning model on sound and light waves topic.

METHOD

Research Design

The research use Research and Development method, which research used to create a product and test its feasibility (Yang & Dong, 2022). A series of product developments were developed through the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model research design. At the design and development stage, the validity level of the electronic student worksheet that has been developed will be measured. This validity measurement uses a validation sheet that will be carried out by three validators, namely the material validator, media validator, and learning expert validator. After getting good validity results, the ESW can be tested in schools. At the product development stage, the author developed an ESW on the Google Sites platform to design the media needed. This research was conducted at madrasah in Tasikmalaya because the school required a virtual laboratory-assisted electronic student worksheet practicum media that was in accordance with technological developments and the availability of high school or personal Smartphone facilities owned by all students. This research was conducted from September 2023 to July 2024.

Data were collected using many techniques consisted of questionnaires, interviews, and observation. The author used a closed questionnaire method. Data collection techniques using this questionnaire through three types, namely, needs analysis questionnaires, validation questionnaires, and student response questionnaires. The student needs questionnaire aims

to obtain data on student needs for the ESW product to be developed. The form of a validation sheet involves a validator was used to evaluate the feasibility of an ESW (Ariyansah & Sulistyowati, 2021). In the validation questionnaire, the Likert scale is used to compile the questionnaire, which contains five levels of values to represent the respondents' opinions. This questionnaire is used to obtain product quality data reviewed from several aspects, including media aspects, material aspects, and learning expert aspects. Student and teacher response questionnaires were given to students who acted as test samples and physics subject teachers with the aim of obtaining their responses to the learning media products that had been developed, as well as to assess the extent to which the product was practical as a learning tool. The questionnaire uses a Likert scale to indicate the level of respondent agreement.

Participants

The population consisted of students of the 11th-grade MSP at madrasah in Tasikmalaya. Based on population data, the population of the 11th-grade mathematics and science program is 211 students. According to Sugiyono (2022), the sample is part of the number and characteristics of the population. In sampling, the author uses cluster random sampling on the grounds that the population class is considered homogeneous and has the same opportunity. Maharani (2020) stated that the sample can be determined using the Taro Yamane or Slovin formula, expressed as: $n = \frac{N}{1+Ne^2}$, where n is the number of respondents, N is the total population size, and e is the acceptable margin of error.

If the percentage of error used by the author is 5%, then the number of research sample sizes needed is 138 students. If this number is divided by the average number of students in the 11th MSP, which is 35 people, then the research sample size is four classes. The sample member data is determined using a lottery technique. Sampling for quantitative research is generally done randomly, which can be done with random numbers, computers, or by lottery (Berndt, 2020). Based on the determination of the population and samples that have been carried out, the ESW was tried by students of 11th MSP 3, 11th MSP, 11th MSP 1, 11th MSP 6 at madrasah in Tasikmalaya.

Instruments

The research instruments needed in conducting this research are observation sheets, interview sheets, questionnaires of validation, and questionnaires of student and educator responses. The observation questionnaire is used to collect data on the availability of learning media and ESW on sound and light wave topic used in the field. This instrument was created by students by looking at the research background regarding learning facilities and the availability of physics learning media in schools. Interview activities in the preliminary study were conducted with Physics subject teachers of 11th MSP madrasah in Tasikmalaya to find out data and analysis worksheet needs. This interview instrument was designed by the author with an open interview type with educators with grids, including the implementation of practical activities, availability of practical tools and materials, use of student worksheets, and evaluation of physics learning.

This questionnaire instrument is divided into three types, namely the student needs questionnaire, the validation questionnaire, and the student and educator response questionnaire. The student needs questionnaire instrument was created by the author by designing a grid for obstacles, methods, learning processes, use of ESW media, and student interest in ESW. The validation questionnaire grid was adapted from research conducted by

Fauzi (2019), Ariyansah & Sulistyowati (2021), and Septiana et al. (2023). The grid of student and educator responses was also taken from research conducted by (Septiana et al., 2023) which contains 4 aspects, namely the interest, the practicality, the material and the language. The aspect of interest contains an attractive ESW display, encourages learning independence, and can provide enthusiasm in solving the problems presented. The aspect of practicality contains ESW can be accessed easily. The aspect of material contains material related to daily life and is easy to understand. The aspect of language contains language and letters that are easy to understand, simple and easy to understand. According to Purwanti & Putri (2021), the Likert scale used in the questionnaire consists of five core categories, where a score of 5 indicates very good, a score of 4 indicates good, a score of 3 indicates pretty good, a score of 2 indicates not good, and a score of 1 indicates very bad.

Data Analysis

Data of observations and interviews were analyzed by reducing the data. This data reduction is a technique of summarizing to select the main points, focusing on the important things. Analysis of student needs questionnaire data will be carried out using descriptive statistics to obtain information about the needs of learning media that need to be developed. Data collected using validation questionnaire instruments and student response questionnaires will be analyzed using descriptive statistics to find out the validity and practicality of ESW. The first stage in the analysis is to calculate the percentage of student responses using the Guttman formula, in which the percentage is obtained by dividing the number of students who answered "yes" by the total number of respondents and then multiplying the result by one hundred (Rizal et al., 2025). According to Arikunto (Mail et al., 2020) , the level of knowledge can then be categorized based on the resulting percentage: a value of 75% or higher indicates a Good category, values between 56% and 74% indicate a Sufficient category, and values below 55% fall into the Less category.

The data obtained from the trial activities will be categorized into two types, namely qualitative data and quantitative data. Qualitative data consists of comments, criticisms, and suggestions submitted by material experts, media experts, and learning experts that will be used to improve the electronic student worksheet for this practical work. Meanwhile, quantitative data was obtained from the product validity sheet using three validators and the student response questionnaire. Quantitative data is in the form of an assessment of the questionnaire based on a Likert scale questionnaire. To obtain valid results, the author uses Aiken's V formula. In 1985, Aiken's V formula was used to calculate the content validity coefficient (Yanto et al., 2023; Damayanti et al., 2022). A product is declared to be valid if t average of the expert validity instruments are converted into the expert test validity criteria (Sugiyono, 2022). The validity criteria described in Table 1. The practicality test questionnaire used a 1–5 Likert scale, and the results were analyzed by calculating the practicality score, which was obtained by dividing the total score achieved by the highest possible score and then multiplying the result by one hundred (Ariyansah & Sulistyowati, 2021). The practicality criteria shown in Table 2.

Table 1. Expert Test Validity Criteria

Average Score	Validity Level
0.8 < V ≤ 1.0	Very high
0.6 < V≤ 0.8	High
0.4 < V ≤ 0.6	Moderate
0.2 < V ≤ 0.4	Low
0.0 < V ≤ 0.2	Very low

(Damayanti et al., 2022)

Table 2. Interpretation of practical aspects

Score	Criteria
86% - 100%	Very Practice
76% - 85%	Practice
60% - 75%	Quite practice
55% - 59%	Less practice
54%	Not very practice

Source: (Ariyansah & Sulistyowati, 2021)

RESULTS AND DISCUSSION

Results

The development of this product was designed with the Google Site application. The development contains 7 ESW with resonance topic, sound intensity and sound intensity levels, closed organ pipes, doppler effects, light reflection on concave mirrors, interference on slits, and light diffraction, where each meeting consists of: 1) ESW Cover, 2) Identity of subject, 3) Basic Competencies, Competency Indicators, and Learning Objectives, 4) Supporting information, 5) Learning syntax, 6) Virtual laboratory, 7) Learning videos, and 8) Five questions in each meeting. This ESW can be accessed via smartphone, laptop, or computer through the link provided, allowing students to use it anytime and anywhere. Physics learning mostly requires learning media in the form of teaching aids or supporting tools to facilitate understanding of the material being taught, especially material related to natural phenomena (Purnama et al., 2020). Experimental or practicum methods allow most students to gain a more real physics learning experience so that they are able to understand the material better. However, there are several limitations that need to be considered, including time constraints, the availability of practicum equipment that is still inadequate, and student responses to learning methods so that the students need ICT for physics learning.

The development of this product was carried out in several stages, the first stage in this development research is the analysis stage, namely the needs analysis by conducting observations and interviews with physics subject teachers and 11th MSP students at madrasah in Tasikmalaya. The needs analysis was carried out by distributing questionnaires to students to find out their needs. The questionnaire data were used as a basis for researchers to compile and develop the ESW. The results of the analysis showed that an interesting ESW integrated with a virtual laboratory was needed virtual laboratories can be provided for students who can not have physically access to a laboratory or if practical equipment is not available (Kapilan et al., 2021). ESW are then created using the Google Sites platform, which allows the creation of student worksheets digitally by inserting videos, images, simulations, and practice questions,

which are not found in printed student worksheets in general.

The planning stage is carried out by creating a flowchart and storyboard, compiling materials, compiling the electronic student worksheet format, and selecting an electronic student worksheet development platform. According to Rizal et al. (2022) the flowchart is a graphical depiction of the steps and sequence of procedures of a program. After the flowchart is created, the next step is to create a storyboard, where the flowchart functions as a guide for its creation. The storyboard here is a sketch that uses words. The material presented in the electronic student worksheet is sound and light waves. This material consists of several sub-materials such as sound resonance, intensity and intensity levels of sound, organ pipes, the Doppler effect, reflection of light on mirrors, light interference, and light diffraction. Some of the content in ESW includes how to use ESW, learning outcomes, concept maps, materials, videos, practical activities, virtual laboratories, physics facts, and evaluations. Illustrations on the background cover of the page and subpages, as well as several illustrative images, are provided by the Canva platform (https://www.canva.com/). The components of ESW are arranged using the Google Sites platform because the platform has several features that can contain multimedia, such as virtual practical links, videos, Google forms, etc. Users can open the electronic student worksheet product using a laptop, computer, or smartphone via the published link.

The development stage includes the activity of creating ESW products, which is carried out using Google Sites, and the validation results of expert validators. According to Anh and Truong (2023), Google Sites is a Google product that functions as a tool for creating websites. On the home page menu, there are menu features, including an introduction, materials, an electronic student worksheet, evaluation, physics facts, and developer profiles. These features are shown in Figure 1.

Wahyuni et al. (2021) described the most essential thing in ESW is the content or material presented. The validation by material experts consisted of three assessment aspects, namely content, language, and presentation, with a total use of 16 indicators. The validity of ESW is categorized as very high, with the Aiken index reaching 0.87. The data from the validation by material experts shown in Table 3. Mardianti et al. (2022) explained an ESW needs to be presented with an attractive and interactive display, using various media such as videos, images, and animations to facilitate student understanding of the material. The validation results by media experts consist of three assessment aspects, namely the format, the display, and the interactivity, with the use of a total of 9 indicators. The evaluation validation by media experts are in the very high category, with the Aiken index reaching 0.84. The data from the validation of media experts shown in Table 4. Mardianti et al. (2022) explained learning should ensure that the electronic student worksheet design takes into account pedagogical aspects such as learning strategies, learning methods, and interactions between students and teachers. The validation by learning experts consisted of two assessment aspects, namely the SETS syntax and the presentation, with a total of 9 indicators used. The validation results of learning experts are in the very high category, with an Aiken index of 0.89. The validation of learning experts shown in Table 5.

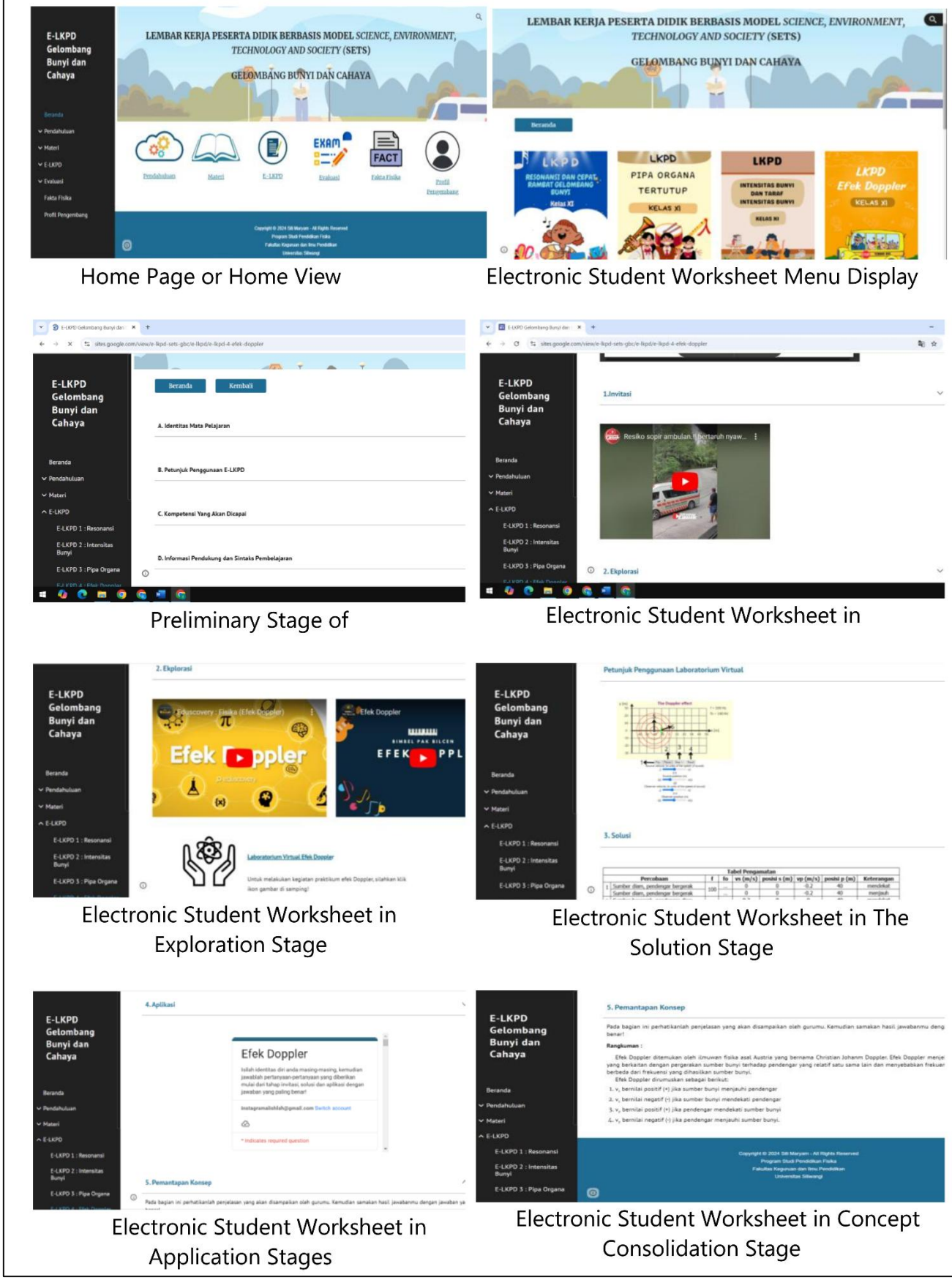

Figure 1. ESW Features

Table 3. Validation of Material Expert

Assessment Aspects	Validity Value (V)	Criteria
Contents	0.86	Very high
Language	0.86	Very high
Presentation	0.90	Very high
Average	**0.87**	**Very high**

Table 4. Validation of Media Expert

Assessment Aspects	Validity Value (V)	Criteria
Format	0.86	Very high
Appearance	0.88	Very high
Interactivity	0.78	Very high
Average	**0.84**	**Very high**

Table 5. Validation of Expert Learning

Assessment Aspects	Validity Value (V)	Criteria
SETS Syntax	0.87	Very high
Presentation	0.92	Very high
Average	**0.89**	**Very high**

In the implementation stage, a trial of the ESW product was conducted on 138 students of grades 11th MSP 1, 11th MSP 3, 11th MSP 4, and 11th MSP 6 at madrasah in Tasikmalaya. The use of this media aims to attract interest in learning and improve student achievement (Fauziah & Sulisworo, 2022). The practicality test assessment was carried out based on four aspects, namely, interest, practicality, material, and language, with a total of 12 indicators used. This assessment was carried out by students of grades 11th MSP 1, 11th MSP 3, 11th MSP 4, and 11th MSP 6 and physics subject teachers of grade XI. The percentage results of the electronic student worksheet practicality test by students were 91.65% and by educators 100%, which shows that the ESW is efficient in terms of interest, effectiveness, material, and language. Data on the student practicality assessment shown in Table 6.

Table 6. Assessment Results of Student Practicality

Assessment Aspects	Percentage	Category
Interest	91.64%	Very Practical
Effectiveness	91.67%	Very Practical
Material	91.12%	Very Practical
Language	92.17%	Very Practical
Average	**91.65%**	**Very Practical**

The evaluation stage in this study contains the results of the analysis of input and responses from educators and students, showing several strengths and weaknesses of this ESW. The evaluation stage involves accepting suggestions from educators and students on the ESW that has been developed, which is then analyzed to find the strengths and weaknesses of the electronic student worksheet Ripani, 2022). Based on comments from educators and students, some of the benefits of ESW include: 1) Electronic student worksheet is made using ICT

advances, which make learning more straightforward to obtain and practical to use; 2) Electronic student worksheet is equipped with various types of multimedia such as images, videos, and virtual laboratories that can attract students' interest in learning. 3) Integration of virtual laboratories is an alternative solution to the limitations of laboratory space and physics demonstration tools for sound and light waves. 4) The provision of learning videos, problem videos, and practical videos enables students to visualize the material presented and to clarify the material presented by educators. The disadvantage of the ESW that was developed is that no observation table can be filled in directly.

Discussion

This research is motivated by students' needs in madrasah schools in Tasikmalaya who still have limitations in the facilities and infrastructure for physics practicums in schools such as the lack of complete physics practicum demonstration tools and the limited space in the physics laboratory which is still integrated with the chemistry and biology laboratories. In addition, the needs analysis also states that 95% of students are very happy to do physics practicum activities. In overcoming these limitations, the author utilizes the development of virtual laboratory technology as an alternative means of carrying out virtual practicums and compiling them in an electronic ESW. The use of ESW has been tried by students on the material of elasticity physics so that students want ESW that is integrated with a virtual laboratory in physics learning. The use of teaching materials or media aims to help students concept comprehension and help educators in delivering the learning material. The use of multimedia is a practicum approach that can be used to provide clear visualization of physics events, thus facilitating student understanding (Lindner et al., 2021).

In the planning stage, researchers used several supporting platforms, including Google Sites as the ESW page, Canva as a tool for creating ESW designs, Youtube as a learning video media and Google formular as a means of answering students. This ESW product contains several practicums using a virtual laboratory from Ophysics which can be an alternative solution to the limitations of teaching aids and real laboratory space in schools. Virtual laboratories can be provided for students who can not access to a physical laboratory or if practicum equipment is not available (Novitasari et al., 2021). The ESW product can be accessed in https://sites.google.com/view/ESW-sets-gbc?usp=sharing, or by scanning the QR code in Figure 2.

SCAN ME

Figure 2. Electronic student worksheet QR Code

This product has been tested for validity by experts and practicality by experts and students. According to(Damayanti et al., 2022) the average validity value criteria of $0.8 < V \leq 1.0$ indicate a very high validity value and a value of $0.6 < V \leq 0.8$ indicate a high validity value. The results of the ESW validity test were carried out by media experts which showed an average validity value of 0.87 with very high criteria, media experts showed an average validity

value of 0.84 with very high criteria, and learning experts showed an average validity value of 0.89 with very high criteria. From the results of this validity test, there is an indicator of the interactivity aspect on the average validity value of media experts showing the smallest value, namely 0.78 with valid criteria. This is because this product has a few shortcomings where each table and questions on the Google Site cannot be answered directly by students, but the author provides Google Form as a means of question and answer in learning activities. The availability of this Google Form is only able to send student answers to teachers, but teachers cannot provide feedback to students. In this aspect of interactivity, it is one of the author's weaknesses, allowing for the latest innovations from subsequent researchers. The appearance of letters, images, and visuals must attract the attention of students so that they become more active and involved in the learning process (Cavanagh & Kiersch, 2023).

The SETS model-based ESW product on sound and light wave material is said to be practical if it is included in the "Practical" category with a percentage value of more than 76% and the "very practical" category with a percentage value of more than 86% (Ariyansah & Sulistyowati, 2021). The results of the practicality test of this ESW product showed an average value of 91.65% with a very practical criterion. The aspect contained in the practicality test that has the highest value is the effectiveness aspect of ESW which shows the largest percentage value of 91.67%. This effectiveness is shown by ESW which can be accessed using students' cellphones or laptops at a more flexible time and place. This is in line with the objectives of ESW, including ESW allowing teachers or instructors to provide worksheets or assignments electronically, so that students can easily access them via computers or mobile devices. This makes it easier to distribute learning materials without having to physically print paper (Aisiah et al., 2023). According to Nuzula et al. (2023), there are several practical impacts of ESW, namely a) it can increase student involvement in the learning process through interactive and dynamic tasks available in ESW, b) it can help students develop concepts and process skills through the steps listed in ESW, c) ESW which is integrated with the learning model can increase the effectiveness of learning.

The development of ESW has greatly contributed to physics learning in schools, especially with the presence of a virtual laboratory. The Ophysics virtual laboratory is the best practicum media that provides quite complete and clear simulations. The sound and light wave simulations provided in this ESW are only a small part of the available simulators. This laboratory can be used at various levels of education and become a means of developing other ESWs for further researchers. However, this research did not run completely smoothly, there were several other limitations, including the ESW field trial was only conducted on students at madrasah schools in Tasikmalaya due to the limitations of the author and the time available, and the developer only evaluated the validity and practicality of the SETS model-based ESW on the material of sound and light waves without assessing its effectiveness in the learning process so that the evaluation stage only contained responses from experts and students regarding the products developed.

CONCLUSION

Validation of the feasibility was carried out by material, media, and learning experts using the Aiken's index, which produced values of 0.87, 0.84, and 0.89, respectively, with an average of 0.86 (very high validity). The practicality test showed results of 91.65% of students and 100% of educators (very practical). As a result, this E-LKPD is very valid and practical to use in learning. The results of the study showed that E-LKPD can help students understand the

material better and improve their learning achievement. This is in line with the results of Sarjono's research (2020) that the use of the SETS learning model has a positive impact on student learning outcomes.

The development of ESW based on the SETS model on the material of sound waves and light is an alternative means of the limitations of teaching aids and laboratory space in schools. This ESW was created based on an analysis of the needs of madrasah schools in Tasikmalaya and students who expressed their interest in virtual laboratories and ESW for physics learning. The ESW created is the latest innovation that combines Ophysics virtual laboratory technology with ESW using Google Sites. In addition, Youtube videos and Google forms are additional parts of the activities in ESW. All the features contained in ESW are able to attract the attention of students to be able to carry out physics learning activities through fun, free, flexible and easy-to-get practicum methods. However, the use of this ESW requires a good internet connection to access virtual laboratories, videos and fill in answers on the Google form. This development is the latest innovation, especially since the author designed ESW on the material of sound waves and light by utilizing the Ophysics virtual laboratory. With this virtual laboratory, students are able to visualize the concepts of sound waves and light easily anywhere and anytime. Students are given the freedom to access ESW for free for school physics learning. Further development of ESW using a virtual physics laboratory will be one of the best multimedia that can be used to create other ESW innovations. However, it is advisable to find a better ESW creation media than Google Sites so that the tables in ESW can be filled in directly and learning is more interactive. The potential of this electronic student worksheet needs to be further developed in further research using various current learning models and other digital learning technologies.

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