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Validity of Electronic Student Worksheets (E-LKPD) Problem-Based on Environmental Pollution Material

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Abstract
The use of less interesting student worksheets can reduce student interest and participation in learning activities. For this reason, worksheets are needed to fulfill these needs. Along with the development of technology, student worksheets can be created in digital form. Electronic worksheets (E-LKPD) not only contain material, but also video material, animations, assignments and other activities that are expected to attract students to be active in learning activities. This study aims to determine the validity of problem-based E-LKPD on environmental pollution materials. The research method used is the Research and Development with a 4-D model (Define, Design, Development, Disseminate) which is then limited to a 3-D model without a deployment stage. The validity test was carried out by three expert validators, namely media experts, material experts and biology subject teachers at MA Muslimin Cipeundeuy. The results showed that the percentage value of problem-based E-LKPD on environmental pollution material from media experts was 75% with the feasible category, the assessment of material experts was 74% with the decent category and biology subject teachers were 92% with the very decent category. The overall validity percentage is 80% and is included in the decent category. Thus, problem-based ELKPD on environmental pollution material developed is suitable for use in learning activities.

INTRODUCTION

Education is defined as the process of changing attitudes as an effort to mature humans. Education is needed as a form of effort to improve and develop human resources for the future. Education is closely related to learning activities. Learning activities are conscious efforts undertaken by individuals to achieve new changes as a result of their experiences in interacting with the environment. A quality and effective learning process will help students achieve the desired skills (Permatasari & Kuntjoro, 2019) . In Indonesia, learning activities in schools use the 2013 curriculum. In the 2013 Curriculum, learning activities are student-centered . Students are a central part of the learning process, actively and independently carrying out activities to understand the learning material. In each learning process, students not only listen to theories presented by the teacher but also take active actions under the teacher's guidance (Noorhidayati, Apriliana, and Hardiansyah 2021). However, in reality, learning activities are often still teacher-centered, with students only receiving information provided, resulting in one-way learning (Yanti & Suryelita, 2021)

Based on interviews with students and subject teachers in the preliminary study, data showed that the learning resources used in learning activities consisted of materials and assignments provided in textbooks and pre-printed worksheets (LKPD). These LKPDs contained material summaries, multiple-choice questions, and essays. During the learning process, students were not actively involved. They simply received information provided by the teacher, easily losing focus and interest in learning. Therefore, teaching materials are needed that can accommodate students' needs while remaining easy to use (Suhartiningsih et al. 2024). Student worksheets (LKPD) are an alternative teaching material used to support learning activities. LKPD are equipped with instructions and steps that students will follow in completing their assignments. The advantages of Student Worksheets (LKPD) are their ability to encourage students to be actively involved in the learning process, help students in discovering concepts, and act as educators and guides for students in carrying out the learning process (Noprinda & Soleh, 2019) . Along with the development of technology and information, LKPD can be created online, known as electronic student worksheets (E-LKPD). E-LKPD are worksheets in digital form that can be accessed via PCs or internet-connected devices and can combine features such as images, learning videos, audio, and *hyperlinks* that enable interaction between teachers and students (Fitriasari & Yuliani, 2021) .

Problem-based e-LKPD is a student worksheet integrated with the *Problem Based Learning* (PBL) model. The PBL model is a learning model oriented towards student involvement, making it a relevant strategy to be implemented in learning with the demands of the 2013 curriculum. In addition, the PBL model is also able to increase understanding, independence, and facilitate problem-solving (Erwanto, 2020). According to Nurjanah and Trimulyono (2022), the PBL learning model is an approach that presents real-world problems in learning where students are directed to solve problems through observation and discussion activities to discover new knowledge. The syntax of this model is used as a guideline in directing student learning activities and encouraging students to actively participate in the learning process and construct their own knowledge (Nasution and Rasyidah 2022).

Research conducted by several previous researchers shows that problem-based student worksheets (LKPD) are suitable for use as a support for learning activities (Melawati et al. 2022). Based on the results of research conducted by Fitriani *et al* . (2016) , problem-based E-LKPD is suitable for use in learning activities on buffer solutions. This is indicated by an increase in conceptual understanding and student learning activities with a percentage of 83.07% and is included in the good category. Furthermore, research by Nurjanah and Trimulyono (2022) shows the effectiveness of achieving critical thinking skills indicators of 85.6% and a positive student response of 97.76%. This indicates that the problem-based E-LKPD used is effective in improving critical thinking skills in learning.

Environmental pollution is a topic taught in grade 10 in the even semester. The core competency of this topic is found in Core Competency 3.11, which is analyzing environmental change data and its impact on life. By developing student worksheets (LKPD) integrated with a problem-based learning model, it is hoped that it will help students discover concepts/materials through investigation and seek alternative solutions to problems, both independently and in groups, particularly in environmental pollution (Harwati and Rokhmat 2021). Based on the explanation and background of the problem described above, this study aims to produce a problem-based E-LKPD on environmental pollution material for grade 10 that is suitable for use in learning activities. The E-LKPD was designed using the *Flip PDF Professional application.*

Literature Review

Problem-based Electronic Student Worksheets (E-LKPD)

E-LKPD is a work guide used by students in electronic form that can be accessed through digital devices to understand learning materials, thus facilitating the learning process. The use of E-LKPD is one medium that can increase student motivation due to its use being based on digital information media (Wahono, 2022). In line with this opinion, Trissa (2022) explains that electronic LKPD is an alternative teaching material used to support learning activities, containing material and tasks that must be completed by students. Electronic LKPD can be easily accessed via gadgets or computers.

E-LKPD is an innovative form of interactive teaching material that can contain multimedia content in the form of illustrations, audio, and video with a more attractive display to support learning activities in the classroom (Nianti, et al., 2022). In an effort to develop an attractive E-LKPD, this was done by developing an E-LKPD in the form of *a Flipbook* which has a printed book-like appearance. In addition, the E-LKPD also includes illustrations and learning videos that can attract students' interest in learning, as well as assignments connected to *Google Form links* , making them easier for students to complete. This is supported by research by Sari, *et al.* (2021) that found that the appropriate use of E-LKPD can increase students' interest in learning and motivation and can encourage students to think and behave scientifically (Maharani and Yohandri 2020).

Integrating e-LKPD with appropriate learning models also helps teachers foster student engagement in learning. One model that can be used is Problem-Based Learning. Problem-based learning models encourage students to develop curiosity through the questions they ask. Through the process of discovering and solving problems, students' thinking skills are developed (Andayani, Raharjo, and Budijastuti 2021).

Problem-Based Learning (PBL) Model

Problem-based learning (PBL) is a student-centered learning model, where students are confronted with real-life problems as part of the learning process. The PBL model emphasizes problems that students must solve using appropriate material concepts. Students are taught to analyze and solve problems independently, with the teacher acting only as a guide during the learning process (Gulo, 2022). In line with this opinion, Savery (2018) explains that *the Problem-based Learning* (PBL) model involves students in learning activities and prioritizes practical problems as a basis for acquiring knowledge and concepts through thinking and problem-solving skills. The stages of the PBL model guide students to investigate, integrate theory with practice, and apply their knowledge and skills to find appropriate solutions to the problems presented.

There are five steps in the PBL model as follows: (1) Orienting students to the problem; (2) Organizing students to learn; (3) Guiding students to explore either individually or in groups; (4) Helping students develop and present their work; (5) Helping students analyze and evaluate the problem-solving process (Sumarmo, 2013). The aim of the problem-based learning model is to motivate students to learn independently, develop thinking skills and problem-solving skills, and provide an understanding of how to work well together in groups (Suryawati et al. 2020).

According to Wasonowati, et al (2014), the advantages of the PBL model are: 1) Encouraging students to develop their thinking skills, 2) The learning process becomes more meaningful because students participate in discovering the knowledge they gain, 3) Encouraging students to actively participate in the learning process. The disadvantages are: 1) Requires a long time to prepare for learning activities, 2) If students do not have a sense of confidence that the problem being studied is difficult to solve, they will feel reluctant to try to solve the problem.

METHOD

The research method used is the *Research and Development (R&D) method. This development* research refers to the 4-D model, which *consists of* the *Define* , Design , Development , *and Dissemination* stages . However, in its implementation, the 4-D model was then modified into a 3-D model so that it did not carry out the dissemination stage (Niak, Mumu, and Palinussa 2020).

Data analysis techniques were implemented using qualitative and quantitative descriptive analysis techniques. Qualitative descriptive data analysis was implemented by collecting data in the form of input from all validators, which was then used as a reference in evaluating and revising the problem-based E-LKPD. Furthermore, quantitative descriptive analysis techniques were carried out by analyzing data in the form of scores from the validation results (Febriansyah et al. 2021).

The developed problem-based E-LKPD product was then validated by experts. The purpose of this validation was to determine the validity of the developed media. This validation was carried out by media experts, material experts, and biology teachers at MA Muslimin Cipeundeuy as potential product users. The validation assessment used a *Likert Scale* of 1-4 criteria (Hidayatul et al. 2020). The validation scores obtained from the three validators were then averaged. The following formula was used to determine the percentage of feasibility of the developed E-LKPD:

$$Score\ validitas\ = \frac{\Sigma scores\ obtained}{\sum Score\ maximum} \times 100\%$$

The criteria for interpreting the validation results by experts can be seen in Table 1. The developed E-LKPD sheet can be categorized as feasible if it achieves a validity percentage score of ≥ 61% (Riduwan, 2017).

Table 1. Interpretation of Validation Scores

Percentage	Criteria
0% - 20%	Totally unworthy
21% - 40%	Not feasible
41% - 60%	Quite decent
61% - 80%	Worthy
81% - 100%	Very worthy

RESULTS AND DISCUSSION

Research result

This research resulted in digital student worksheets integrated with a problem-based learning model for environmental pollution. The problem-based electronic worksheets (LKPD) are presented digitally via *a website* . These worksheets can be accessed via each student's mobile device or PC connected to the internet. The advantage of the E-LKPD lies in the use of technological advances, such as the integration of video and image components (Paradina, Connie, and Medriati 2019). The presence of these videos can help provide meaningful experiences for students by making abstract concepts more concrete, thereby enhancing critical thinking skills (Amalia, Zaini & Halang, 2022).

The developed product has undergone a validation process by three expert validators: a media expert, a material expert, and a biology teacher at Islamic Senior High School Muslimin Cipeundeuy. The expert validation aimed to determine the level of validity of the developed product, ensuring it was feasible and met the needs. A summary of the E-LKPD product validation results from each validator can be seen in the following table.

Table 1of Problem-Based E-LKPD

No	Aspect	Percentage	Category
1.	Graphic Aspects	82%	Very Worthy
2.	Presentation Aspects	77%	Worthy
3.	Content Aspect	86%	Very Worthy
4.	Linguistic Aspects	75%	Worthy
Overall validation score percentage		80%	Worthy

Discussion

Based on the recapitulation of the E-LKPD product validation results (Table 2), the overall assessment of the problem-based E-LKPD obtained a percentage of 80% with a feasible category. The level of validity of the problem-based E-LKPD was assessed based on graphical aspects, presentation aspects, content appropriateness aspects, and language aspects (Meitiyani; et al 2022). The graphic feasibility aspects include cover design, content layout, and typography. Overall, the graphic aspect obtained a percentage of 82%, categorized as very feasible. This indicates that the developed e-LKPD is generally attractive. Regarding the cover design indicator, the developed e-LKPD has a cover design that is appropriate to the topic of environmental pollution and uses a clear and legible font. Khafida (2021) explains that the front cover plays a crucial role in attracting students' attention, so the cover must be well-designed. Furthermore, the use of illustrations on the cover must adequately illustrate the content of the teaching material to facilitate user interaction (Linsida 2022).

In the overall typography indicator, it is included in the decent category. This shows that the developed E-LKPD has a good letter layout arrangement, the use of fonts is not too much of a combination so as not to interfere with students in capturing information. In the layout indicator, layout elements (titles, subtitles, text, illustrations, captions) are placed according to a predetermined pattern so as not to interfere with student understanding or cause misunderstandings about the material presented. According to Asyhar (2012), good teaching materials must be presented clearly and neatly, with the layout or arrangement of presentation formats, text, illustrations or images also presented in a structured and clear manner to support student understanding (Novitasari, Andriana, and Rokhmanah 2023).

Presentation aspects include the presentation system, the relevance of the problems presented to the material, and ease of use. The validation results (Table 2) obtained a 77% rating as feasible. This indicates that the developed E-LKPD is generally appropriate and easy to use. According to Khafida (2021), the E-LKPD presentation system must be presented consistently, with a coherent concept, and in accordance with the material requirements (Hutapea, Sijabat, and Sitinjak 2022). Supporting aspects of this presentation feasibility include attractive images, colors, *layout* , and design of the E-LKPD to increase student interest in participating in the learning process (Setiawan 2022).

The use of illustrations in problem-based e-LKPD is tailored to environmental pollution material. Illustrations are used to visualize the material to facilitate students' understanding of the information presented. The images used are colorful and related to everyday life to attract students' interest. This aligns with Pranata's (2016) opinion that the use of illustrations in teaching materials helps increase reader engagement. Furthermore, Yuliana (2015) explains that the illustrations used must be relevant to life and convey the message. Furthermore, the use of illustrations can effectively attract students' interest in learning (Khairani, Suyanti, and Saragi 2020).

In the content aspect, the validation percentage was 86% with a very feasible category. The content aspect is the result of the process of analyzing student needs and analyzing the curriculum contained in the KI and KD for environmental pollution material for grade X (Cañas, Reiska, and Möllits 2017). The results of the analysis were then developed into indicators of competency achievement and learning objectives. This is in line with the opinion of Herianto (2020), that in preparing student worksheets, it is necessary to pay attention to curriculum analysis so that the worksheets developed are in accordance with the applicable KI and KD (Samadun and Dwikoranto 2022).

The developed problem-based e-LKPD is also integrated with the PBL learning model, which is characterized by presenting authentic, problem-oriented problems. Students are guided to seek

information from the presented problems and then seek solutions. According to Wang & Chiew in Sukorini (2019), PBL-based learning steps guide students to appreciate the learning process, seek solutions, and generate innovative ideas. This process is a cognitive process of the brain in finding solutions (Rerung, Sinon, and Widyaningsih 2017). The PBL model also directs students to learn independently so that it can increase student participation in learning (Safitri, Budiarso, & Wahyuni, 2022).

The final aspect assessed is language. Fitriasari & Yuliani (2021) explain that language is a crucial requirement in developing e-LKPD, which adheres to the General Guidelines for Indonesian Spelling (PUEBI). The language used must be easy to understand and free from ambiguity. Furthermore, the language used must be tailored to the students' abilities to facilitate their understanding of the material. This aspect received a score of 75%, categorized as adequate. This demonstrates that the developed e-LKPD utilizes good language and clear sentence structure (Ambarwati and Kurniasih 2021).

CONCLUSION

Based on the results of the research and discussion, it can be concluded that the problem-based E-LKPD on environmental pollution material for class X is included in the category of being suitable for use in learning activities with an overall validation score percentage of 80% reviewed from the graphic, presentation, content, and linguistic aspects.

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Author Contributions

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Conflicts of Interest

This research is conducted to provide information to the public regarding the research that has been conducted so that it can be used for educational purposes. in addition, this research is used by researchers for lecturer performance loads and accreditation needs of study programmes and institutions

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