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Analysis of the Validity of PBL-Based Electronic Student Worksheets on Alternative Energy Materials

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ABSTRACT

The research is motivated by the fact that the teaching materials used by teachers in physics instruction are still in the form of reading materials and printed student worksheets. The application of the learning model and the integration of technology in physics worksheets has not yet reached an optimal level. This research aims to develop a PBL-based electronic student worksheets on valid alternative energy materials. The type of research used is R&D with the ADDIE development model. The research instruments were in the form of teacher questionnaires, student questionnaires and validity instruments. Validity tests were carried out by 3 UNP physics lecturers. The results of product validity were obtained from the analysis of a validity questionnaire of 88.5% with great validity. The study's result is that electronic student worksheets, which is based on PBL, has very valid alternative energy materials.

INTRODUCTION

The Indonesian education system has the goal of preparing people to become loyal, productive, creative and innovative citizens who are able to contribute to the life of society, the nation, and the state (Nuraliza & Hufri, 2023). One of the efforts made by the government in developing student competencies is by changing the curriculum such as the implementation of the independent curriculum. According to Kemendikbudristek (2021) The Independent Curriculum has general characteristics, namely in the form of soft skill and character competency development where the desired competencies are in accordance with the National Education System are contained in the Pancasila student profile. One of the competencies formulated is independence in learning so that the Independent Curriculum has a concept that requires student's independence in learning.

Independent development of various teaching devices is one of the implementations of the independent curriculum. Teaching materials play a central role as primary learning tools in the implementation of student learning activities. Therefore, the development of teaching materials that support the implementation and characteristics of the independent curriculum is necessary, one of which is the student worksheets (Murni et al., 2024). Teachers can use student worksheets as a learning resource. Student worksheets contains a

series of activities that support students in understanding learning materials and developing skills as part of learning (Wudda et al., 2024). Research conducted by Aslinda & Amir (2017) concluded that the student worksheets developed was effectively used in physics learning. Through technological innovation, student worksheets which is usually presented in print form has now changed into electronic student worksheets which can make learning more flexible and interactive.

Teachers have various roles that are very important to create an effective learning atmosphere and support the development of students. Teachers can apply learning models that demand students' independence in discovering learning concepts with guidance from the teacher (Hufri et al., 2019). The appropriate learning model so that student's can be independent and discover learning concepts is the problem-based learning model (PBL). Problem-Based Learning (PBL) encourages students to develop their curiosity in order to explore the knowledge they possess. This learning model also enables students to learn independently from the problems that have been presented to them. So that from the process of searching and solving problems, students can construct their thinking skills (Duri et al., 2024).

Teachers can design and compile learning scenarios that suits student's needs. According to Hufri et al. (2021) said that the teacher's ability to create structured and interesting learning scenarios has not been optimal. Physics teachers at SMAN 7 Padang experienced obstacles in compiling their own student worksheets. One of them is that if using the PBL model, teachers have difficulty in making problems that will be raised in the student worksheets and time problems in the preparation of student worksheets. Schools have also not provided teaching materials by integrating technology in physics learning. The research conducted has the aim of finding out the validity of the product developed.

METHODS

The types of research used are Research and Development (R&D) with the ADDIE development model. The ADDIE model consists of five stages, namely analyze, design development, implement, and evaluate (Branch, 2009). This research is limited only to the validity test of the module, so the researcher only conducts research steps up to the stage development. The analysis stage is carried out by identifying the need for the development of new teaching materials.

The design stage is determined by the preparation of the electronic student worksheets structure. The electronic student worksheets structure such as covers, electronic student worksheets selection menus, prefaces, instructions for use, competencies to be achieved, supporting information, learning activities based on PBL syntax and bibliography. The development stage, which is a product developed through a validity test process. Research data was collected through teacher interviews, student questionnaires, and validity instruments.

Product validity instruments must be validated first in order for a valid instrument to be used. The validity instrument includes several components, namely: 1) contents feasibility, 2) construction feasibility, 3) PBL model, 4) language feasibility, 5) display feasibility, and 6) software utilization. The weighting of values on the validity instrument uses a Likert scale of 1-4 with the highest score of 4 and the lowest score of 1 (Sugiyono, 2018). In this study, the product is declared valid if it meets the minimum criteria of ≥ 61% (Riduwan, 2012). The validity value can be obtained through Equation (1):

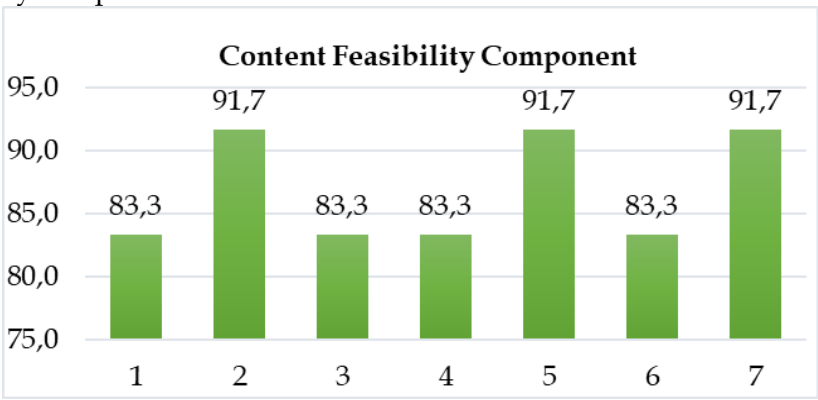
$$Validity\ value = \frac{number\ of\ score\ obtained}{maximum\ score} \text{ x } 100\% \quad (1)$$

RESULTS AND DISCUSSION

Results

The purpose of this study is to produce a PBL-based electronic student worksheets on valid alternative energy materials. At the analysis stage, data was obtained that schools did not have electronic student worksheets using the PBL model. The next stage is design, in the process of designing products and preparing validity instruments. The electronic student worksheets design utilizes canva and is accessed by students through the live worksheets site. The design of electronic student worksheets is cover, optional menu, preface, competencies to be achieved, supporting information, learning activities arranged based on PBL syntax, and bibliography. The next stage is development, which is the process of realizing the design of PBL-based electronic student worksheets products on alternative energy materials. electronic student worksheets validity results were obtained from the analysis of validity instruments consisting of six assessment components including contents feasibility, construction feasibility, PBL model, language feasibility, display and software utilization.

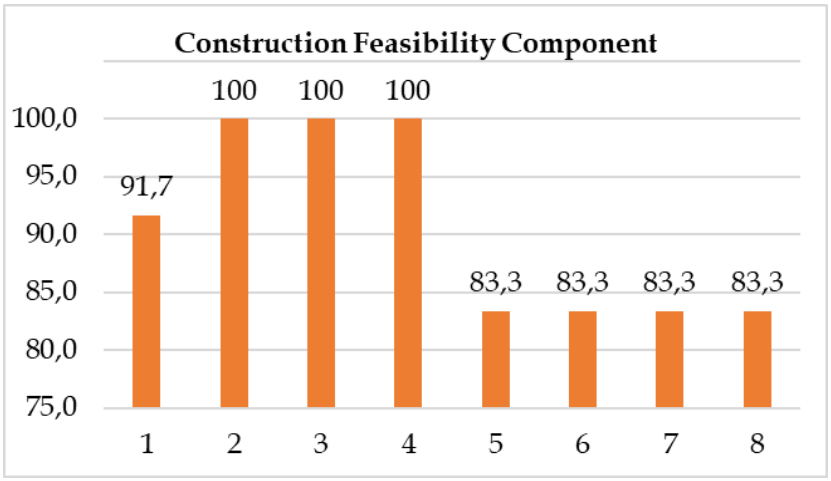
The first component in the validity instrument is the contents feasibility component which has seven statements. The statement on the feasibility component of the content consists of: 1) in accordance with the electronic student worksheets with learning outcomes (CP), 2) the substance of the material in accordance with the learning objectives, 3) in accordance with the needs of the students), 4) the material presented can encourage the curiosity of students, 5) the truth of the physics equation, 6) the addition of knowledge insights, 7) the evaluation in accordance with the learning objectives. The analysis of the content eligibility component value is shown in Picture 1.



Picture 1. Content Feasibility Component Values

Based on Picture 1, it can be concluded that the results of the validity of electronic student worksheets in contents feasibility component obtained values that varied between 83.3%-91.7%. The average validity result based on the contents feasibility component was 86.9% which was categorized as very valid.

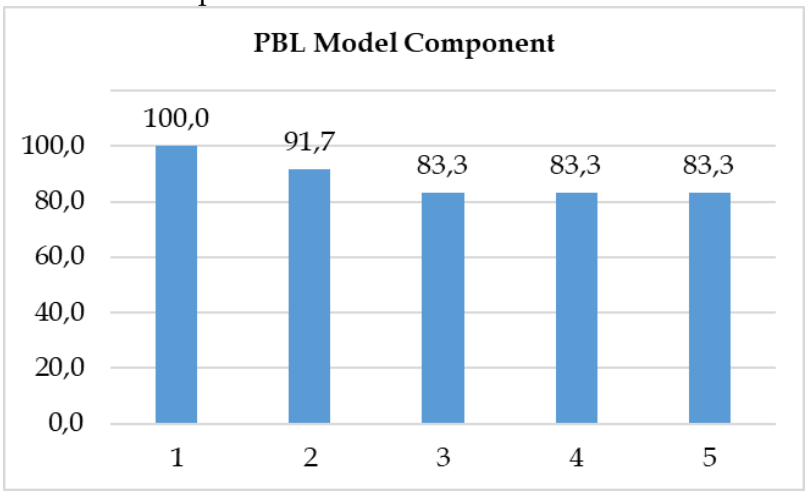
The second component on the validity instrument is the constructability component consisting of eight statements. The statement on the construction feasibility component consists of: 1) electronic student worksheets structure, 2) use of illustrations, 3) use of images, 4) use of videos, 5) have a clear purpose, 6) easy-to-understand questions, 7) clear information. Analysis of constructability components value is shown in Picture 2.



Picture 2. Construction Feasibility Component Value

Based on Picture 2 it can be concluded that the validity results for the construct feasibility component of the electronic student worksheets varied between 83.3% and 100%. The average validity score for the construct feasibility component is 90.6%, categorized as very valid.

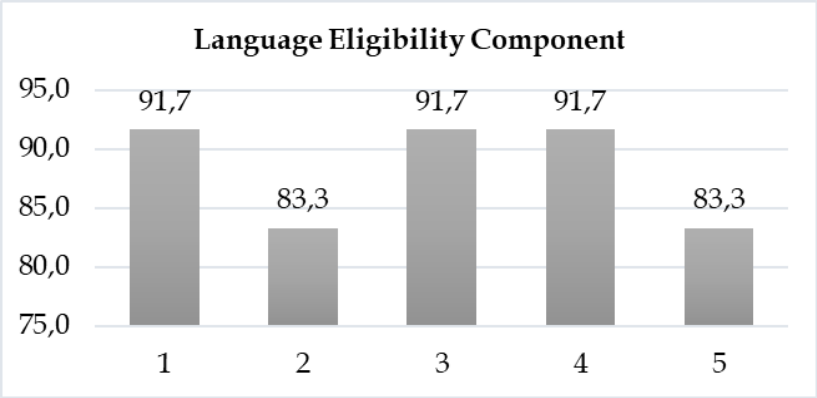
The third component in the validity instrument is the assessment component for the PBL learning model, which consists of five statements. The statements for the PBL learning model assessment component are: 1) orienting students to the problem, 2) organizing students for learning, 3) guiding individual and group investigations, 4) developing and presenting work results, 5) analyzing and evaluating the problem-solving process. The analysis of the PBL model component scores is shown in Picture 3.



Picture 3. Component Value of PBL Model

Based on Picture 3, it can be concluded that the results of the validity electronic student worksheets in the construction feasibility component obtained values that varied between 83.3%-100%. The average validity result based on the PBL model component is 88.3% which is categorized as very valid.

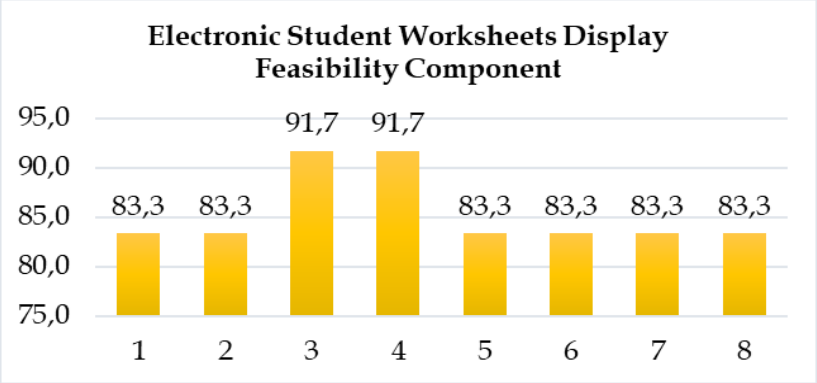
The fourth component of the validity instrument is the language feasibility component which comprises five statements. The statements of the language feasibility components are: 1) sentences are easy to understand, 2) paragraphs are interrelated, 3) accuracy in the use of punctuation, 4) accuracy in the use of hyphens, 5) sentences do not cause double meaning. The analysis of the value of the language eligibility component is shown in Picture.



Picture 4. Language Eligibility Component Values

Based on Picture 4, it can be concluded that the results of the validity electronic student worksheets in the average validity result based on the language feasibility component was 88.3% which was categorized as very valid.

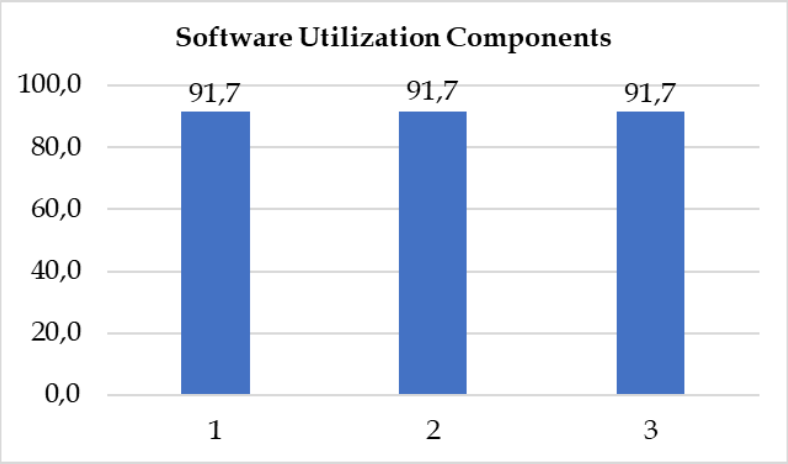
The fifth component on the validity instrument is the display feasibility component which consists of eight statements. The statement of the feasibility of the display is: 1) cover according to alternative energy materials, 2) use of proportional font types and sizes, 3) use of attractive color combinations), 4) layout between interesting parts, 5) attractive and consistent layout, 6) use of images in accordance with alternative energy materials, 7) use of images in accordance with alternative energy materials, 8) use of navigation. m The analysis of the feasibility component of the electronic student worksheets display is shown in Picture.



Picture 5. Electronic Student Worksheets Display Feasibility Component Values

Based on Picture 5, it can be concluded that the validity results for the content feasibility component of the electronic student worksheets varied between 83.3% and 91.7%. The average validity score for the presentation feasibility component is 85.4%, categorized as very valid.

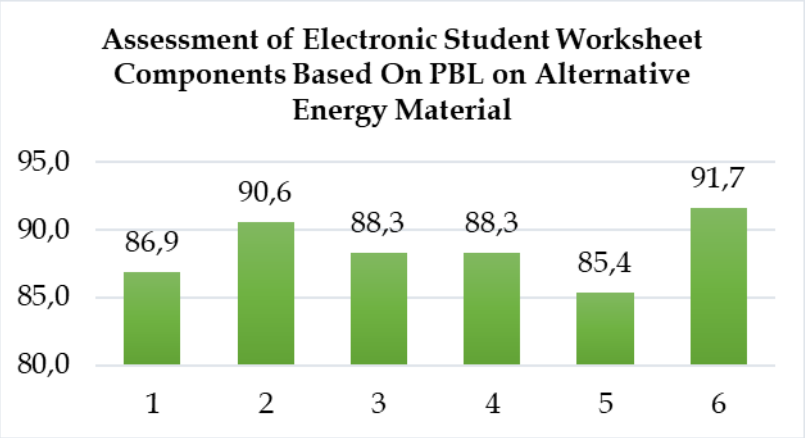
The sixth component of the validity instrument is the software utilization component which consists of three statements. The statements of the software utilization components are: 1) the application is easily accessible, 2) can be accessed on a computer or *mobile phone*, 3) the link can be accessed properly. The analysis of the value of the software utilization component is shown in Picture 6.



Picture 6. Components of Software Utilization

Based on Picture 6, it can be concluded that the validity results for the content feasibility component of the electronic student worksheets varied between 83.3% and 91.7%. The average validity score for the content feasibility component is 86.9%, categorized as very valid.

Based on the average scores for the components in the validity assessment of the electronic student worksheets, which were obtained from the statements for each component: 1) content feasibility, 2) construct feasibility, 3) PBL model, 4) language feasibility, 5) presentation feasibility, and 6) software utilization. The average scores for the validity assessment components of the PBL-based electronic student worksheets on alternative energy materials can be seen in Picture 7.



Picture 7. Average Product Validity Assessment

Based on Picture 7, it can be concluded that the average scores for each evaluation component of the PBL-based electronic student worksheets on alternative energy materials are as follows: the average score for the content feasibility component is 86.9%, categorized as very valid; the average score for the construct feasibility component is 90.6%, also categorized as very valid; the average score for the PBL model component is 88.3%, categorized as very valid; the average score for the language feasibility component is 88.3%, categorized as very valid; the average score for the presentation feasibility component is 85.4%, categorized as very valid; and the average score for the software utilization component is 91.7%, categorized as very valid. Based on the average scores for each component, the overall validity score for the PBL-based electronic student worksheets on alternative energy materials is 88.5%, categorized as very valid. Therefore, it can be

concluded that the PBL-based electronic student worksheets on alternative energy materials falls into the very valid category. It can be said that the PBL-based electronic student worksheets on alternative energy materials meets the standards for use in physics education.

Validators provide suggestions and comments on validated products to minimize the shortcomings of electronic student worksheets making it suitable for use in physics learning. Based on the suggestions from the validators, there are several changes to the electronic student worksheets before and after the revision.

(a) Before revision (b) After the revision

Picture 8. Cover Revision

Based on Picture 8, the revision made by the researcher is to replace the image of alternative energy material on the cover with a real image that is in accordance with alternative energy material. The next suggestion is to improve the instructions for use for students. Then, the improvement in the source link section was previously the same writing size, but after the improvement in the source link section in the electronic student worksheets as a whole, the writing size is smaller and adds and corrects the writing on the supporting information. Change in electronic student worksheets 1 syntax to guide individual or group investigations where before the revision there were no finished drawings to make it easier for students to know the practicum tools and materials, so images of these tools and materials were added. In the work step, there are changes with the aim that students can easily understand the sentences in the work step. In the syntax of developing and presenting the work, there are also changes in the data table where the data table with data analysis must be different because in the data table only the data achieved at the time of observation.

The next suggestion, namely to improve the questions in the evaluation syntax, the questions in this evaluation syntax are changed according to the learning objectives and apply to all evaluation questions in the PBL-based electronic student worksheets on alternative energy materials. Then, change the electronic student worksheets 2 in the syntax to guide individual and group investigations where before the revision there were no finished drawings to make it easier for students to know the practicum tools and materials, then images of these tools and materials were added, this applies to all PBL-based electronic student worksheets on alternative energy materials, especially those that use practicum tools and materials. In the syntax of developing and presenting the work, there are also changes in

the data table where the data table with data analysis must be different because in the data table only the data achieved at the time of observation. The last suggestion is to replace the image that matches the problem sentence in the syntax of student orientation towards the problem

Discussion

The research focused on the validity of the electronic student worksheets based on Problem-Based Learning (PBL) for the topic of alternative energy. The product validity was assessed by three experts using six evaluation components. These evaluation components were referenced and modified based on the instructional material development guidelines (Depdiknas, 2008), which include content feasibility, construct feasibility, language feasibility, presentation feasibility, alignment with the PBL model, and the use of software. The electronic student worksheets is considered valid if the validity assessment score falls within the valid category (Riduwan, 2012).

The first component is content feasibility. The results of the content feasibility assessment indicate a validity score categorized as "very valid." This result suggests that the electronic student worksheets contains content that aligns with the competencies and learning objectives in physics education (Prastowo, 2014). The second component is construct feasibility. The validity result for this component is also categorized as "very valid." This indicates that the electronic student worksheets meets the criteria for well-developed worksheets.

There are three requirements in the criteria for good electronic student worksheets that are developed, namely didactic requirements, construction requirements, and technical requirements. Didactic requirements, namely the electronic student worksheets that is compiled must pay attention to the effectiveness of the learning process and adjust to individual differences in students in understanding the material. Construction requirements, namely requirements regarding the appropriateness of the use of language, sentence structure, vocabulary used so that it can provide clarity and convenience for students in using electronic student worksheets. Technical requirements, namely the electronic student worksheets that is compiled must provide an attractive appearance in terms of letters, images, audio and video presented. So, the requirements for good electronic student worksheets must be able to be used by all students, attractive, and present easy-to-understand work steps (Indriyani, 2013).

The third component is the PBL learning model. According to Arends (2014), the PBL model has five key steps: 1) orienting students to the problem; 2) organizing students for learning; 3) guiding individual or group investigations; 4) developing and presenting work results; 5) analyzing and evaluating the problem-solving process. The validity result for the PBL model component was also classified as "very valid," meaning the learning activities in the electronic student worksheets were designed in alignment with the PBL model syntax.

The fourth component is language feasibility. The language feasibility assessment resulted in a "very valid" validity score, indicating that the electronic student worksheets has clear information and utilizes effective and efficient language (Depdiknas, 2008). The fifth component is presentation feasibility. The validity result for presentation feasibility was categorized as "very valid," proving that electronic student worksheets has an attractive appearance and a design that meets aesthetic quality standards in supporting students in interacting and understanding learning materials (Wudda et al., 2024).

The sixth component involves the use of software. The validity result for the software utilization component was also classified as "very valid." This indicates that the software used to access the electronic student worksheets is easily accessible by stundents. This is in

line with what was stated by Syafitri (2020) electronic student worksheets can simplify and free up space and time so that learning becomes more effective and can be accessed independently by students. Overall, the validity results for the six evaluation components indicate that the electronic student worksheets falls into the "very valid" category. In the course of this research, several suggestions were made by the validators to improve the electronic student worksheets. These suggestions were used to revise the electronic student worksheets, with the aim of enhancing its quality.

Based on the research results, the validity score of the PBL-based electronic student worksheets on alternative energy material is 88.5%, categorized as "very valid." This is in line with the study by Duri et al. (2024). Their research showed that the PBL-based electronic student worksheets on sound waves, which incorporates critical thinking skills, is highly valid. Additionally, the study by Sagita & Putra (2023) also demonstrated that the PBL-based electronic student worksheets on momentum and impulse is both valid and highly practical. The connection between this study and previous research lies in the fact that both developed valid PBL-based electronic student worksheets. However, there is a weakness in the product that is made, namely because it is electronic-based, even though it can be accessed anywhere, accessing it requires an internet network.

CONCLUSION

Based on the research results that have been discussed, the PBL-based electronic student worksheets product for alternative energy materials obtained an average validity score of 88.5%, categorized as very valid. This proves that the developed PBL-based electronic student worksheets for alternative energy materials is valid for use in physics education.

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