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Validity And Practicality of PjBL-Based Teaching Materials Environmental Pollution For Physics Phase E

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Abstract

The purpose of this research is to test the validity and practicality of the project-based learning teaching materials that have been developed.. This research is research and development (R&D) with a model-4D development model. Data analysis uses Aiken V. The results of the validity test, gets a score was 0.89846 with valid criteria. Meanwhile, the results of the practicality test by 3 physics teachers obtained an average overall score of 93.25% using practical criteria, and the results of the practicality test by 19 students obtained an average overall score of 88.28% using practical criteria, so it can be concluded that the environmental pollution teaching materials for phase E project-based learning that have been developed have met the validity and practicality requirements and are suitable for use by teachers in teaching and for students in learning.

Keywords : *Teaching Materials, Validity, Practicality, Phase E*

INTODUCTION

The most crucial element in determining a country's prosperity and the caliber of its people's resources is its level of education. The process of education can provide original, imaginative concepts for modern advancements. Curriculum development is one action to improve the quality of education. The correct educational policy will appear when the curriculum is implemented because "the curriculum is the heart of education", which determines the continuity of education (Munandar & Stkip Bima, 2017). The curriculum is a learning plan that aims to educate students (Achmad Noor Fatirul & Djoko Adi Walujo, 2021). The educational curriculum is dynamic. This is because curriculum development must adapt to the needs and characteristics of students according to current developments (Cholilah, 2023). In 2022, Indonesian education will begin implementing an independent curriculum. An independent curriculum is defined as a learning design that is able to provide opportunities for students to learn in a fun, relaxed, calm manner, free from pressure and stress, so that they can show their natural talents, such as freedom and creative thinking in learning (Rahayu et al., 2022) .

The independent curriculum is one with a variety of extracurricular activities and better material, giving students the opportunity to enhance their understanding and build their skills. The independent curriculum focuses on the overall development of student learning outcomes that include literacy, numeracy, and character competencies (Ayu Permata Sari & Suryelita, 2023). According to the Ministry of Education and Culture (2022), an independent curriculum is a crucial tool for fostering inclusive education, namely that educational units are able to organize a learning atmosphere that accepts and respects differences, including social, cultural, religious, and ethnic differences. In the independent curriculum, it is possible to demonstrate inclusion by using the Pancasila student profile. For instance, via project-based learning and the aspects of global variety and morality toward others. Project-based learning will inherently promote the development of tolerance, enabling the realization of inclusive learning (Kemendikbud, 2022). The independent curriculum has the following main characteristic: interdisciplinary project-based learning for the development of character and soft skills in accordance with the Pancasila student profile, concentrate on the most important content to allow sufficient time for in-depth acquisition of fundamental skills like reading and numeracy, flexibility for educators to modify instruction based on students' skill levels and take into account the local context and curriculum(Nugroho & Narawaty, 2022). The independent curriculum has its own characteristics compared to other curricula, namely the emphasis on implementing learning methods that are student-centered and can train students' independence, namely .project-based learning (PjBL)(Fahlevi, 2022; Pertiwi et al., 2022).

Student-centered learning is what project-based learning is (Syarifah, 2021). A learning process that directly involves students to produce a project" is what project-based learning is all about (Sari, 2018). In essence, this learning paradigm gives priority to the improvement of problem-solving abilities while working on a project that might provide a product (Handayani, 2020; Hidayat, 2023). This is consistent with the findings of by Kuni Maratus's research (2022) that the application of the model project based learning can increase students' creativity and can improve learning outcomes (Solehah, 2022). The results of research from Fatemah (2015) state how using project-based learning enhances students' abilities, and students become more diligent, active and motivated in learning. Students need various material sources to realize project-based learning. However, in reality, the material content in the available teaching materials is still small and not yet project-based Thus, in order to assist students in applying what they have learned, project-based teaching materials are required. Project-based learning is an approach to education where students apply the fundamental information and concepts they have learned in class to solve real-world issues while also developing their critical thinking and problem-solving abilities (Azzahra, 2023; Dewi, 2017). One of the essential materials studied in the independent curriculum for phase E physics subjects is environmental pollution. This material studies the characteristics of environmental pollution, what are the causes of environmental pollution, what impacts are obtained from environmental pollution and

how to overcome the impacts of environmental pollution. This material consists of several sub-materials including water pollution, air pollution and land pollution.

Teaching materials are a set of learning materials that refer to the curriculum used to achieve predetermined learning objectives (Saputri, 2022). According to the Ministry of National Education (2008), the guide to developing teaching materials explains that teaching materials have basic components, namely learning instructions (student/teacher instructions), basic competencies of teaching materials or learning outcomes, supporting information for exercises, task guidelines, which may take the form of worksheets, and assessment (Eka, 2017). All items used by teachers to aid students in their learning are considered teaching materials, whether written or unwritten. This teaching material is developed systematically using the relevant curriculum's learning objectives in mind and is expected to increase students' interest in learning independently (Magdalena et al., 2020). The concept of education in Indonesia currently takes into account the individual abilities and creativity of students, to implement this by conducting project-based learning, this is in line with the results of Hattarina's research (2022) (Hattarina, 2022). This is also in line with Dhira's (2023) research that independent curriculum activities focus on students and are project-based (Kharisma, 2020). Based on the findings of the preliminary investigation, it was discovered that the educational resources utilized in schools were exclusively acquired from subject teacher meetings (MGMP) and the existing expectations of the curriculum were not met by the instructional materials, namely not yet in the form of project-based learning. To realize this, of course it must be adapted to the learning model. This research focuses on learning modelsProject Based Learning (PjBL).

The findings of physics teachers' interviews at high schools that have implemented the independent curriculum, namely SMAN 3 Bukittinggi, showed that the teaching materials used were not meeting the requirements of an independent curriculum, where they had not used project-based teaching materials that supported students to help them carry out learning and understand. material, especially environmental pollution material. Based on the background that has been explained, the problem studied is the validity and practicality of environmental pollution teaching materials for phase E based on project based learning which has been made.

METODE

This type of research is development research (Research and The Development) using a 4D model. According to Thiagarajan, S.S (1974) the 4D model has four stages of development, namely;Define, Design, Develop, and Disseminate(Maulia, 2018). However, in this research, researchers only carried out the development stage (develop) with validity tests and practicality tests. In developing teaching materials, the Ministry of National Education (2008) states that the components of developing teaching materials consist of constructs, namely appropriateness of content and language, and constructs, namely presentation and graphics (Yudha, 2023). The content appropriateness component consists of 13 indicators, linguistics has 5 indicators, presentation has 31 indicators and graphics has 7 indicators.

The research was conducted from August to December 2023 at SMAN 3 Bukittinggi. The data collected in this research are data from validity tests of teaching materials by 3 physics lecturers and data from practicality tests by 3 physics teachers and a small group of students. The instrument used to collect data was a validity test questionnaire arranged according to a Likert scale, with score categories seen in Table 1.

Table 1. Validation Score Category Table

Interval	Category
$0.8 < V$	Height
$0{,}4 < V \leq 0{,}8$	Currently
$\leq 0{,}4$	Low

(Source: Retnawati, 2016)

The results of validation research are analyzed through an assessment of the validity index proposed by Aiken V which is formulated in Equation (1)

$$V = \frac{\sum s}{n(c-1)} \quad (1)$$

Information:
IN = item validity index
s = score set by the rater (validator) less the category's lowest score (in this case = 1)
r = score of the rater's (validator's) chosen category
c = category that the rater (validator) can choose (in this case = 5)
n = number of raters (validators)

The practicality test will be carried out by providing teacher and student response questionnaire sheets. The practicality test has an answer score with the following criteria:

1 = Strongly Disagree (STS)
2 = Disagree (TS)
3 = Neutral (N)
4 = Agree (S)
5 = Strongly Agree (SS)
With the following formula:

$$P = \frac{f}{N} \times 100\% \quad (2)$$

P = Product Practicality
f = Total value obtained from the questionnaire
N = Maximum questionnaire value

Practicality tests are carried out to determine the value of ease, clarity, attractiveness and benefits of the learning modules that have been created.

Table 2. Practicality Criteria Table

No	Achievement Rate (%)	Criteria
1	0% - 20%	Impractical
2	21% - 40%	Less Practical
3	41% - 60%	Quite Practical
4	61% - 80%	Practical
5	81% - 100%	Very Practical

(Source: Sudjana, 2001)

RESULT AND DISCUSSION

Before phase E environmental pollution teaching materials were based project that has been prepared for use in learning activities, this teaching material should have valid and practical status. The purpose of validation activities in this research is to obtain valid status from the experts. The teaching materials that have been designed are then carried out in the validation stage by providing validation sheets to the experts. Expert validation is carried out to obtain input and suggestions as well as provide an assessment of teaching materials that have been prepared and designed using a Likert scale model, namely a score of 1 to 5 with each statement indicating a rating of strongly disagree, disagree, neutral, agree, and strongly agree. The validation criteria for this teaching material consist of 3 validation experts. The assessment results from the three experts were analyzed using the Aiken's V formula to determine the validity of Phase E Environmental Pollution teaching materials based on project which has been developed.

A. Validity Test Results

The components of content appropriateness consist of 13 assessment indicators, namely 1) Match the topics discussed with learning outcomes. 2) Suitability of material to learning objectives. 3) Linkage of activities with real life. 4) There is a project based learning syntax, namely asking fundamental questions. 5) appropriate PjBL syntax for planning projects. 6) Compatibility of PjBL syntax to create a scheduler. 7) Completion of PjBL Project Monitoring Syntax. 8) Compliance with PjBL syntax for results assessment. 9) Compliance with PjBL evaluation syntax. 10) Accuracy of images/videos with the material. 11) Supports students with a visual learning style. 12) Supports students with an audio learning style and 13) Supports students with a kinesthetic learning style. The findings of the content feasibility component's validity are as follows:

Table 3.Content Feasibility Validation Test Results Table

Indicator	Nilai V'Aiken	Criteria
1	0,91667	Height

2	0,91667	
3	0,83333	
4	0,91667	
5	0,83333	
6	0,91667	
7	0,75000	Currently
8	0,58333	
9	0,91667	
10	0,83333	
11	0,91667	Height
12	0,91667	
13	0,91667	
Rate-rate	**0,85897**	**Height**

Table 3 shows that the content appropriateness indicator's validation value falls between 0.58333 and 0.91667. There are two moderate validity evaluation indicators out of the thirteen assessment items, namely 0.58333 on the PJBL syntax suitability indicator for assessing results and 0.75000 on the PJBL Syntax conformity indicator for Project Monitoring, this states that the teaching materials do not show enough PJBL syntax, namely project monitoring and assessment of results. There are then eleven validation assessment indications that have a high classification, namely ranging from 0.83333 to 0.91667. The content appropriateness indicator's average validation value is 0.85897. The generated instructional materials are deemed valid in terms of content appropriateness on a scale of 0.858976, according to Retnawati (2016)'s Likert scale (Masithah, 2022). Therefore, In terms of content feasibility components, it can be said that the project-based learning (PjBL) based teaching materials on environmental pollution material in Physics phase E have high validity.

The language component's results represent the outcome of the second validity test. This component seeks to ascertain if users can readily read and comprehend the language used in project-based learning based on environmental pollution content in phase E. There are 5 assessment indicators that comprise the language appropriateness component, namely 1) The language used is communicative. 2) The language used does not have double meaning. 3) The language used is good and correct in Indonesian grammar. 4) Clarity of the information conveyed. 5) The spelling used refers to EYD. The language appropriateness component's validity result can be seen in Table 4:

Table 4.Language Component Validation Results

Indicator	Nilai V'Aiken	Criteria
1	0,91667	
2	0,91667	
3	0,91667	Height
4	0,91667	
5	0,83333	
Rate-rate	**0,90000**	**Height**

Table 4 shows that for five indicators with strong validation requirements, the language appropriateness component's validity was attained, where 4 indicators had a value of 0.91667 and 1 indicator had a value of 0.83333 Students will comprehend the learning information more easily if the language used is simple and appropriate for their developmental stage. Thus, it can be concluded that in terms of language appropriateness components, the project-based learning based instructional materials on phase E environmental pollution material generated have validity in the high category.

The presenting feasibility component has the findings of the third validity test. This section seeks to ascertain whether the phase E environmental pollution teaching materials, which use project-based learning, have supplied the necessary knowledge for learning. There are 31 indications for assessing the appropriateness of the presentation, namely 1) Foreword. 2) Table of contents. 3) Instructions for use. 4) Learning outcomes. 5) Learning objectives. 6) Concept map. 7) Material description. 8) Practice questions. 9) Test. 10) Glossary. 11) Bibliography. 12) Answer Key. 13) Clarity of learning objectives to identify the characteristics of water pollution. 14) Clarity of learning objectives to analyze the causes of water pollution. 15) Clarity of learning objectives to analyze the impact of water pollution. 16) Clarity of learning objectives to solve problems as an effort to overcome the impacts of water pollution. 17) Clarity of learning objectives to identify the characteristics of air pollution. 18) Clarity of learning objectives to analyze the causes of air pollution. 19) Clarity of learning objectives to analyze the impact of air pollution. 20) Clarity of learning objectives to solve problems as an effort to overcome the impacts of air pollution. 21) Clarity of learning objectives to identify the characteristics of soil pollution. 22) Clarity of learning objectives to analyze the causes of soil pollution. 23) Clarity of learning objectives to analyze the impact of soil pollution. 24) Clarity of learning objectives to solve problems as an effort to overcome the impacts of land pollution. 25) Consistency of concept presentation. 26) Related images/videos support strengthening understanding of concepts. 27) The presentation of material is interactive and participative. 28) Relationships between sub-materials. 29) The integrity of meaning in learning activities. 30) Order of questions from simple to complex. 31) Clear bibliography. The results of the validity assessment of the presentation feasibility component can be seen in Table 5:

Table 5.Presentation Component Validation Results

Indicator	Nilai V'Aiken	Criteria
1	1,00000	
2	1,00000	
3	0,91667	
4	1,00000	Height
5	0,83333	
6	0,83333	
7	0,91667	

8	0,91667	
9	0,91667	
10	0,91667	
11	0,91667	
12	0,91667	
13	1,00000	
14	1,00000	
15	0,91667	
16	1,00000	
17	0,91667	
18	1,00000	
19	1,00000	
20	1,00000	
21	0,91667	
22	0,91667	
23	0,91667	
24	1,00000	
25	0,91667	
26	0,91667	
27	0,83333	
28	0,91667	
29	0,83333	
30	0,83333	
31	0,91667	
Rate-rate	**0,93011**	**Height**

Table 5 shows that, with high validation requirements, the validation values for the presenting feasibility component of the 31 evaluation indicators ranged from 0.83333 to 1.00000. With a high validity score, the content appropriateness indicator's average validation value is 0.93011. The research's findings align with the recommendations for creating (Ministry of National Education, 2008). As a result, it can be said that the phase E environmental pollution teaching materials designed for project-based learning have high validity in terms of presentation feasibility components.

On the graphic feasibility component, the fourth validity test results are displayed. This part seeks to ascertain if project-based learning on environmental pollution material in phase E displays can be enjoyed by users. There are 7 assessment indications in the graphic feasibility component, namely 1) Use of attractive and harmonious colors. 2) presentation of images and videos that are clear, interesting and appropriate. 3) Use of clear and legible fonts. 4) Appropriate font size. 5) Use text colors that contrast with the background. 6) Regularity in layout and layout. 7) Attractive design appearance. The results of the graphic feasibility components validity assessment can be seen in Table 6 :

Table 6.Graphical Component Validation Results

Indicator	Nilai V'Aiken	Criteria
1	0,91667	
2	0,83333	
3	1,00000	
4	0,83333	Height
5	1,00000	
6	0,91667	
7	0,83333	
Rate-rate	**0,90476**	**Height**

Rate-rate 0,90476 Height

Table 6 shows that seven evaluation indicators, with values ranging from 0.83333 to 1.00000, which are categorized as high validity requirements, had the validation values for the graphic components reached. As a result, it can be said that in terms of graphic feasibility components, the project-based learning based teaching materials on phase E environmental pollution material generated are extremely valid.

The assessment findings are based on the validity evaluation that has been carried. The overall validity of project-based learning based teaching materials on phase E environmental pollution material can be seen in Figure 1 below :

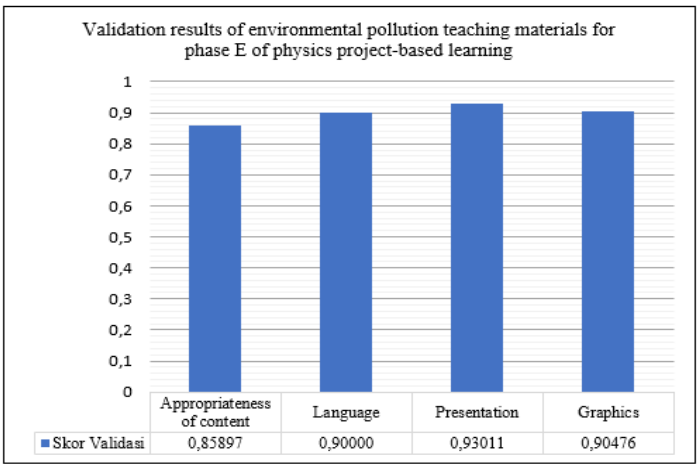

Figure 1. Validation results of environmental pollution teaching materials

B. Practicality Test Results

Next, a practicality test was carried out. The purpose of this practicality test is to assess how practical the PjBL teaching resources that have been developed are. Three physics teachers used practical instruments to measure the practicality of instructional materials.. The results of the project-based learning-based practicality analysis of teaching materials for Phase E environmental pollution have been applied to four aspects of the practicality evaluation. These components include the

components of clarity of content, attractiveness of the dish, ease of use and benefits. In summary Table 7 displays the results of the practicality test.

Table 7.Results of Practicality of Teaching Materials by Teachers

No	Assessment Aspects	The Value of Practicality	Criteria
1	Content Clarity	94%	Very Practical
2	Attractiveness of the Dish	96%	
3	Ease of Use of Teaching Materials	91%	
4	Benefits of Teaching Materials	92%	

Table 7 shows that the practicality test results that Physics professors conducted had very good scores, where the content clarity component gets a score of 94%, for the attractiveness of the dish component the score is 96%, for ease of use of teaching materials it gets 91%, and for The benefit component obtained was 92%. Therefore, it can be stated that the project-based learning based teaching materials on phase E environmental pollution material developed are very practical. Furthermore, the results of practicality data by a small group of 19 students can be seen in Table 8.

Table 8.Results of Practicality of Teaching Materials by Students

No	Assessment Aspects	Assess Practicality	Criteria
1	Content Clarity	84%	Very Practical
2	Attractiveness of the Dish	83%	
3	Ease of Use of Teaching Materials	84%	
4	Benefits of Teaching Materials	83%	

Table 8 shows that the results of the practicality test data carried out by students are included in the very high category, where the content clarity component gets a score of 84%, for the attractiveness of the dish the score is 83%, for ease of use of teaching materials it gets 84%, and for The benefit component was found to be 83%. As a result, it can be said that the phase E environmental pollution teaching materials designed for project-based learning are practical.

The results of the practicality test of project-based learning (PjBL) based teaching materials were obtained using practicality instruments by 3 Physics teachers and 19 students. The practicality instrument used by teachers consists of 4 types of components, namely the practicality instrument, the clarity component of the content of teaching materials, the attractiveness component of the presentation of teaching materials, the ease of use component of teaching materials, and the benefits component of teaching materials. From these four components, an overall average score of 93.25% was obtained in the very practical category. The practicality instrument used by students consists of 4 components, namely, clarity of the content of teaching materials, component of attractiveness of presentation of teaching materials, component of ease of use of teaching materials, and component of benefits of teaching

materials. From the four components, it was also found that PjBL-based teaching materials were classified as very practical with an overall average score of 83.33%. Based on the practicality test findings, it can be concluded that project-based learning-based teaching materials on environmental pollution are useful and simple for teachers and students to use in their instruction. This is in accordance with the opinion. This is in accordance with the opinion of (Gitnita, 2018) that useful instructional resources can enhance students' comprehension of the subject matter.

CONCLUSION

This research produces a new product, namely environmental pollution teaching materials for phase E project-based learning . The study's findings indicated that the phase E environmental pollution teaching materials, which were based on the project, satisfied the criteria for validity and practicality and could be used by teachers to instruct students as well as by students to learn.

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