Validity and Practicality of Teaching Materials Based on Project Based Learning on Global Warming Material for Phase E

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ABSTRACT

The Independent curriculum demand students to be active, creative and independent learners. The learning process requires teaching materials to support students' learning. Learning materials are organized materials that enable students to work independently, which is consistent with the demands of the independent curriculum. Appropriate teaching materials for the independent curriculum cannot ignore the three elements of meaningful understanding, provoking questions and possibilities for learning. In fact, there are teaching materials that do not meet the requirements of the independent curriculum. This article aims to explore the feasibility and usability of project-based teaching materials on the subject of global warming. The research methodology used the 4D model, research and development (R&D) through definition, design, development and disposal. The validity analysis results of the manual using three validators revealed a high category of 0.89 for the presentation component, 0.90 for graphics, 0.93 for content validity and 0.86 for language, while the usability test of the manual using three physics teachers and 60 students revealed an average of 95% and a very practical category of 81.65%. It was therefore confirmed that the E-level textbook based on project-based learning on global warming is valid and practical and can be used as a teaching aid.

INTRODUCTION

In the 21st century, the education system prioritizes the ability of each individual to solve problems using knowledge (S. Keleşoğlu and N. Kalaycı, 2019 ; M. Yılmazlar and A. Çorapçıgıl, 2019). The education system certainly requires a curriculum. Currently, the Merdeka curriculum is used in Indonesia based on Regulation No. 56/2022 of the Education, Culture, Science and Technology Minister on the Guidelines for the Curriculum Implementation in Enabling Learning. The autonomous curriculum is a real effort of the government to increase the education quality in relation to the requirements of the 5.0 era society (Manalu et al., 2022). The autonomous curriculum requires students to be more active,

creative and autonomous in solving problems (Suryaman, 2020 ; Khoirurrijal et al., 2022). This curriculum focuses on learner freedom by encouraging to shape the independent spirit of teachers and students. With an independent spirit in learning, both teachers and students can be free and open in seeking knowledge, attitudes and environmental skills (Daga, A. T, 2021 ; Widayati, 2022). This is related with the independent learning concept, which aims to liberalize education (Vhalery, R., Setyastanto, A. M., & Leksono, A. W, 2022).

This independent program differs from previous programs in that it focuses on students' attitudes towards global diversity, mutual cooperation, independence, reasoning, critical thinking, and creativity, which are key characteristics of the profile of Pancasila student. Students also benefit from differentiated learning. Differentiated learning is learning that prioritizes the concept that everyone has different requests, talents, and potentials (Faiz, A., Pratama, A., & Kurniawaty, I., 2022). Learning that uses the concept of differentiation is a need for interests, learning preferences, and students to meet learning outcome standards (Marlina, 2020). The independent curriculum ensures learner-centered learning. Teachers are not used as the main source in delivering learning with teaching materials, but students are demanded to be more active in learning. In the age of self-directed learning, learning is driven by teacher and student ownership of learning goals, methods, materials, and assessments. Teaching materials are one of the means for teachers and also students in harmonizing learning that refers to an independent curriculum. The material for teaching used is one of the learning media. Media is essentially part of a learning system (Anwar, A. 2022). With this teaching material, it makes it easier for teachers and students in the teaching and process of learning.

Teaching materials based on an independent curriculum refer to a material and media tools or facilities, guidelines that are made in an organized manner to suit the needs of students. Teaching materials have a major role in developing learning strategies and as a means of information (Maulida, U., 2022 ; Endang, Nuryasana, E., & Desiningrum, N., 2020 ; Magdalena, I. et al., 2020). The learning materials themselves can be described as implementing a stream of learning objectives (LEOs) developed from learning outcomes (LOs), focusing on the Pancasila learner profile. Learning materials are useful as an aid for students in their learning (Magdalena, I. et al., 2020 ; Depdiknas, 2008). Instructional materials are essentially the "content" of the curriculum and take the form of lessons or study areas with topics/subtopics and explanations (Ruhimat, T., 2011). Instructional materials can also be interpreted as any form of material systematically prepared for students' independent learning and designed according to the current curriculum (Maulida, U., 2022).

On the other hand, in the teaching material component of the Merdeka Curriculum, there are 3 quite crucial terms that cannot be ignored. The three components are Meaningful Understanding, Sparking Questions, and Learning Sheets. Meaningful Understanding refers to a statement that explores and describes the learning process as an activity that connects concepts with concepts in order to build a complete understanding. The teaching materials made of course use a model of learning that is in related with the learning design. Based on observations through school observations, there are already teaching materials, but they are still not in related with the demands of the independent curriculum to support the learning process. In learning we are not only required to understand theories or concepts, but are expected to understand how symptoms, problem solving analysis, cause and effect can occur. To solve the problem, a suitable learning model is needed, so the project-based learning (PjBL) model is very suitable and is a solution for improve the quality of education. The PjBL model

will make learning activities more enjoyable, increase learning interactions and students become directly involved in the process of mastering the material.

Poor motivation results in a lack of interest and shallow learning for learners. Although there are usually learners who have high grades, usually have higher motivation to learn so that it causes no boredom and can learn better (M. Kurek et al., 2016 ; Cunningham, D. J, 2016 ; W.Ng., 2012). Project Based Learning (PJBL) is a part of the models for learning used in helping students understand learning. The implementation of PjBL in schools can be an innovative way to improve the learning process. The project-based learung (PJBL) model is a type of learning that places learning using projects or activities as its main goal (Anwar, A., 2022 ; Azmin, N., 2018) ; Erlinawati, C. E., Bektiarso, S., & Maryani, M., 2019 ; Thomas, J. W et al., 2000 ; Larmer et al., 2015 ; Markham, 2011). Learners are guided to find information and manage it into a work that is acceptable and useful for life. Basically, this learning model focuses on students, where students design a problem and then find the solution themselves. Learning activities can be done in small groups or individually. The advantages of the project-based learning (PJBL) model are in its characteristics, which help students to be able to design a topic of discussion in order to find a result, and this also trains students to be responsible for making information (Kristanti, Y. D., & Subiki, S., 2016). The project-based learning model can improve students' skills or abilities in finding and solving problems (Rahmadani, Sucilestari et al., 2018). After conducting various studies from various sources, it turns out that there are still gaps. Curriculum implementation with learning models that are less effective and innovative. The imbalance that occurs causes the implementation of the objectives of the independent curriculum as a whole for all institutions and educational units.

Based on the observations results has done at SMAN 1 Banuhampu, which refer to the research stage, namely define, there are realities that do not match the desired expectations. The hope of an independent curriculum is that there can be a development of the learning system and create quality human resources, the reality is that at SMAN 1 Banuhampu, which is a school with a new independent curriculum implementation scale of 1 year, the learning system has not been effective. In the final initial analysis, an analysis of teaching materials was conducted. It was found that the teaching materials used by schools were only teaching materials from the government and local libraries. The learning media used by the school has not been implemented as a whole because there are still some parts that are not in related with the meaning of the independent curriculum. Learning that is carried out is still focused in the classroom so that it is boring for students. In the analysis of students, using the distribution of questionnaires, students still use package books provided by the government and regional libraries. Still fixated on books, so students are easily bored. This is due to the implementation of their curriculum which is still new at SMAN 1 Banuhampu and the lack of maximizing the making of teaching modules based on the Project Based Learning (PjBL) model in the independent curriculum.

To overcome the problems at SMAN 1 Banuhampu, the school needs teaching materials that facilitate students with an independent curriculum. This material for teaching is required to be able to give understanding to students for the process of learning physics, especially making useful products that are in related with the learning concept. In the teaching materials there is a project-based learning method, which is a project-type learning. The solution is to create a project-based learning-based textbook for an valid and practical Key Stage E global warming textbook. This textbook also features learning that meets the needs of an independent curriculum.

Based on this design, the researchers created a project-based textbook on global warming and wanted to find out if it was feasible in terms of feasibility and practical applicability. Feasibility was investigated by three physics teachers at UNP and consisted of four factors: realizability of content, graphics, presentation, and language. Then, practical feasibility was investigated by three physics teachers and 60 students. Practical feasibility consisted of four factors: attractiveness, content validity, usefulness, and usability. Based on this, we will investigate how the feasibility and usability of the Phase E global warming project-based learning materials can be evaluated.

METHODS

This study uses the research and development (RnD) research type; RnD research is useful for producing a new product or improving an existing product to perfect it and validate its effectiveness (Sugiyono, 2019). The study uses a 4D model consisting of four stages: define, design, develop, and disseminate (Okra & Novera, 2019).

The study begins with a definition phase in which goals, learning materials, and teaching (instructional) requirements are identified and defined. This activity requires an analysis, commonly referred to as needs analysis. This requires a concept analysis, a learner analysis, and an analysis of existing features based on what is needed. In this study, data will be collected in the form of an observational questionnaire and interviews to obtain initial data. In the definition phase, the questionnaire was given to the students and the interview form to the physical teacher.

The next stage is design, which involves the design of instructional materials, including the structure of instructional materials in (Depdiknas, 2008). In this phase, the first product (prototype) or product design is created. In the context of instructional material development, this phase is undertaken to create instructional materials according to the content framework of the curriculum and the results of the instructional material analysis. Since the curriculum to be used is an independent curriculum, it is necessary to incorporate independent curriculum concepts such as the Pancila Profile and the use of projects as activities to enhance students' creativity and action skills. The materials consist of a cover page, preface, table of contents, learning instructions, learning outcomes, learning objectives, description of the materials, exercises, and student worksheets that include project-based learning (PjBL) syntax.

After the product is designed, the study continues into development. This activity is evaluated by experts in the respective fields. Suggestions made are used to improve the materials and learning design that have been prepared. In this phase, the product design is tested on real subjects. Two tests were conducted: validity and usability. The researchers used three expert teachers of UNP physics to check the validity of the product. For the practical test, three physics teachers and 60 students were used.

Based on the problem to be studied, the method used to find validity and practicality is Aiken's V index. The product to be tested is *project-based learning-based* teaching materials for global warming material.

Validity

To see the validity of a product, a validity test is carried out. To reveal the feasibility of materials for teaching on global warming, the researchers conducted a validity test. The researchers used 3 expert professors from the UNP of Physics to test the product validity. The items in the validation tool consisted of 4 modules, namely content feasibility, presentation module, graphical module and language validation (Depdiknas, 2008). The evaluation was conducted using the Likert scale (Retnnawati, 2016). The technique used for data analysis was the Aiken V formula (Aiken, 1980). Validated test results were scored as 1, 2, 3, 4, 5 or 0, 1, 2, 3

or -3, -2, -1, 0, 1, 2, 3 (Aiken, 1985).). A Likert scale was used for assessment as shown in Table 1 below :

Tabel 1. Skor Scala Likert

Score	Final Grade (%)	Assessment
1	0-20	Strongly Disagree (STS)
2	21-40	Disagree (TS)
3	41-60	Neutral (N)
4	61-80	Agree (S)
5	81-100	Strongly Agree (SS)

(**Retnawati, 2016**)

The formula for the Aiken V index is as follows:

$$V = \frac{\Sigma_s}{n\,(c-1)} \qquad (1)$$

$$S = r - l_0 \qquad (2)$$

Description:
V = aiken validity index
S = total score
R = number specified by the validator
n = number of evaluators/validators
c = the number of categories that the rater can choose
l_0 = lowest assessment number

The data obtained by the respondent's approval index is then interpreted using categories on a scale of 0 to 1, according to Table 2.

Tabel 2. Aiken's V-index based solution

Intervals	Category
< 0.4	Low
0.4 < v < 0.8	Medium
0.8 <	High

(**Retnawati,2016**)

The product is stated feasible to use if the validity is in the categories in medium and high (Retnawati,2016).

Practicality

After the validity assessment is carried out, then the practicality analysis is carried out. Practicality test was conducted by 3 high school physics teachers and 60 students. The assessment instrument is adjusted to the lattice from the Ministry of National Education (Depdiknas, 2008). The assessment component consists of 4 parts, namely aspects of the attractiveness of materials for teaching, ease of use of materials for teaching, the benefits of materials for teaching and the clarity of the content of materials for teaching. The formula used to calculate the practical assessment shown in equation (3):

$$P = \frac{f}{N} \times 100\% \qquad (3)$$

Description:

P = presentation

F = the number of data frequencies

N = the maximum number of scores of the processed sample

The practicality results of materials for teaching based on PJBL on global warming subject are seen from the results of the questionnaire of students and teachers. The criteria for the assessment questionnaire were compiled based on the provisions of Riduwan (Riduwan, 2012) as in Table 3.

Table 3. Practicality criteria

Final Grade (%)	Assessment
0-20	Not Practical
21-40	Less Practical
41-60	Practical enough
61-80	Practical
81-100	Very Practical

(**Riduwan, 2012**)

RESULTS AND DISCUSSION

Results

According to the established facts to see the validity and practicality of materials for teaching based on PjBL on global warming subject, it is obtained:

Validity Analysis

The feasibility analysis results of the educational material based on the global warming plan were based on the Depdiknas guidelines. The components include content, language, presentation and graphic validity. The first validity check score concerns the appropriateness of the component of content, which purpose to reveal whether the content of the educational material based on the global warming science plan, Phase E, meets the requirements of the subject matter. The component of presentation consists of 26 evaluation indicators. The results of the assessment of validity for the component of presentation are presented in Table 4.

Table 4. Validity Analysis Results of presentation

	Indicators	V'Aiken	Criteria
1.Presentation of teaching materials	a. Study guide	0.92	HIGH
	b. Competencies to be achieved	0.92	
	c. Content	0.92	
	d. Supporting information	0.92	
	e. Exercises	0.83	
	f. Learner worksheet	0.92	
	g. Evaluation	0.83	
	h. Evaluation feedback	0.83	
2.Clarity of learning objectives	1. Identify the facts of environmental changes as a global warming result	0.83	

	2. Describe global warming	0.83
	3. Analyze the environmental facts change as an impact of global warming	0.92
	4. Analyze environmental changes as a result of global warming	0.92
	5. Describe the greenhouse effect process	0.83
	6. Analyze human activities that cause environmental changes as a global warming impact	0.92
	7. Create solutions to address environmental changes as a result of global warming.	0.83
3.Orderly presentation of concepts	1. The facts of global warming	0.92
	2. The impact of environmental change on the sustainability of ecosystems	0.92
	3. Greenhouse effect. Definition, process of the greenhouse effect, causes of increased greenhouse gases	0.92
	4. Human activities that cause global warming	0.92
	5. Global warming solutions	0.92
4. There are pictures, diagrams, illustrations		1.00
5. Presentation of material		0.92
6. Linkages between activities		0.83
7. Integrity between activities		0.92
8. Questions in teaching materials		0.92

9. Teaching materials have a clear bibliography	0.92	
average	**0.89**	**High**

Based on the above evaluation results, it was found that there are several components with the lowest value of 0.83 and the highest value of 1.00. The results have an overall mean value of 0.89 with high criteria. This learning material has a very high level of validity in the presentation component, especially in the section with diagrams, figures and illustrations. In addition, the presentation of the learning material also has high criteria, so it can be considered valid. The validator noted that the presentation component of the learning material meets the criteria. However, there are some aspects that are less important, such as the relationship between the materials. Based on the results of the validation of the presentation component, there are therefore some points that need to be improved. This learning material can be called valid as it exceeds the limit index for the high criteria.

The second validity test is the graphic component. The graphical component consists of 7 indicators that will be tested for validity. The validation test results shown in Table 5.

Table 5. Results of the Validity Analysis of the Graphic Component

Indicators	V'Aiken	Criteria
1. Using attractive and harmonious colors	0.92	HIGH
2. Presents clear, interesting and appropriate images/illustrations/videos/photos.	0.92	
3. Using clear and legible fonts	0.92	
4. Appropriate font size	0.92	
5. Writing color that contrasts with the background	0.92	
6. Has an organized layout and layout	0.92	
7. Has a simple and attractive design	0.83	
average	**0.90**	**HIGH**

Based on the data analyzed from the graphic component, it can be seen that the lowest value is 0.83 and the highest is 0.92 with an average overall index of 0.90. Then the graphic component of this teaching material can be said to be very valid.

The third validity component test is the feasibility component of the material for teaching content. The graphical component consists of 15 indictors that will be tested for validity. The validation test results shown in Table 6.

Table 6: Results of Content Validity Analysis of Teaching Materials

Indicators	V'Aiken	Criteria
1. Global Warming topics presented in teaching materials are in accordance with the Learning Outcomes and Learning Objectives	0.92	HIGH

2. The teaching material presents brief material about Global warming that is in line with the learning objectives		0.92	
3. Activities and observations are linked to students' real life		1.00	
4. There is global warming material		1.00	
5. The accuracy of the images/illustrations/video with the material global warming		0.92	
6. Encourage curiosity		0.83	
7. Global Warming teaching materials based on project-based learning	a. Presentation of the Problem	0.92	
	b. Planning	0.92	
	c. Scheduling	0.92	
	d. Project creation and monitoring	0.92	
	e. Assessment	0.92	
	f. Evaluation	0.83	
8. Supports learning based on learners' learning styles (visual, audio, and kinesthetic)	a. Visual, there is information/activities presented to learners in the form of colorful pictures/illustrations, diagrams, photos or videos.	1.00	
	b. Audio, there is information/activities presented to learners in the form of recordings/audio, or video Explanation.	1.00	
	c. Kinesthetic, there is information/activities that are presented to learners can be practiced and tried out. direct.	1.00	
average		**0.93**	**HIGH**

Based on the data analyzed from the feasibility component of the content of teaching materials, it can be seen that the lowest value is 0.83 and the highest is 1.00 with an average overall index of 0.93. Then the graphic component of this teaching material can be said to be very valid according to **Table 2 of the** Aiken V index decision.

The last validity component test is the language component of teaching materials. The language component consists of 6 indictors that will be tested for validity. The validation test results shown in Table 7.

Table 7. Language Feasibility

Indicators	V'Aiken	Criteria
1. The language used is communicative	0.83	HIGH
2. The language used motivates learners to do the job	0.92	
3. The language used is not double-meaning	0.83	
4. The language used is good and correct according to grammar rules. Indonesia	0.92	
5. The information provided is clear	0.92	
6. Spelling used refers to EYD	0.75	
averange	**0.86**	**HIGH**

Based on the a assessment results of the linguistic aspects, it shown that the lowest value is 0.75 and the highest is 0.92 with an average overall index of 0.86. Then the graphic component of this teaching material can be said to be valid according to **Table 2 of the** Aiken V index decision.

The validity test results show that the PjBL-based materials for learning are valid in terms of components, graphics, content and linguistic appropriateness and can therefore be used in the learning process. The graph of the validity test is shown in Figure 1 as follows.
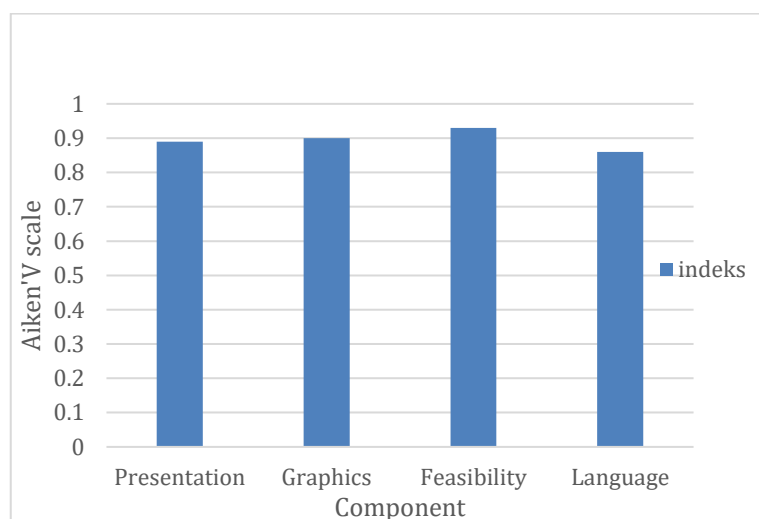

Figure 1. Validity analysis graph

It can be seen based on Figure 1, the validity value of *project-based learning-based* teaching materials on global warming material is high. However, of the 4 assessment components, there is a lower value, namely in the language component with an index of 0.86. The presentation component is 0.89, the content component is 0.90, and the highest index value is 0.93. Therefore, it can be stated that the textbook based on project-based education on global warming is valid and suitable for use according to the provisions of the independent curriculum.

Practicality

After product validation, then the next is practicality. The results of the analysis of the practicality of *project-based learning* teaching materials on Phase E global warming material have been carried out in 4 aspects of practicality assessment based on the National Education Department guidelines. These components include the attractiveness of materials for teaching, ease of use of materials for teaching, benefits of materials for teaching, and clarity of material for teaching content. The practicality test was conducted by 3 high school physics teachers and 60 Phase E students. The first practicality test results were on physics subject teachers. Practicality results can be shown in table 8 below:

Table 8. Teacher Practicality Analysis Results

Assessment Aspect	Practicality Score	Criteria
Attractiveness	94.3%	Sensibel
Ease of use	94.4%	Sensibel
Benefits	96.7%	Sensibel
Clarity of content	97.4%	Sensibel
average	**95.7%**	Sensibel

The usability evaluation shows that all components are very practical: the usability evaluation values for each component are 94.3% for attractiveness, 94.4% for ease of use, 96.7% for usefulness of learning materials, and 97.4% for clarity of content. As shown in Table 3, based on the usability test based on the theory of (Riduwan, 2012) we can say that the learning materials are practical. The value of the attractiveness component is low compared to the other components with a value of 94.3%. Meanwhile, the content clarity component received the highest score of 97.4%. The result of the practical test for teachers had an average score of 95.7%. This value shows that the practical results are better. Teachers say that this teaching material is very interesting and makes reading interesting. In addition, the developed teaching material is easy to use, thanks to the 3 teachers who carried out practical tests on the teaching material. And the teaching materials are also easy to use and have clear content. Therefore, the project-based learning material for the application of global warming for Phase E can be considered useful because it meets the value aspect and meets the requirements of the independent curriculum, so it can be used as a learning tool.

The second practicality test results were on 60 students in phase E. The practicality results can be shown in table 9 below:

Table 9. Results of Practicality Analysis of Learners

Assessment Aspect	Practicality Score	Criteria
Attractiveness	83,1%	Sensibel
Ease of use	81,3%	Sensibel
Benefits	81,0%	Sensibel
Clarity of content Teaching materials	81,2%	Sensibel
average	**81,65%**	Sensibel

Based on the student practicality analysis test, it can be seen that each aspect has a good enough value to be said to be practical. However, in the aspect of the benefits of teaching

materials getting a smaller value than other aspects, namely 81.0%. Although buy for the overall average value of the teaching material practicality analysis test is 81.65%. The results of the practice test analysis show that 60 students can easily understand the course material. Students also stated that the teaching materials provided could be helpful in understanding physics learning concepts. The material in the teaching material is clear. The appearance of teaching materials has a high attractiveness, judged by the existing colors, images and videos. So it can be said that project-based learning materials for the greenhouse effect material for phase E are quite practical. The results of the practical test show that the created project-based learning resources are practical in terms of attractiveness, ease of use, advantages of teaching materials and clarity of the subject matter, so that they are very suitable for use in the learning process in accordance with the requirements of the independent curriculum.

Discussion

The results of the validity analysis of the project-based learning textbook on global warming showed that the textbook in Phase e had a very good average index interval of 0.895, which is in the high category. This value was obtained from the textbook validation evaluation by three UNP physics lecturers. Based on the results of the expert validation and the calculations using Aiken V's data analysis technique, it can be concluded that the project-based learning for global warming textbook for level E is effective. This is in line with a previously conducted study, a physics learning module based on project-based learning for a stationary fluids textbook to enhance learning creativity of Class X SMA/MA students (Novianto, et al., 2018). Another comment said that the instructional modules from the independent curriculum of the English subject at SMK Surabaya can be used for learning. In addition, according to Utami Maulida (2022), educational modules based on independent curriculum are used in most educational units at all levels, while Eko Mulyadi (2015) mentioned that the application of project-based learning model to improve physical learning outcomes and achievement of vocational trainees was able to bring about changes in students' performance to improve their learning achievement. As such, the project-based learning for global warming textbook at level E is suitable for use as a learning media in schools.

Practicality test of the textbook based on project-based learning on global warming in SMAN 1 Banuhampu showed that 3 physics teachers and 60 students rated the textbook as practical. The practicality result of the textbook based on the opinion of the school physics teacher was 95.7% on average, and the practicality result of the textbook based on the opinion of the students was 81.65% on average. Based on these two results, it can be seen that the textbook based on project-based learning on global warming is very suitable for stage E, which is consistent with the theory. In addition to these results, the textbook contained a variety of information, as well as photos/illustrations/videos to illustrate knowledge and learning, which made it easier for students to understand. In addition, the textbook included learning videos as an alternative learning medium that was easily accessible because it contained barcodes. This is in line with previous research findings that students prefer learning with videos to facilitate learning and increase their interest in the subject (Rendra et al., 2018). In addition, using a learning model that meets the requirements of a standalone curriculum may require students to understand the learning. The practical relevance of the material may increase students' motivation to learn.

CONCLUSION

Based on the assessment results of the feasibility and feasibility analysis, the results of assessing the validity of project-based learning based on global warming materials showed that the validity value for the components, namely the presentation, graphic representation, appropriateness of the content and the linguistic component had a mean value of 0.895 on the high validity criteria. In addition, the results of the practical assessment of project-based learning based on global warming materials by 3 high school science teachers had an average score of 95.7% on the highly practical criteria for each component. Meanwhile, for practical aspects, each student has an overall average score of 81.65% on highly practical criteria. It can be concluded that the project-based learning material on global warming phase E is suitable in terms of validity and usability, so that it can be used in school physics learning process on global warming material for class X SMA

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