

DEVELOPING A PBL-INTEGRATED PHET MODULE TO IMPROVE STUDENTS' LEARNING INTEREST

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Abstract

This research aims to implement PhET Simulations supported by teaching modules to develop the learning interest of junior high school students in ecosystem sub-materials. PhET Simulations is a site that provides free science practicum learning that can be used for classroom or individual learning. The background of this research is based on the low grade average score for science subjects still below the standard of completeness score, which is 68. while the KKM score (*Kriteria Ketuntasan Minimal*) is 75%. To address this problem, teaching modules were developed specifically designed to help increase students' interest in learning through materials relevant to daily life. The teaching modules developed include various components, such as instructions for use, information maps, competency objectives, and material descriptions accompanied by learning activities, practice questions, and final tests. This study uses the PhET Simulations teaching material method with the help of a teaching module with a PBL development model. The validity of the teaching module is measured through validity tests, teacher readability tests, and student readability tests. Based on the results of the teaching module validation test which stated that the criteria were valid with an average score of 84.82, the LKPD validation was declared valid with an average score of 84.68. Meanwhile, the results of the students' questionnaire responses showed an average score of 49.56 very agreeable answers. The results of the research are expected to show the process and results of the implementation of PhET Simulations that are valid and effective in developing students' learning interests in ecosystem sub-materials. This research produces outputs in the form of articles published in international journals, copyright registration documents, and teaching module products.

Keyword: PhET Simulations, Teaching modules, Learning interest

INTRODUCTION

Education is important in shaping a competent and competitive young generation. According to Law No. 20 of 2003, education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed by themselves, society, nation and state (Amir, 2016). Student learning interest plays an important role in the success of learning. When students are interested in the subject matter, they are more actively involved, motivated, and strive to understand the concepts being taught (Lisnawati, 2023). Student learning interest acts as a driving factor that motivates them, because learning interest can encourage students to pay greater attention to learning (Rahmayanti, 2016). This helps students to concentrate on learning and

avoid distractions that come from external sources, so as to strengthen the memory of the subject matter and reduce boredom in the learning process.

According to previous research, the tendency of low student interest in learning has an impact on low student learning outcomes. The class average score for science subjects is still below the standard completeness score of 68, while the KKM (Minimum Completeness Criteria) is 75% (Lanusi, 2018). According to researchers, there are 2 factors that cause the problem of low student interest in learning, namely the delivery of less interesting subject matter and less creative and innovative teachers in managing the classroom (Laila, 2022). To overcome the above problems, there must be innovation and creativity to create meaningful learning situations. So to overcome these problems, researchers apply learning by using PhET learning media.

PhET is a website that provides free science practicum learning that can be used for classroom and individual learning (Muzana, 2021). The advantage of this site is that it can be used as a learning approach that requires the involvement of students who have creative thinking where students must be able to combine the initial knowledge they know with the virtual findings of the experiments being carried out, the learning that takes place will be more interesting because students can learn while playing on experiments through PhET (Lidiana, 2018). In addition, using PhET can visualize science concepts in the form of image models.

In addition, various efforts have been made to improve students' knowledge and understanding. Examples are curriculum changes, the use of methods and models that are closer to students, and also the procurement and development of media or educational learning tools (Sunita, 2019). One of the learning models that can develop students' interest in learning is by applying the Problem Based Learning (PBL) learning model (Fathonah, 2024). This is because this learning model emphasizes more on the activities of students looking for solutions and can solve problems in real life.

This Problem Based Learning (PBL) learning model is a learner-centered learning model by exposing learners to various problems faced in real life (Astutik, 2022). Then learners are asked to try to solve the problem. In this model, learning focuses on a problem that must be solved by students, so that students have the responsibility to analyze and solve the problem with their own abilities, while the role of educators is only as a facilitator and provides guidance to students (Ariandi, 2017).

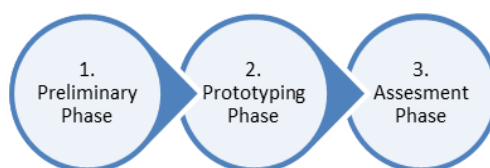
Based on the description above, the research question in this activity, is how is the development of a Phet laboratory virtual teaching module with a PBL learning model to develop junior high school students' learning interest in ecosystem material valid? Starting from the research question, the research objective is to develop a Phet Laboratory Virtual Teaching Module with PBL Learning Model to develop junior high school students' learning interest in ecosystem material.

METHOD

Judging from this research, the aim is to develop a Phet Laboratory Virtual Teaching Module with a PBL Learning Model to develop junior high school students' learning interest in ecosystem material. From these objectives, the research includes a type of development research. The source of data is the assessment of teaching materials assessed by 3 validators. In addition, the participants in this study were junior high school students who would take part in learning with the PBL learning model by referring to the development of Plomp 2013. The research method with Plomp refers to the research approach developed by Jan Plomp, an education expert who is famous for his work in the field of educational evaluation (Rudhito, 2019). This method is often used in the context of educational research to identify problems, plan, implement, and evaluate actions taken in an educational context. The stages used in this method are (Plomp, 2013):

1. Preliminary Phase: Conduct preliminary studies, literature studies, and determine the limitations of related material content. The resulting output is a framework to be developed.
2. Prototyping Phase: Developing teaching modules that will be tested and revised. The teaching module can initially be formatively evaluated through expert assessment.
3. Assessment Phase: Conducting trials of teaching modules that have been developed. The results of the trial are analyzed, in order to determine the quality of the teaching module.

The schematic development of the Plomp model is as follows



Picture. Schematization of the Plomp Model Stages

Validity is important for effective research, which means to accurately measure, describe, and explain or theorize (Budiastra, 2020). The validity of the teaching materials consists of teaching modules, RPP, LKPD, and assessment sheets. Teaching modules are learning materials that are structured and systematic to support the learning process. The validity of the teaching module lies in the accuracy of the information presented, relevance to the learning objectives, clarity of presentation, and the ability to facilitate students' understanding of concepts. RPP (*Rencana Pelaksanaan Pembelajaran*) is a document that details the learning plan over a specific period, including learning objectives, learning strategies, assessments, and evaluations. Validity RPP lies in its relevance to curriculum standards, feasibility of implementation in a classroom context, and its ability to effectively

guide the learning process. LKPD is a document that contains a series of activities or exercises that students must complete to support their understanding of the learning material. Validity LKPD It depends on the clarity of the instruction, relevance to the learning objectives, the level of difficulty that corresponds to the student's ability level, and the ability to measure the student's understanding of the concepts being taught. Assessment sheets are used to evaluate students' understanding and learning achievement. The validity of the assessment sheet includes research capabilities (Instrument 1d) with assessment aspects in accordance with the indicators that have been determined. The assessment of the validity of the content of the teaching material includes the aspect of the content (relevancy) aspect and and the reliability coefficient or inter-observer agreement coefficient (R). The average score (P) of the validators' assessment results was adjusted to the assessment criteria in Table 1.

Table.1 Likert scale

Scale	Criteria
4	Very good
3	Good
2	Good less
1	Very Less

Data analysis started with specified scores for each item, with validation score specified based on the scale Likert (Riduwan,2016).

Furthermore, the percentage of data calculated using the Likert scale is calculated using the following formula:

$$\text{Percentage (\%)} = \frac{\text{total score}}{\text{maximum total score}} \times 100\% \quad (1)$$

Decide, maximum total score = highest value × total aspects × total validators

The results of the calculation of the score obtained by each student are translated according to the score interpretation criteria found in Table 2 below (Riduwan,2012).

Table 2. Interpretation Criteria for Percentage Values of Validation Results

Percentage	Criteria
90% - 100%	Very valid
80% - 89%	Valid
65% - 79%	Quite valid
55% - 64%	Less valid
0 %- 54 %	Not valid

(Riduwan,2016).

RESULTS AND DISCUSSION

Table 3. Results of the validity test of the teaching module

No.	Aspects	Percentage score (%)	Criterion
1.	Eligibility of the content of the material	84,25	Valid
2.	Presenter qualifications	85,41	Valid
3.	Language Qualifications	82,14	Valid
4.	Feasibility of design graphics	87,5	Valid
Total		339,3	Valid
Average		84,82	

Based on the results of the teaching module validation test which states that the criteria are Valid. Judging from the validator test score in the aspect of feasibility of the content of the material, the percentage score was 84.25%, the feasibility of the presenter was 85.41%, the feasibility of the language was 82.14%, and the feasibility of the design chart was 87.%. So that if it is averaged it produces a value of 84.82%. This shows that the teaching modules developed have been valid both in terms of the feasibility of the content components, the feasibility of presentation, and language.

Table 4. Results of the LKPD validity test

No.	Aspects	Percentage score (%)	Criterion
1.	Serving	87,5	Valid
2.	Language	82,5	Valid
3.	Contents of the material	75	Quite valid
4.	Design charts	93,75	Valid
Total		338,75	Valid
Average		84,68	

Based on the results of the LKPD validation test which states that the criteria are valid. Judging from the validator test score in the aspect of presenting the percentage score is 87.5%, Language 82.5%, material content 75%, design graphics 93.75%. If summed up, it is 338.75% so that it gets an average of 84.68%. It states that the LKPD that has been made is valid in terms of presenters, language, material content, and design graphics.

Table 5. Results of questionnaire responses using *PhET Simulation* on 31 students

No.	Question	Presentase (%)
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		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	Learning using Simulation PhET made me more interested in learning.	0	0	3,2	32,3	64,5
2.	I find it easier to understand the material when using the Simulation PhET.	0	0	9,7	38,7	51,6
3.	PhET Simulation makes learning more interactive than other methods.	0	0	9,7	38,7	51,6
4.	The use of Simulation PhET makes the lessons feel more enjoyable.	0	0	0	41,9	58,1
5.	I became more excited to take the lessons after using the Simulation PhET.	0	0	9,7	38,7	51,6
6.	The use of Simulation PhET increased my interest in learning.	0	0	3,2	48,4	48,4
7.	I was more active in discussing and trying on my own after using the Simulation PhET.	0	0	16,1	35,5	48,4
8.	The Simulation PhET helped me better understand the concepts being taught.	0	3,2	9,7	41,9	45,2
9.	I would like to use the Simulation PhET more often in learning.	0	0	6,5	41,9	51,6
10.	I find PhET Simulation easy to use without much difficulty.	0	3,2	19,4	35,5	41,9
11.	I can understand how to use a Simulation PhET without much guidance from the teacher.	6,5	9,7	19,4	32,3	32,3
Total		6,5	16,1	106,6	425,8	545,2

Average	0,59	1,46	9,69	38,71	49,56
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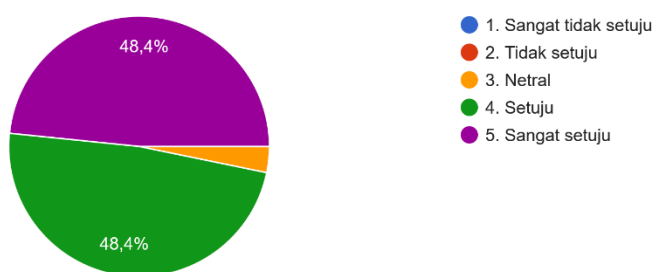
Teaching module validation is an evaluation process carried out by experts or validators to ensure that the teaching module meets the quality standards required in learning. Data analysis from the teaching module validity questionnaire assessed includes the feasibility of content components, feasibility of testing, and language. The results obtained showed that the validator gave a positive response to the aspects of ease and understandability. This shows that the teaching module is good enough in terms of providing material that is easily accessible and understood by students. However, the validators also identified some parts that needed improvement, especially in terms of visual appeal and conformity with the suggested learning format.

Based on the validation results, there are suggestions from validators which indicate that in the content of the material needs to be added more, the font color does not contrast with the base color, so the writing becomes difficult to read. Improvements in this aspect are very important to ensure that students can easily read and understand the information presented in the teaching module. In addition, the validator also gave suggestions for sentences in the discussion to be written with student activities not teachers, such as the example “The teacher invites students to read a prayer to start learning” changed to the sentence “Students read a prayer to start learning”. This is important because modern education emphasizes a student-centered approach, where students are the center of learning. The teacher acts as a facilitator, no longer as a one-way lecturer. Meanwhile, the results of the validation of the readability test from the validator show that overall the teaching module is good, easy to read and easy to understand. The appearance of the teaching module is attractive and systematic so that it can increase the enthusiasm for learning of students. Suggestions for improvement from the validator, namely to provide a cover with the identity of the teaching module maker. In addition, the source of the image should use a more reliable image source.

This research develops teaching modules on ecosystem material. In addition, this study also expects to develop students' interest in learning as measured by distributing questionnaires to students after the implementation of learning using PhET Simulation. Learning by using PhET Simulation is very practical so that it can be used by students online anywhere and anytime.

Meanwhile, the results of the questionnaire responses to students showed interest in the use of *PhET Simulations* in learning activities so that it could increase students' interest in learning. This is seen from the average response of the student questionnaire who voted strongly disagree 0.59%, disagree 1.46%, neutral 9.69%, agree 38.71%, and strongly agree 49.56%. This data shows that most students respond positively to the use of *PhET Simulations* as a learning aid. The interactivity and visualization contained in *PhET Simulations* help students understand the concept of ecosystems in a different way.

Penggunaan PhET Simulasi meningkatkan minat saya dalam belajar.
31 jawaban



Picture 4. Student Questionnaire Question Graph

The graph above is one of the questions contained in the student questionnaire. There were 31 students who answered the questionnaire, there were 15 students who answered that the use of *PhET Simulations* was very helpful to increase learning interest. Just like before, there were 15 students who answered yes, while 1 student answered neutrally. Students who gave a neutral response generally stated that it took longer to adapt to the use of *these PhET Simulations*. Therefore, teacher assistance in the early stages of using *PhET Simulations* is very necessary to ensure that all students can take advantage of the available features optimally.

Increasing students' interest in learning is one of the main focuses in the world of education. Various studies have been carried out with different approaches and methods, including through the validation of learning tools such as LKPD and teaching modules, as well as the use of questionnaires as a tool to measure student response. These studies show that systematic validation of learning tools contributes significantly to the increase of students' interest and learning outcomes. The teaching module as one of the instruments in the independent curriculum has also proven to play an important role. Research by maulida in 2022 suggested that teaching modules that are validated in terms of content and construction encourage students to learn independently and increase their interest in learning. Teaching modules that are arranged with a systematic structure and attractive visuals are considered to be able to strengthen the attractiveness of learning materials for students (Maulida, 2022). Research by (Pebriani et al. 2022) shows that scientifically-based LKPD validation can increase students' active involvement in learning. LKPDs validated by experts are declared feasible and effective for use in learning, and are able to increase interest in learning because they present contextual and challenging activities. This is in line with the findings of Putri and Susanto who revealed that LKPD developed with a contextual approach is more in demand by students because it suits their daily lives (Dewi & Eka, 2023). Furthermore, the student response questionnaire is used as a measuring tool to assess the effectiveness of the developed learning tools. The study by Sobron and Bayu used a questionnaire to evaluate students' responses to the LKPD used. The results showed that more than 80% of students responded positively to the validated LKPD, stating that the material presented was interesting and easy to understand. This proves that student perception is an important indicator in measuring the success of teaching tools (Sobron & Bayu, 2019).

By comparing the three approaches, it can be concluded that the validation of the LKPD and the teaching module supported by positive responses from the student questionnaire provides a positive picture of the success of increasing learning interest. Validation by experts ensures the quality of the instrument, while student responses become a benchmark for practical acceptance in the field.

CONCLUSION

The teaching module to develop the learning interest of junior high school students in the ecosystem sub-material was declared very valid with an average score of 84.82%. All aspects, such as the feasibility of the content of the material, the feasibility of presentation, the feasibility of language, and the feasibility of the design graphic meet the valid criteria, with suggestions for sentence improvement in the learning activities section written by students who are not teachers. As well as being given an attractive cover with the identity of the module maker.

The development of PhET-based teaching modules with the PBL model has proven to be effective in increasing students' interest and understanding of ecosystem materials. With the most responses, students chose to strongly agree with an average score of 49.56%.

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