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Pengembangan Video Pembelajaran Berbasis *Project Based Learning* (PjBL) Pada Materi Kimia Hijau Berorientasi Motivasi Belajar Siswa

(Development of Project-Based Learning (PjBL)-Based Learning Videos on Green Chemistry Materials Oriented to Student Learning Motivation)

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ABSTRACT. Learning videos are one of the digital learning media that can support a more interesting and meaningful learning process. In green chemistry material, students are required not only to understand the concept of applying chemical principles in daily life, but also to have concern for the environment. However, the learning process that still uses a less varied approach causes low student motivation to learn. This study aims to develop a Project Based Learning (PjBL)-based learning video on green chemistry material, determine the feasibility level of learning videos based on the assessment of material experts, media experts, and teachers, and find out students' responses to the developed learning videos reviewed from learning motivation. This research is a research and development using the Lee & Owens model. The research instruments used included interview sheets, validation questionnaires for material experts and media experts, teacher assessment questionnaires, and student response questionnaires. The developed products are validated by material experts and media experts, then assessed by teachers and tested through small group trials. The data analysis techniques used are qualitative data analysis and quantitative data analysis. The results of the study showed that PjBL-based learning videos on green chemistry materials obtained a validation percentage from material experts of 90% and media experts of 92% with the category of "Very Feasible". The teacher's assessment showed a percentage of 90% with the "Very Feasible" category, while the students' response to the small group trial obtained a percentage of 93.7% with the "Very High" category. Based on the results of the study, PjBL-based learning videos on green chemistry materials are declared theoretically and practically feasible and have the potential to increase student learning motivation and help students understand concepts independently.

INTRODUCTION

Education is one of the important aspects in improving the quality of the nation's generation. Based on the Law of the Republic of Indonesia number 20 of 2003 concerning the National Education System, national education functions to develop abilities and shape the character and civilization of a dignified nation. In line with this, the government continues to update the curriculum as a form of adjustment to the needs of students and the development of the times.

In the context of the Independent Learning Curriculum, learning tools serve as important tools that detail the learning plan in detail and according to the context to achieve student competencies. The implementation of this curriculum prioritizes project-based learning and supports innovative learning strategies in accordance with the principles of the Independent Curriculum [1]. During the learning process, student activeness is a very important aspect, but many students are less enthusiastic and tend to be passive due to the dominance of conventional learning methods and lectures. As a result, students' understanding of learning materials becomes suboptimal, especially in chemistry subjects. This is reinforced by the statement that learning difficulties are obstacles in the learning process [2].

In chemistry learning, students need to understand this science through three levels of representation, but chemistry material is still often considered as difficult to understand because of its abstract and complicated concepts [3]. Especially green chemical materials as a branch of chemical science that focuses on making environmentally friendly chemical products and processes. Green chemistry aims to reduce or eliminate the use of hazardous materials as well as toxic waste through certain basic principles [4].

In high school, green chemistry lessons not only enhance students' understanding of science, but also instill concern and social responsibility for the environment. However, this material is often considered difficult and abstract so it requires an innovative learning approach. This green chemistry learning material often faces various problems and difficulties that hinder the achievement of learning objectives due to its abstract and complex

nature. Internal and external factors such as monotonous teaching methods and limited infrastructure further exacerbate this situation [5].

Learning media that is less varied and interactive is also the cause of students finding it difficult to stay focused and active, so that students still have difficulty in achieving a deep understanding of the material being studied. The unvaried learning process causes boredom and decreased enthusiasm for students, especially in abstract materials such as chemistry. Therefore, digital technology-based learning media innovations that are interesting, interactive, and relevant are needed to overcome this obstacle and to increase students' enthusiasm, interest, and motivation in learning [6].

Based on the results of an interview with one of the chemistry teachers at SMA Negeri 14 Jambi City, information was obtained that students were not too involved and interested in learning chemistry, especially green chemistry because the teaching methods used were still dominant using lecture methods and the use of less-than-optimal learning media, as well as the use of learning models that did not vary. This is also strengthened by the results of the needs analysis of 31 students in class X E1 which showed that 73% of students had difficulty understanding chemistry concepts, 90.3% of students stated that the learning media currently used is not helpful in understanding green chemistry materials, 93% of students have difficulty relating the principles of green chemistry to environmental problems, and 97% of students want more diverse learning methods. In addition, 84% of students expressed enthusiasm for visual and interactive media. This situation shows that the low variety of learning methods and media has direct implications for students' learning motivation, so learning innovations are needed that are able to arouse students' interest, curiosity, interest, and active participation in the chemistry learning process.

The development of technology and information communication has entered the world of Education and allows educators to design engaging and enjoyable learning. Therefore, educators need to develop and utilize innovative learning media [7]. As a solution, this study plans to use learning videos to make it easier for students to understand the learning material. Learning videos allow students to access the material anytime and anywhere and increase student engagement in the learning process. Learning videos are able to present material with the context of daily life and provide concrete visual images so as to help students understand abstract concepts [8], [9].

In this study, the Project Based Learning (PjBL) learning model was used, namely to change learning that was initially teacher-centered to student-centered learning. The application of the Project Based Learning (PjBL) model to green chemistry materials is still rarely carried out, making learning tedious and monotonous. The Project Based Learning (PjBL) model has been proven to be effective in increasing student learning activity and motivation through real projects that are meaningful and in line with the needs of the 21st abd [10]. Green chemistry is suitable to be applied in the Project Based Learning (PjBL) model because it encourages students to think creatively, find solutions, and develop projects independently and in groups [11].

Based on various previous studies, the use of video media and the application of the Project Based Learning (PjBL) model have been proven to be able to increase students' activeness and motivation to learn. However, most of the studies still examine video media and Project Based Learning (PjBL) models separately. In addition, research that specifically develops Project-Based Learning (PjBL)-based learning videos on green chemistry materials and is oriented towards increasing student learning motivation is still very limited. Therefore, there is a research gap in the development of learning media that integrates these three aspects combined simultaneously.

This research provides a solution that develops learning videos that integrate green chemistry materials and Project Based Learning (PjBL) stages by paying attention to aspects of student learning motivation, So as to present a more integrated learning design compared to previous research. The novelty of this research lies in the systematic integration of green chemistry materials, the stages of Project Based Learning (PjBL), and the orientation to increase student learning motivation in one integrated learning video design. Therefore, this study aims to develop a learning video based on Project Based Learning (PjBL) on green chemistry materials, assess the feasibility of the product developed, and analyze students' responses to learning motivation as a result of the use of learning media.

RESEARCH METHODS

This research uses the development method (Research and Development). The R&D method is the process of creating a particular product as well as testing the product. This process begins with analyzing the need to know the problem at hand, then developed according to the results of the analysis, and then testing the effectiveness of

the product so that it can be widely used [12]. The product developed in the study is *a Project Based Learning* (PjBL)-based learning video on green chemistry materials. This study uses the development model of Lee and Owens. This development model consists of five customized stages. This model was chosen because this model has regular and systematic steps, namely analysis, design, development, implementation, and evaluation. By implementing these steps, researchers can identify student needs, design appropriate materials, develop videos efficiently, carry out the learning process, and comprehensively assess the results. A more detailed development procedure can be seen in **Figure 1**.

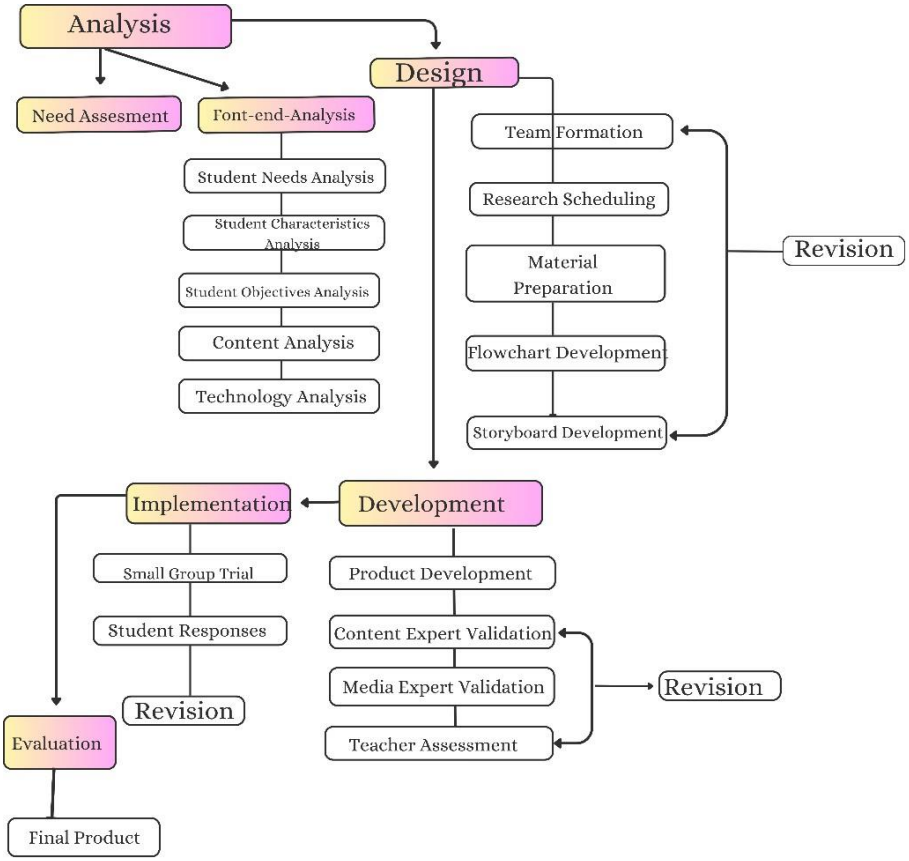

Figure 1. Development Procedure

At the analysis stage, the researcher identifies learning needs and problems that occur in the field. Activities at this stage include a needs analysis through interviews with chemistry teachers and the distribution of questionnaires to 31 students of class X E1 at SMA Negeri 14 Jambi City, curriculum analysis based on Learning Outcomes (CP), Learning Objectives Flow (ATP), and Learning Objectives (TP) of the Merdeka curriculum, as well as analysis of green chemistry materials that include definitions, basic principles, and their application in daily life. Then the final result of this stage will be used for the basis in product design.

At the design stage, it aims to design the concept and structure of the learning video to be developed. Activities at this stage include the preparation of material structures, the design of learning flows based on Project Based Learning (PjBL), the preparation of flowcharts and storyboards. The design stage produces a conceptual design of the product as a development guideline and at this design stage an initial evaluation of the product concept to be made will be carried out.

At this stage of development, it is the stage of realization from design to a learning video product. At this stage, the video production process is carried out, the integration of green chemistry materials with the Project Based Learning (PjBL) syntax, as well as the development of multimedia elements in the form of visuals, audio, animation, and narrative. The resulting products are then validated by material experts and media experts, then revised based on suggestions and input from validators, and assessments are also carried out by chemistry teachers to obtain the feasibility of the product theoretically and practically.

Furthermore, the implementation stage is carried out on a product trial on a small group test scale, at this stage students use learning videos developed in learning activities,then students are given a student response questionnaire to measure aspects of practicality, media attractiveness, material clarity, and their impact on student learning motivation.

The last stage, the evaluation stage, is carried out thoroughly in each development. This evaluation includes the analysis of expert validation results, teacher assessments, and student responses. The results of the evaluation are used as a basis for product improvement so that a Project Based Learning (PjBL)-based learning video on green chemistry material is obtained that is theoretically and practically feasible and oriented towards increasing student learning motivation.

The subject of the trial in this development research is students in class X phase E1 of SMA Negeri 14 Jambi City which was only limited to a small group trial of 10 students. The taking of trial subjects was based on the cognitive abilities of students who have high cognition, moderate cognitive and low cognitive by considering the opinions of teachers who teach in class X phase E1 of SMA Negeri 14 Jambi City. This trial was carried out to obtain student responses to the products that have been developed.

The types of data obtained in this study include qualitative and quantitative data. Qualitative data was obtained from interviews with teachers, validation questionnaires from material experts and media experts, and teacher assessment questionnaires that included responses, comments and suggestions to improve the quality of the developed products. Meanwhile, quantitative data was obtained from student response scores to Project Based Learning (PjBL)-based learning videos, including the results of student needs analysis questionnaires and student response questionnaires in the form of assessment scores after using the developed learning media. Data collection in this development research is carried out in stages using measuring instruments known as instruments. The instruments used included teacher interview sheets, material expert validation questionnaires, media expert validation questionnaires, teacher assessment questionnaires and student response questionnaires. The calculation of the analysis of student needs and characteristics is carried out using the rating scale with the following formula:

$$\%Score = \frac{Total\ score\ obtained}{Total\ score}\ x\ 100\%$$

The data obtained from the validation analysis sheet of material experts, media experts, and teacher assessments are quantitative. The validation categories based on subject matter experts, media experts and teacher assessments are based on the average score of the answers, which are calculated using the following formula:

$$Average = \frac{Total\ score}{Number\ of\ items}$$

The determination of assessment categories ranging from very feasible to unfeasible on the Likert scale, interval calculation is used. The categories of quantitative data assessment are analyzed based on:

Tabel 1. Categories of Assessment Validation and Teacher Assessment.

No	Average score	Vlidation Criteria
1.	>4,2 – 5,0	Very Feasible
2.	>3,4 – 4,2	Feasible
3.	>2,6 – 3,4	Less Feasible
4.	>1,8 – 2,6	Not Feasible
5.	1,0 – 1,8	Very Unfeasible

[13]

The products that have been evaluated by material experts, media experts and teachers, are then tested on students, through small group trials. To determine the classification of student responses, the eligibility percentage is used with the formula:

$$K = \frac{F}{N\ x\ I\ x\ R}\ x\ 100\%$$

Description:
K : Percentage of Eligibility
F : The total number of respondents' answers

N : Highest score in the questionnaire
I : Number of questions in the questionnaire
R : Number of respondents
The assessment criteria for the percentage of student response questionnaires are presented in table 2.

Table 2. Category of Assessment Instrument Test Small Group of Students.

No	Value Scale (%)	Validation criteria
1.	81 – 100	Very High
2.	61 – 80	High
3.	41 – 60	Moderately High
4.	21 – 40	Low
5.	1 – 20	Very Low

[14]

RESULTS AND DISCUSSION

This section presents the results and discussion of the development of Project Based Learning (PjBL)-based learning videos on green chemistry materials oriented to student learning motivation. The analysis was carried out on the results of the research obtained through the validation of material experts, validation of media experts, the assessment of chemistry teachers, and the students' response to the small group trial as the basis for assessing the feasibility of the product and user response to the developed learning media.

3.1. Subject Matter Expert Validation

Table 3. Results Of Material Expert Validation Results.

Validation stage	Total Score	Average	Percentage (%)	Criteria
I	43	3,3	66%	Less Feasible
II	59	4,5	90%	Very Feasible

The results of the validation of the material experts in table 3 show that the Project Based Learning (PjBL)-based learning video on green chemistry material is considered suitable for use in learning. In the first validation stage, a total score of 43 was obtained with an average score of 3.3 which was in the interval of >2.6-3.4 and obtained a percentage result of 66% with the category "Less Feasible". Some suggestions for improvement are given, namely, adding an explanation of the 12 principles of green chemistry, adding to the slide display a picture of the materials used, namely by adding *a voice over* related to the explanation of the materials used in relation to the 3 principles taken from the 12 principles of green chemistry, clarity of voice over in asking questions, strengthening the relationship between the materials used and the principles of green chemistry. And add a sentence of information to the slide project on the application of green chemistry. This is in line with the theory of cognitivism which emphasizes the importance of systematic structure and presentation of information so that students can understand the material better [13]. In line with this, previous research has shown that the presentation of structured and contextual material supports the process of processing students' information so that learning becomes more meaningful [14], [15].

After being revised according to expert advice, the second stage of validation showed an increase to a total score of 59 with an average score of 4.5 which was in the interval of >4.2-5.0 and obtained a percentage result of 90% in the category of "Very Feasible". These results show that the material presented in the learning video was developed in accordance with the learning objectives and was able to support students' understanding of the concept of green chemistry more comprehensively.

3.2. Media Expert Validation

Table 4. Results Of Media Expert Validation Results.

Validation stage	Total Score	Average	Percentage (%)	Criteria
I	52	3,2	64%	Less Feasible
II	75	4,6	92%	Very Feasible

Based on Table 4, the results of the validation of media experts in the first stage showed a score of 52 with an average score of 3.2 which was in the interval of >2.6-3.4 and obtained a percentage result of 64% in the

category of "Less Feasible". Suggestions and improvements provided by experts include correcting writing errors, choosing font types and sizes, clarity of narrative intonation, illustration and background variations, and adding supporting visual elements and appropriate color selection to make videos look more attractive and less monotonous. This is in line with humanistic theory which emphasizes the importance of paying attention to the affective aspects and feelings of students in the learning process. This visual comfort can be supported through the application of the right color theory in learning media, because the selection and variation of appropriate colors can create a more interesting, non-monotonous media appearance, and help students feel more comfortable in participating in learning [16].

After revision according to the input of media experts, the results of the second stage of validation showed the results of calculating a total score of 75 with an average of 4.6 which was in the interval of >4.2-5.0 and obtained a percentage result of 92% with the category "Very Feasible". Therefore, the media expert validator stated that the Project Based Learninng (PjBL) based learning videos were declared feasible and could be tested for students. By using videos as a learning medium, the delivery of material can be more interesting, so that it can attract the attention of students who usually only focus on books and pens. The use of video media can also contribute to increasing student learning motivation. This is in line with the theory of constructivism which states that knowledge is actively built by students through meaningful learning experiences. Project-Based Learning (PjBL)-based learning videos provide a space for students to be actively involved in the learning process, thereby helping students build a deeper understanding of chemistry concepts. This is also in line with the research conducted by [17], namely, that the learning videos used in the learning process can foster understanding of concepts and motivation of students in chemistry learning.

The display of Project Based Learning (PjBL)-based learning videos on green chemistry materials that are oriented to student learning motivation and have been validated by material experts and media experts can be seen in Figure 2.

Figure 2 Learning Video Products

The learning video product in figure 2 can be accessed via the following link:
https://app.lumi.education/run/5Z23XE

3.3. Teacher Assessment

Table 5. Results Of Teacher Assessment.

Validation stage	Total Score	Average	Percentage (%)	Criteria
I	55	4,5	90%	Very Feasible

Based on Table 5 which shows the results of teacher assessments of Project Based Learning (PjBL)-based learning videos, the total score is 55 with an average score of 4.5 and with a percentage of 90% in the category of "Very Feasible". Teachers assessed that the learning media developed was in accordance with the characteristics of green chemistry materials, was easily accessible, and could be used both jointly and independently by students through digital devices. This assessment is able to strengthen the results of the validation of material experts and the validation of media experts that learning videos are suitable for application in classroom learning.

3.4. Small Group Trials

Table 6. Results Of the Small Group Trial.

Number of Students	Total Score	Percentage (%)	Criteria
10	656	93,7%	Very High

Student responses were obtained through a small group trial involving 10 students. The results of the student response questionnaire showed that the percentage of answers for all students was 656 with a percentage of 93.7% which was in the range of 81%-100% which was in the "Very High" category. These results show that students respond very positively to the use of Project-Based Learning (PjBL)-based learning videos, and the learning videos developed can be very well received by students and are considered able to create an interesting and meaningful learning experience. The positive response from the students is reflected in increased interest, active engagement, and increased motivation to learn during lessons. Student involvement in the project activities presented in the video allows students to connect the concept of green chemistry with the context of everyday life, making learning more relevant andeasy to understand. This shows that the learning media developed is not only feasible in terms of appearance and content but can also potentially increase students' motivation to learn. In addition, the results of the evaluation contained in the learning media showed an average student score of 88.1%. This shows that most students areable to achieve learning achievement indicators after using the developed learning videos. The achievement of learning outcomes is in line with student responses, that high learning motivation during learning contributes positively to a better understanding of concepts.

Based on these results, it can be concluded that the results of validation of material experts, media experts, teacher assessments, and student responses show that the Project Based Learning (PjBL)-based learning videos developed are in the category of being very feasible. This media can also be used as a means of supporting learning in the classroom or as a means of independent learning because it is easily accessible, has an attractive appearance, and is able to foster students' learning motivation through active involvement in project-based learning activities that are relevant to daily life.

CONCLUSION

Based on the results of the development research, the Project Based Learning (PjBL)-based learning video on green chemistry materials oriented to students' learning motivation was developed using the Lee & Owens model which includes the stages of analysis, design, development, implementation, and evaluation. The results of the study showed that the Project Based Learning (PjBL)-based learning video on green chemistry material obtained a validation percentage of material experts of 90% and media experts of 92% with the category of "Very Feasible". The teacher's assessment showed a percentage of 90% with the "Very Feasible" category, while the student response in the small group trial obtained a percentage of 93.7% with the "Very High" category, so that this Project Based Learning (PjBL)-based learning video has the potential to foster student learning motivation and the product developed is declared theoretically and practically feasible as one of the learning resources that can help students understand concepts independently.

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