Analysis Validation of Modern Physics Learning Media Based on Smartphone Integrated Project Based Learning to Improve Students’ Creativity and Scientific Literacy

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Abstract: The development of modern physics learning media based on project based learning integrated with smartphones to increase students' creativity and scientific literacy has been successfully carried out. The aim of this development is to produce modern physics learning media based on project based learning integrated with smartphones that is valid to increase students' creativity and scientific literacy. The media development uses a 4D model which consists of four stages, namely: define, design, develop and disseminate. Based on the results of assessments by material experts, learning media experts and learning experts, it can be concluded that modern physics learning media based on project based learning integrated with smartphones is very suitable to be used as a learning media in increasing students' creativity and scientific literacy.

Keywords: Creativity; Learning media; Modern physics; Project based learning; Scientific literacy

Introduction

Education has now entered the 21st century and is also known as the era of industrial revolution 4.0 which is marked by the rapid development of science and technology (Doyan, Susilawati, Harjono, et al., 2023; Fadli, 2021). 21st century education aims to encourage students to learn skills that help them adapt to changing times. In the 21st century, students are required to be able to solve various problems by thinking creatively and being skilled in using technology. In the field of education, the use of technological media makes learning more effective and efficient (Doyan, Gunawan, et al., 2020; Susilawati, Doyan, & Muliyadi, 2022).

Modern physics is one of the important subjects for students of the physics education study program (Sartika et al., 2017; Verawati et al., 2022). This course discusses concepts developed in the 20th century, where formulations in classical physics are no longer able to explain phenomena that occur in matter on an atomic or subatomic scale and particles that move at speeds close to the speed of light (Nitriani et al., 2018). Students need to understand the material well and correctly, as a first step to understanding higher levels of science such as quantum physics, statistical physics, introduction to solid state physics and introduction to core physics (Widyawati et al., 2018).

Modern physics material whose material characteristics are dominated by abstract and microscopic concepts, if taught theoretically without being supported by examples that make it more optimal, such as with the help of animations and videos, can lead to differences in understanding among students. The learning resources used in the form of reference books and teaching materials from lecturers were deemed insufficient for understanding modern physics material and as a source of independent learning outside of class (Jh, 2018).

How to Cite:
The results of interviews with several students who have studied modern physics subjects show that they still experience difficulties in understanding concepts and formulas. One of the reasons is because it is difficult to understand teaching materials (mandatory reference materials), which results in students not having the initial skills so that the learning process is lecturer-centered which causes students to become dominant in listening and taking notes, which is also a learning factor that does not actively involve students. Apart from that, limited teaching materials also result in the learning process being less effective. This has an impact on many students who are not enthusiastic when taking part in learning. This is what causes the learning outcomes of modern physics to be low, especially in the aspects of scientific literacy and creativity.

One way to overcome this problem is to use the project based learning (PJBL) model in learning modern physics (Arifin et al., 2023; Doyan, Susilawati, Andayani, et al., 2023). The project based learning model is an effective educational approach that focuses on creative thinking, problem solving, and interaction between students and their peers to create and use new knowledge (Dewi et al., 2021; Hartini, 2017; Marwani et al., 2020). This project based learning model includes problem solving activities, decision making, investigation skills and work creation skills (Fitriyani et al., 2019; Mahtumi et al., 2022; Rahman, 2022). Students should focus on solving problems or questions that guide them to understand the concepts and principles related to the project (Kusuma, 2018). Apart from this learning model, there is also a need for media that can help lecturers and students in learning (Doyan, Gunawan, et al., 2020; Susilawati, Doyan, Mulyadi, et al., 2022).

One of the learning media that suits the learning needs of the 21st century is learning media that utilizes smartphones (Farida, 2019; Rohmah et al., 2020). Android-based smartphones have unique characteristics, namely that they can be used anywhere and at any time, supported by attractive visualization, so that they can increase students’ learning motivation, creativity and literacy (Harianto et al., 2017).

Based on the description above, it is necessary to develop a learning media that can help students in learning modern physics. Therefore, researchers developed a modern physics learning media based on project based learning integrated with smartphones to increase students’ creativity and scientific literacy.

Method

This type of research is development research (Research and Development) by adopting a 4D model development model. The 4D model includes several stages, namely define, design, develop and disseminate (Sugiyono, 2019). This research is limited to the development stage, which includes validity testing (Susilawati et al., 2023).

The data obtained from this research is data from the results of assessments by validators. Media validation is carried out by experts consisting of material experts, learning media experts, and learning experts, each consisting of two people. The data obtained in this research were analyzed using equation 1 (Khasanah et al., 2019). Furthermore, the level of validity can be determined based on criteria according to Arikunto (2012) which include: very less valid (1.0 ≥ V ≤ 1.8), less valid (1.8 ≥ V ≤ 2.6), quite valid (2.6 ≥ V ≤ 3.4), Valid (3.4 ≥ V ≤ 4.2), and Very Valid (4.2 ≥ V ≤ 5.0).

$$V = \frac{\text{the average value of expert validity}}{\text{max score}}$$

(1)

Result and Discussion

The research aims to determine the feasibility of modern physics learning media based on project based learning integrated with smartphones in increasing students’ creativity and scientific literacy. The device was developed using a 4D model which includes several stages, namely define, design, develop and disseminate. The define stage aims to define and establish learning conditions. This definition stage consists of five main steps, namely problem analysis, student analysis, task analysis, material analysis, and specification of learning objectives (Doyan et al., 2022). Problem analysis was carried out on 6th semester students in the Physics education study program at Mataram University. The purpose of this analysis is to surface and determine the basic problems faced in learning modern physics. The results of problem analysis and student analysis show that students’ abilities in receiving and responding to modern physics subject matter vary. This is because the material in modern physics discusses more abstract physics concepts, thus influencing student enthusiasm during the learning process. This is the cause of students' low ability to understand concepts, creativity and low scientific literacy. Based on this problem, a modern physics learning media is needed that can increase students' creativity and scientific literacy in studying modern physics, the material of which mostly discusses abstract material. To overcome this problem, an alternative is needed, namely developing modern physics learning media based on project based learning integrated with smartphones to increase students' creativity and scientific literacy.

The next step is to carry out concept analysis, task analysis, and specification of learning objectives. In this
case, the modern physics learning material chosen consists of 8 chapters, namely: Special theory of relativity; Quantum phenomena; Matter waves; Rutherford and Bohr model; Quantum theory of the hydrogen atom; Statistical mechanics; Atomic nucleus; and Radioactivity and nuclear reactions.

The next stage is design, where at this stage the researcher designs modern physics learning media based on smartphone integrated project based learning. At the design stage, modern physics material is prepared in accordance with the curriculum, media selection is appropriate to the objectives, format selection and initial design. After the learning device design process is complete, the next step is carried out, namely the develop stage (Susilawati, Rahmana, Kosim, et al., 2022).

The develop stage aims to develop modern physics learning media based on project based learning integrated with smartphones that is valid to increase students' creativity and scientific literacy. At the development stage, validation of the learning media is carried out. Validation of the device was carried out by three validators (Doyan, Jufri, et al., 2020). The results of the learning device validation are shown in figures 1, 2, and 3.

Figure 1 shows the validation results of modern physics learning media based on smartphone integrated project based learning carried out by 2 material experts. The validation results show an average achievement of 4.31 (validator 1) and 4.41 (validator 2) with very decent interpretations in all aspects measured, namely coverage of modern physics material, suitability of media components with modern physics material, and grammar used.

Figure 2 shows the validation results of modern physics learning media based on project based learning integrated with smartphones carried out by 2 learning media experts. The validation results show an average achievement of 4.33 (validator 1) and 4.39 (validator 2) with very adequate interpretation in all aspects measured, namely completeness of media components, media display format, and grammar used.

Figure 3 shows the validation results of modern physics learning media based on project based learning integrated with smartphones carried out by 2 learning media experts. The validation results show an average achievement of 4.29 (validator 1) and 4.45 (validator 2) with a very feasible interpretation in all aspects measured, namely the feasibility of analyzing the presentation of modern physics material, the characteristics of the PjBL learning model in modern physics learning, and the appropriateness of the language in learning.

Conclusion

Based on the results of assessments by material experts, learning media experts and learning experts, it can be concluded that modern physics learning media based on project based learning integrated with smartphones is very suitable to be used as a learning media in increasing students' creativity and scientific literacy.

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Conflicts of Interest
The authors of this article declare no conflict of interest.

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