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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).

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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 ($1.0 \geq V \leq 1.8$), less valid ($1.8 \geq V \leq 2.6$), quite valid ($2.6 \geq V \leq 3.4$), Valid ($3.4 \geq V \leq 4.2$), and Very Valid ($4.2 \geq V \leq 5.0$).

$$V = \frac{\text{the average value of expert validity}}{\text{max score}} \quad (1)$$

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.

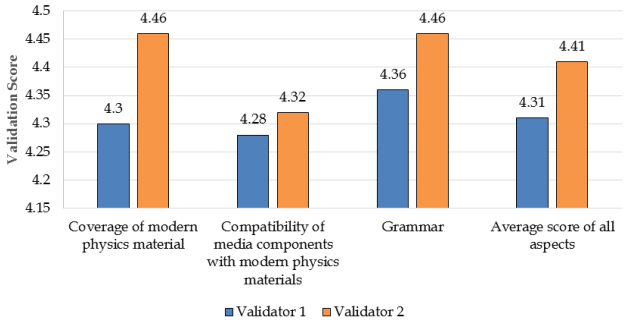

Figure 1. Material expert validation test results

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.

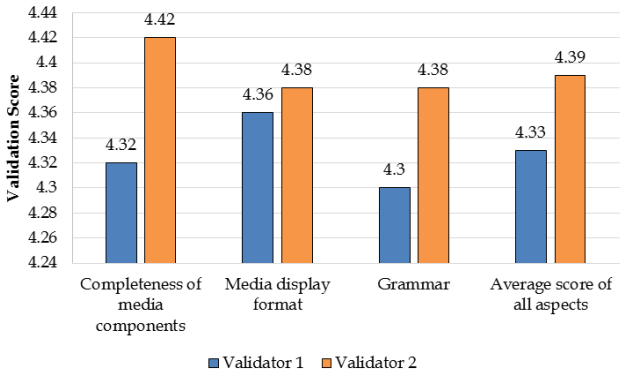

Figure 2. Validation test results from learning media experts

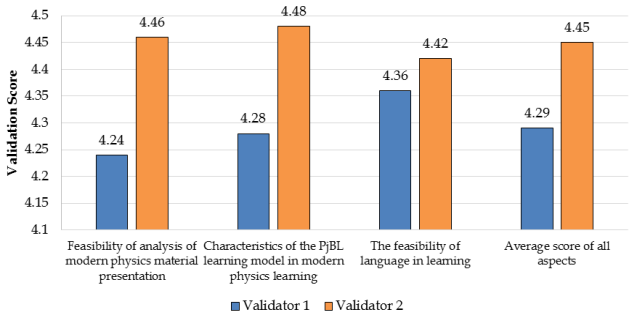

Figure 3. Learning expert validation test results

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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Author Contributions
Conceptualization: S., A. D., and J. R.; formal analysis: S., A. D., and L. M.; investigation: S.

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

References

Arifin, A. A., Doyan, A., Mahrus, M., Susilawati, S., Andayani, Y., & Muntari, M. (2023). PjBL Learning Training Based on Science Practicum Tools DNA and RNA Structures at the Attohiriyah Alfadiliyah Islamic Boarding School. *Unram Journal of Community Service*, *4*(2). https://doi.org/10.29303/ujcs.v4i2.453

Arikunto, S. (2012). *Dasar-Dasar Evaluasi Pendidikan Edisi 2*. Bumi Aksara.

Dewi, L., & Fauziati, E. (2021). Pembelajaran Tematik di Sekolah Dasar dalam Pandangan Teori Konstruktivisme Vygotsky. *Jurnal Papeda: Jurnal Publikasi Pendidikan Dasar*, *3*(2), 163–174. https://doi.org/10.36232/jurnalpendidikandasar.v3i2.1207

Doyan, A., Gunawan, Susilawati, Khasanah, B. U., & Muliyadi, L. (2020). The effectiveness of quantum phenomenon learning media with think pair share model implementation on understanding concept of students. *Journal of Physics: Conference Series*, *1521*(2), 022037. https://doi.org/10.1088/1742-6596/1521/2/022037

Doyan, A., Jufri, A. W., Hardiyansyah, A., Auliya, K., Hakim, S., & Muliyadi, L. (2020). Development of learning media of microscope portable auto design to increase student's problem-solving ability in light and optical tools topic. *4th Asian Education Symposium (AES 2019)*, 300–302.

Doyan, A., Susilawati, S., Andayani, Y., Muntari, M., Mahrus, M., & Lugi, F. (2023). PjBL Learning Training Based on Science Practicum Tools for Vernier Calipers and Screw Micrometers at Pondok Pesantren Attohiriyah Alfadiliyah Bodak. *Unram Journal of Community Service*, *4*(3), 62–64. https://doi.org/10.29303/ujcs.v4i3.456

Doyan, A., Susilawati, S., Hadisaputra, S., & Muliyadi, L. (2022). Analysis Validation of Quantum Physics Learning Devices using Blended Learning Models to Improve Critical Thinking and Generic Science Skills of Students. *Jurnal Penelitian Pendidikan IPA*, *8*(3), 1581–1585. https://doi.org/10.29303/jppipa.v8i3.1920

Doyan, A., Susilawati, S., Harjono, A., Muliyadi, L., Hamidi, H., Fuadi, H., & Handayana, I. (2023). The effectiveness of modern optical learning devices during the Covid-19 pandemic to improve creativity and generic science skills of students. *AIP Conference Proceedings*, *2619*(1). https://doi.org/10.1063/5.0122553

Fadli, M. R. (2021). Hubungan filsafat dengan ilmu pengetahuan dan relevansinya di era revolusi industri 4.0 (Society 5.0. *Jurnal Filsafat*, *31*(1), 130–161. https://doi.org/10.22146/jf.42521

Farida, E. (2019). Media pembelajaran teknologi digital untuk meningkatan efektivitas belajar siswa pada abad-21. *Jurnal Didaktika Pendidikan Dasar*, *3*(2), 457–476. https://ojsdikdas.kemdikbud.go.id/index.php/didaktika/article/view/102

Fitriyani, D., Jalmo, T., & Yolida, B. (2019). Penggunaan problem based learning untuk meningkatkan keterampilan kolaborasi dan berpikir tingkat tinggi. *Jurnal Bioterdidik*, *7*(3), 77–87. Retrieved from https://core.ac.uk/download/pdf/289778112.pdf

Harianto, A., Suryati, S., & Khery, Y. (2017). Pengembangan media pembelajaran kimia berbasis Android untuk penumbuhan literasi sains siswa pada materi reaksi redoks dan elektrokimia. *Hydrogen: Jurnal Kependidikan Kimia*, *5*(2), 35–47. https://doi.org/10.33394/hjkk.v5i2.1588

Hartini, A. (2017). Pengembangan Perangkat Pembelajaran Model Project Based Learning Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Sekolah Dasar. *ELSE (Elementary School Education Journal): Jurnal Pendidikan Dan Pembelajaran Sekolah Dasar*, *1*(2a). https://doi.org/10.30651/else.v1i2a.1038

Jh, T. S. (2018). Pengembangan e-modul berbasis web untuk meningkatkan pencapaian kompetensi pengetahuan fisika pada materi listrik statis dan dinamis SMA. *WaPFi (Wahana Pendidikan Fisika)*, *3*(2), 51–61. https://doi.org/10.17509/wapfi.v3i2.13731

Khasanah, B. U., Doyan, A., Gunawan, S., Kartini, H., S., & Muliyadi, L. (2019). Analysis Validation of Learning Media Quantum Phenomenon. *Jurnal Penelitian Pendidikan IPA*, *5*(2), 189–193. https://doi.org/10.29303/jppipa.v5i2.265.

Kusuma, I. G. A. J. (2018). Penerapan Model Pjbl Berbantuan Media Audiovisual Untuk Meningkatkan Hasil Belajar Ipa Siswa Kelas V Sd. *Jurnal Ilmiah Pendidikan Profesi Guru*, *1*(1), 29–38. https://doi.org/10.23887/jippg.v1i1.14263

Mahtumi, I., Purnamaningsih, I. R., & Purbangkara, T. (2022). *Pembelajaran Berbasis Proyek (Projects Based Learning)*. Uwais Inspirasi Indonesia.

Marwani, R., & Sani, A. R. (2020). Pengaruh Model Project Based Learning Berbasis STEM Terhadap Kemampuan Berpikir Kreatif Siswa Pada Materi

Pokok Fluida Statis di Kelas XI SMA Negeri 4 Tebing. *Jurnal Inovasi Pembelajaran Fisika*, *8*(2), 8–15. https://doi.org/10.24114/inpafi.v8i2.18678

Nitriani, N., Saehana, S., & Darsikin, D. (2018). Pengembangan bahan ajar mata kuliah fisika modern menggunakan model ADDIE. *JPFT (Jurnal Pendidikan Fisika Tadulako Online)*, *6*(1), 6–12. Retrieved from http://jurnal.untad.ac.id/jurnal/index.php/EPFT/article/view/10012

Rahman, A. (2022). *Project Based Learning sebagai Upaya Meningkatkan Hasil Belajar dan Keterampilan Proses Sains Peserta Didik*. Penerbit NEM.

Rohmah, F. N., & Bukhori, I. (2020). Pengembangan media pembelajaran interaktif mata pelajaran korespondensi berbasis android menggunakan articulate storyline 3. *Economic & Education Journal*, *2*(2), 169–182. Retrieved from http://ejurnal.budiutomomalang.ac.id/index.php/ecoducation/article/download/892/523/

Sartika, D., & Humairah, N. A. (2017). Analisis Kesulitan Memecahkan Masalah pada Mata Kuliah Fisika Modern Mahasiswa Calon Guru Fisika. *Jurnal Pendidikan MIPA*, *7*(1), 7–11. Retrieved from https://ejournal.tsb.ac.id/index.php/jpm/article/view/14

Sugiyono. (2019). *Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif dan R & D)*. Alfabeta.

Susilawati, Rahmana, F., Kosim, & Muliyadi, L. (2022). Practicality of problem-based physics learning tools with video assistance to improve problem-solving ability of students. *Journal of Science and Science Education*, *3*(1), 55–59. https://doi.org/10.29303/jossed.v3i1.1614

Susilawati, S., Doyan, A., & Muliyadi, L. (2022). Effectiveness of Guided Inquiry Learning Tools to Improve Understanding Concepts of Students on Momentum and Impulse Materials. *Jurnal Penelitian Pendidikan IPA*, *8*(3), 1548–1552. https://doi.org/10.29303/jppipa.v8i3.1919

Susilawati, S., Doyan, A., Mulyadi, L., Abo, C. P., & Pineda, C. I. S. (2022). The Effectiveness of Modern Physics Learning Tools Using the PhET Virtual Media Assisted Inquiry Model in Improving Cognitive Learning Outcomes, Science Process Skills, and Scientific Creativity of Prospective Teacher Students. *Jurnal Penelitian Pendidikan IPA*, *8*(1), 291–295. https://doi.org/10.29303/jppipa.v8i1.1304

Susilawati, S., Doyan, A., Rokhmat, J., Gunawan, G., Gunada, I. W., & Hikmawati, H. (2023). Validation of PhET-Based Core Physics Teaching Materials to Improve Activities and Learning Outcomes of Physics Education Students. *Jurnal Penelitian Pendidikan IPA*, *9*(5), 2715–2719. https://doi.org/10.29303/jppipa.v9i5.3929

Verawati, N. N. S. P., Hikmawati, H., Wahyudi, W., & Prayogi, S. (2022). Pengalaman Mengajar Fisika Modern Menggunakan Simulasi Virtual PhET: Analisis Kinerja Keterampilan Penalaran Mahasiswa. *Empiricism Journal*, *3*(2), 188–195. https://doi.org/10.36312/ej.v3i2.997

Widyawati, W., Saehana, S., & Wahyono, U. (2018). Pengembangan media pembelajaran berbasis e-learning pada mata kuliah fisika modern. *JPFT (Jurnal Pendidikan Fisika Tadulako Online)*, *6*(1), 32–39. Retrieved from http://jurnal.untad.ac.id/jurnal/index.php/EPFT/article/view/10016