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Journal of Physics: Conference Series

PAPER • OPEN ACCESS

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To cite this article: J Siswanto *et al* 2022 *J. Phys.: Conf. Ser.* **2392** 012025

Digital Learning Integrated with Local Wisdom to Improve Students' Physics Problem-Solving Skills and Digital Literacy

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Abstract. Digital learning integrated with local wisdom is designed to improve students' physics problem-solving skills and digital literacy. The study aims to analyze the practicality and effectiveness of digital learning integrated with local wisdom designed to improve students' physics problem-solving skills and digital literacy. The research was conducted by applying a pre-experimental design, one group pre-test and post-test for 66 high school students. When the learning process is carried out, observe the practicality of learning. The data collected from the pre-test and post-test were analyzed using paired t-test and n-gain. The results show that digital learning integrated with local wisdom is designed to improve students' physics problem-solving skills and digital literacy. It is proven that: it is practical (applicable) which is indicated by each phase that can be implemented by teachers with good categories; and effective in increasing students' physics problem solving and digital literacy, as indicated by a significant increase in physics problem-solving skills and digital literacy at 5%, and the average n-gain is in the medium category.

1. Introduction

Local wisdom is very important to be conveyed in schools, even though most learning enters the digital era. This needs to be done so that local wisdom is not lost by the times. In addition, learning to strengthen character education can be applied by considering local wisdom. The perspective and translation of the local wisdom of the community need to be reviewed from various sides to obtain comprehensive knowledge. A logical and in-depth exploration and understanding are needed to avoid misinterpretation of developing local wisdom [1]. A narrow perspective can produce narrow knowledge. Local wisdom comes from the interaction between humans and the environment through a long (long-lasting) and hereditary internalization process. In this process, there is an evolution of values that are crystallized in the form of customary law, local beliefs, and culture [2].

Physics is one of the fields of natural science that studies natural phenomena around. Physics is also known as the oldest science because it studies everything related to the universe since it first existed or was created. Judging from the initial process of local wisdom, which is internalized from human interaction with the environment, it needs to be studied scientifically, and it is related to physics. Therefore, physics learning needs to be developed with the aim of equipping mastery of content and also equipping the ability to understand natural phenomena around, including local wisdom.

Physics learning still rarely presents local wisdom as facts or reality for learning physics concepts. Therefore, learning is needed that is able to combine original knowledge of local wisdom with scientific knowledge [3]. In addition, the use of technology in physics learning, through digital learning, needs to be integrated with local wisdom. The digital learning model integrated with local wisdom for physics learning was developed from the blended learning model. Blended learning is learning by integrating face-to-face and online instruction [4,5]. Blended learning models are often conducted in the classroom and also offer additional learning opportunities through digital platforms. Elements of digital learning are open to every student and can usually be accessed anytime and anywhere via the internet. In this learning, the interaction of teachers and students is not limited by space and time and can be carried out at any time. In this study, digital learning integrated with local wisdom for physics learning has a syntax; 1) Orientation: directing students to local wisdom, which will be explained with the concept of physics; 2) Seeking: seeking learning information from various sources of information available online, books, as well as delivering/demonstrating empirical phenomena of science in local wisdom through face to face in class; 3) Acquisition: interpreting and elaborating information personally or in groups; and 4) Synthesizing: reconstructing knowledge through the process of assimilation and accommodation from the results of analysis, discussion and formulation of conclusions from the information obtained.

Digital learning was chosen because it is in accordance with the times, with the aim of equipping digital literacy skills. Digital literacy indicators are internet search, hypertext navigation, content evaluation, and knowledge compilation [6]. Digital physics learning is expected to be able to facilitate students to learn in a variety of ways, not only in verbal form but also in more varied forms such as text, visuals, audio, and supporting the motion, or what is called multi-representation. The local wisdom presented will be studied with physical representations, namely verbal, pictures, graphics, and/or mathematics, which are expected to support the understanding of physics concepts that support physics problem-solving skills. Physics problem-solving skills are a tradition that cannot be separated from physics learning [7]. The indicators of physics problem-solving skills are (1) problem identification, (2) problem-solving planning, (3) implementing according to plan, and (4) evaluation [8]. In addition, students have digital literacy skills for the provision of life in the current digital era, so they are able to sort and choose information properly and correctly.

2. Methods

The research emphasizes the implementation of digital learning integrated with local wisdom to improve students' physics problem-solving skills and digital literacy. The research design used is a pre-experimental one-group pre-test and post-test design, presented in Figure 1

Pre-test	**Treatment/Intervention**	**Post-test**
O_1	X	O_2

Figure 1. Research design

This research was conducted on 66 high school students of class XI who were determined using the cluster random sampling technique. This technique is easier to do because it is applied to groups, so it does not require much time [9]. Methods of collecting data using tests, observations, and questionnaires. The analysis of the practicality of learning uses quantitative descriptive, while the analysis of the effectiveness of learning is carried out by analyzing the mean pre-test and post-test scores with (a) paired-sample t-test [10]; (b) calculating the mean N-gain with the formula: N-gain = (post-test score – pre-test score) / maximum score – pre-test score), with categories: (1) high if N-gain 0.70; (2) moderate if 0.70 > N-gain 0.30; and (3) low if N-gain < 0.30 [11].

3. Results and Discussion

This research was conducted on learning materials for fluid. Learning is carried out by teachers who were previously given teaching training using a digital learning model that is integrated with local wisdom. In learning, use Google Classroom as a learning management system which is supported by software for digitizing learning devices. Data on the practicality of digital learning integrated with local wisdom in physics learning is presented in Table 1.

Table 1. The practicality of digital learning integrated with local wisdom

Learning Phase and Class situation	Learning 1		Learning 2	
	score	criteria	score	criteria
A. Phase				
1. Orientation	3.25	very good	3.50	very good
2. Seeking	3.25	very good	3.25	very good
3. Acquisition	3.50	very good	3.50	very good
4. Synthesizing	3.25	very good	3.25	very good
B. Class situation				
1. The suitability of learning activities with learning objectives	3.50	very good	3.50	very good
2. Student-centered learning	3.50	very good	4.00	very good
3. Teacher-student interaction	3.50	very good	3.50	very good
4. Interaction between students	3.00	good	3.25	very good

The data on the average score of students' physics problem-solving skills and digital literacy test results and analysis results are presented in Table 2 and Table 3.

Table 2. The average score of students' physics problem-solving skills and digital literacy

Skill	Class-XI A		Class-XI B	
	Mean pre-test score	Mean post-test score	Mean pre-test score	Mean post-test score
Physics problem solving	43.22	81.85	37.80	81.00
Digital literacy	50.08	81.72	51.30	84.56

Table 3. Results of data analysis

Skill	Class	Test	∑	R	Normality p(α=0,05)	Homogeneity p(α=0,05)	Paired t-test p(α=0,05)	N-gain	
								Score	criteria
Physics problem solving	XI A	Pre	33	43.22	0.180	0.172	p < 0.001	0.68	medium
		Post	33	81.85	0.200				
	XI B	Pre	33	37.80	0.060	0.084	p < 0.001	0.69	medium
		Post	33	81.00	0.144				
Digital literacy	XI A	Pre	33	50.08	0.180	0.122	p < 0.001	0.63	medium
		Post	33	81.72	0.200				
	XI B	Pre	33	51.30	0.068	0.144	p < 0.001	0.68	medium
		Post	33	84.56	0.144				

The practicality of the integrated digital learning model with local wisdom, as presented in Table 1, shows that each phase of learning can be carried out by teachers with very good criteria. Each of these learning phases can be carried out well by providing a learning environment that supports students in improving their physics problem-solving skills and digital literacy. The model syntax describes the overall direction of learning activities [12].

The syntax of the digital learning model integrated with local wisdom can empirically work well. The orientation phase directs students to local wisdom, which will be explained with the concept of physics. The teacher presents events or objects related to local wisdom. In accordance with the ARCS theory (Attention, Relevance, Confidence, and Satisfaction) that in order to arouse curiosity and interest in the learning to be carried out, students must pay attention [13]. Cognitive involvement will make students active in the learning process [14]. The seeking phase is the search for learning information from various sources of information available online, books, as well as the delivery/demonstration of empirical science phenomena in local wisdom through face-to-face in class. Concept exploration activities are carried out individually or in groups. The teacher facilitates and guides students in the concept exploration process so that the information obtained remains relevant to the learning topic being discussed. Exploration and investigation activities have a positive effect on students to control the learning process [15]. In the acquisition phase, students interpret and elaborate information/concepts personally or in groups. The individual gradually develops the capacity to process information and acquires complex knowledge and skills [16]. Synthesizing phase, reconstructing knowledge through the process of assimilation and accommodation of the results of analysis, discussion, and formulation of conclusions from the information obtained. Individuals integrate new perceptions, concepts, or experiences into their cognitive schemes, and assimilation will occur, while accommodation occurs when individuals face stimuli that enter their cognitive structure [17].

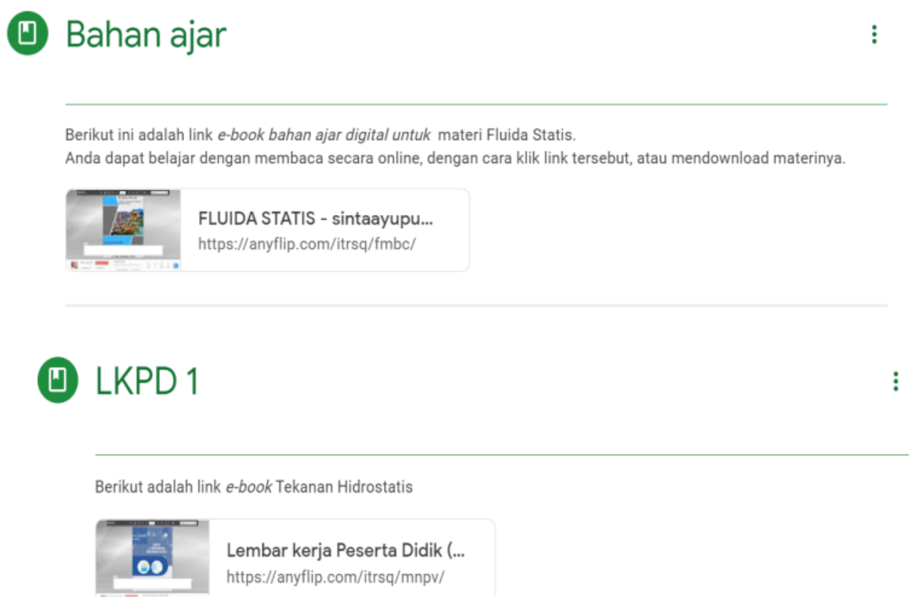

Figure 2. Learning tools in google classroom

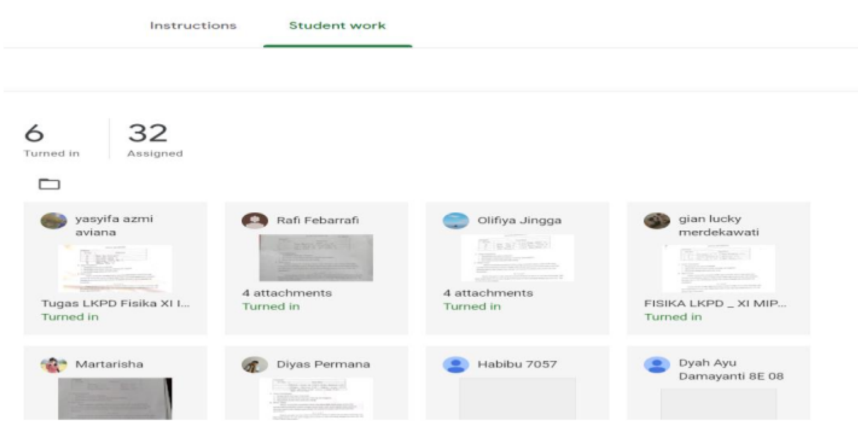

Figure 3. Student work in digital learning

The implementation of digital learning integrated with local wisdom has an impact on improving students' physics problem-solving skills and digital literacy (Table 2 and Table 3). The results of the analysis using paired t-test showed that there was a significant difference between the value of problem-solving skills before and after learning. Likewise, in students' digital literacy, there is a difference between before and after learning. Students experienced an increase in physics problem-solving skills with moderate criteria and an increase in digital literacy with medium criteria. Digital learning integrated with local wisdom and its supporting tools, as shown in Figures 2 and 3, plays a role in improving students' physics problem-solving skills and digital literacy. This is in accordance with Vygotsky's constructivist social theory, which has four main implications, namely social learning, zone of proximal development (ZPD), scaffolding, and cognitive apprenticeship [18]. Social learning, namely, students learn through interaction with other people who are more capable. ZPD is the zone between the actual level of development shown by the ability independently and the level of potential development under the guidance of someone who is more capable. Scaffolding is to provide sufficient assistance during the learning process in completing assignments as needed by students. Cognitive apprenticeship is the process by which students achieve step-by-step expertise in their interactions with lecturers or other students who are more capable.

4. Conclusion

Based on the results of the research and discussion above, it can be concluded that digital learning integrated with local wisdom on the topic of fluid to improve physics problem-solving skills and digital literacy, has been proven to be: 1) can be applied in learning, which is shown by each phase of teaching can be carried out by teachers with a very good category; and 2) effective, which is shown by: (a) an increase in students' physics problem-solving skills and digital literacy significantly at 5%, (b) the average N-gain of students' physics problem-solving skills and digital literacy are in the medium category.

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