The Effect of the Video-Assisted Learning Cycle 7E Model to Improve Science Literacy in Atomic Core Materials and Radioactivity

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Abstract. The primary objective of this study is to assess the impact of the video-assisted learning cycle 7E model on scientific literacy skills concerning atomic nuclei and radioactivity. The research design employed a non-equivalent approach using quasi-experimental methodology. The study focused on senior high school students in class XII as its target population. The instrument used for evaluating scientific literacy skills comprised multiple-choice questions crafted based on indicators of scientific literacy within the competency aspect, and its validation was conducted by a validator. The findings indicated that the experimental class achieved an average post-test score of 88.23, while the control class scored 80. The data from both groups exhibited normal and homogeneous distribution, as confirmed through homogeneity and normality tests. The t-test hypothesis analysis supported the conclusion that the video-assisted learning cycle 7E model has the potential to enhance students' scientific literacy skills.

Keywords: Learning cycle 7E models, Videos, Scientific literacy, Atomic nuclei and, Radioactivity

1 Introduction

The 21st-century evolution of education is characterized by a focus on science education, which plays a crucial role in enhancing the overall quality of education. This emphasis on science learning is instrumental in addressing and resolving challenges within the community environment that arise due to the consequences of scientific advancements. [1]. The existing science learning approach remains centered around the teacher as the focal point of learning [2], posing challenges for students to actively engage in the learning process. The primary objective of science education is to enhance students' scientific literacy, defined as their capability to apply scientific knowledge for questioning, drawing conclusions based on evidence, and comprehending science. This proficiency assists students in making informed decisions about science and understanding its transformations influenced by human activities [3].

According to research carried out by the OECD [4], the scientific literacy of Indonesian students in 2018 was positioned at 70 out of 78 countries, attaining a score of 396 points against a maximum achievable score of 500 points. In contrast, the average sci-

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ence proficiency score in other countries was 489 [5]. Consequently, findings from international-level research indicate that the scientific literacy level of Indonesian students falls into the lower category.

The initial study conducted at Senior High School 3 Banda Aceh identified several challenges related to scientific literacy. One key issue is the limited involvement of students in the learning process, exacerbated by insufficient interaction between students and teachers. This aligns with Yuyu's research, which indicates a predominantly teacher-centered approach in classrooms, with a focus on achieving material targets and a lack of proficiency in implementing problem-based learning. Additionally, teachers exhibit weaknesses in aligning learning processes with the nature of science [6].

Furthermore, the study highlights that science education at the school is characterized by the mere transfer of scientific knowledge, emphasizing memorization of scientific products such as facts, laws, and theories. Unfortunately, this approach neglects the essential aspects of science as a process and an attitude. The utilization of physics learning media is also suboptimal [7]. Consequently, students face challenges in formulating problems, identifying scientific questions, explaining phenomena, using scientific evidence, and problem-solving. Despite having a considerable curiosity about science, students often fail to explore it actively. Moreover, the study underscores the underutilization of supporting media in the learning process, despite its pivotal role in enhancing the learning experience [8].

Enhancing students' low scientific literacy skills can be achieved through regular practice of questioning and reading [9]. Research by Setyaningsih suggests that the 7E learning model, based on the learning cycle, is effective in improving scientific literacy skills [10]. This model consists of seven stages: eliciting initial knowledge, engaging students' interest, exploring concepts, providing explanations, applying knowledge, evaluating understanding, and extending knowledge [11]. The 7E learning cycle model proves to be particularly advantageous in improving science process skills in physics when compared to the problem-based learning model [12]. Notably, one of the topics covered in physics lessons is nuclear physics, specifically focusing on the atomic nucleus and radioactivity.

The examination results of Senior High School 3 Banda Aceh's twelfth-grade students revealed lower scores in the topic of atomic nuclei and radioactivity. This trend can be attributed to the abstract nature of core physics, which lacks visual clarity [13]. Effectively conveying core physics concepts demands additional creativity from teachers, prompting the use of instructional aids such as videos. Utilizing appropriate video materials during lessons proves beneficial in aiding students to attain learning objectives and facilitates an environment conducive to improving scientific literacy. This multimedia approach not only supports students in comprehending challenging subjects but also assists teachers in enhancing the overall learning experience [14].

Based on these problems, researchers are interested in conducting research on the Effect of the Video-Assisted 7E Learning Cycle Model to Improve Scientific Literacy in the subject matter of Atomic Nuclei and Radioactivity.

2 Method

This study employs a quantitative approach through a quasi-experimental method, specifically utilizing a non-equivalent control group design. The research design involves administering a pretest before the learning activities and a post test after the completion of the learning activities. This comparative analysis enables a precise assessment of the impact of the learning activities on the participants. The study encompasses all twelfth-grade students at Senior High School, with two samples selected randomly using purposive sampling techniques to form the experimental and control classes.

Validation sheets, evaluated by experts, play a crucial role in assessing the validity of instruments utilized in the learning process. This study focuses on validating three key elements: scientific literacy ability tests, lesson plans, and worksheets. The scientific literacy ability tests comprise pretest and posttest formats, each containing 10 multiple-choice questions centered around the Atomic Nucleus and Radioactivity material. These questions are designed based on indicators measuring scientific literacy, encompassing the ability to identify scientific questions, explain phenomena scientifically, and employ scientific evidence. Prior to implementation, the test questions underwent validation by experts. The observation sheet of the implementation of the Learning Cycle 7E model is used to observe the implementation of the Learning Cycle 7E model carried out by 2 observers during the learning process.

The research data were analyzed with the aim of examining the impact of the video-assisted Learning Cycle 7E model on the enhancement of students' scientific literacy skills. The assessment of the increase in scientific literacy competence among students who applied the 7E learning cycle model was carried out using the normalized gain score test. The calculation of this test is based on the formula as specified in reference [15].

$$(g) = \frac{Spost - Spre}{Sideal - Spre} \quad (1)$$

Information (g) is the average normalized gain, Spost and Spre are the averages of the posttest and pretest. Normalized gain criteria, if $g > 0.7$ means high category; $0.3 \leq g \leq 0.7$ medium category and if $g < 0.3$ means low category. Furthermore, according to [16] the effectiveness of the 7E learning cycle learning model in increasing scientific literacy competence can be seen from the minimum n-gain average in the medium category and there is a significant difference between pre-test and post-test through inferential analysis of the hypothesis submitted by student distribution test (independent sample test) assisted by SPSS 22 with a significance level of 0.05 where previously the data obtained were tested for normality and homogeneity.

3 Results and Discussion

The outcomes of a descriptive analysis detailing the scientific literacy competence achievements of students in both the experimental class and the control class have been summarized in Table 1 and Table 2. These tables provide concise information regarding the categories and percentages associated with each indicator, namely Identifying Scientific Questions or Problems, Explaining Scientific Phenomena, and Using Scientific Evidence.

Table 1. Achievement of science literacy indicators in the experimental class

No	Science Literacy Indicator	No Question	Achievement Percentage Experiment Class		
			Before	*After*	*Criteria*
1	Identifying Scientific Questions or Problems	1,2,3,4,5	41 %	88 %	Very good
2	Explain scientific phenomena	6,7,8	51 %	94 %	Very good
3	Using scientific evidence	9,10	37 %	79 %	Good
	Amount		129%	261%	
	Average		43 %	87 %	Very good

Table 2. Achievement of science literacy indicators in the control class

No	Science Literacy Indicator	No Question	Achievement Percentage Experiment Class		
			Before	*After*	*Criteria*
1	Identifying Scientific Questions or Problems	1,2,3,4,5	35 %	76 %	Good
2	Explain scientific phenomena	6,7,8	34 %	88 %	Very good
3	Using scientific evidence	9,10	21 %	79 %	Good
	Amount		90%	243%	
	Average		*30%*	*81 %*	*Very good*

Based on table 1 and 2, it shows that literacy skills have increased in each indicator both in the experimental class that applied the Learning Cycle 7e model and the control class that applied the direct instruction model. The results of the descriptive analysis of scientific literacy competency achievements (n-gain) are detailed in table 3.

Table 3. N-gain scores

No	**Class**	**N-gain score**	**Category**
1.	Experiment	79.76	High
2.	Control	69.61	Medium

Table 3. shows that the N-gain score in the experimental class was 79.76 which was in the high category and in the control class it was 69.61 which was in the medium category. The increase in students' literacy skills before and after learning can be obtained by the N-gain test. The N-gain category obtained by students in summary is in Table 4.

Table 4. N-gain data on scientific literacy ability

Experiment class		Control class	
High (g ≥ 0.70)	29	High (g ≥ 0.70)	21
Medium (0.30 ≤ g < 0.70)	5	Medium (0.30 ≤ g < 0.70)	13
Low (g < 0.30)	0	Low (g < 0.30)	1
Total	*34*	*Total*	*35*

Table 4 shows that in the high category experimental class there were 29 students, while 5 students, and no students in the low category. Meanwhile, in the control class in the high category, there were 21 students, 13 students in the middle, and 1 student in the low category.

The average N-gain value of the experimental class was higher than that of the control class, but both classes experienced an increase. Testing the normality of the data was carried out using a statistical test. In this study, a significant level of a = 0.05 was used. The results of the normality test and homogeneity of the research data are presented in Table 5 and Table 6.

Table 5. Normality test results

Variable		**Alpha (α)**	**Decision**
Science literacy	Pretest	0.060	Normal distribution
	Posttest	0.090	Normal distribution

Table 6. Homogeneity test results

Variable	**N**	**Alpha (α)**	**Decision**
Science literacy	67	0.752	Homogeneous data

According to [17] if the significance is greater than 0.05 then the data is normally distributed. Based on table v on the normality test for pretest values for the experimental class and control class using the Kolmogorov-Smirnov significant at 0.060 > 0.050, it can be concluded that the pretest values in this study fulfilled the assumptions of normality. In the posttest normality test for the experimental class and control class using the Kolmogorov Smirnov, it is significant at 0.090 > 0.050, so it can be concluded that the pretest scores in this study have met the assumptions of normality. Based on table 6 it is known that both data have a significance of > 0.05 which is equal to 0.752 so that both data have the same or homogeneous group variance.

Testing the hypothesis using the t-test for differences in pretest and posttest values as well as regarding differences in the N-gain value of scientific literacy skills against the learning cycle 7E and conventional learning models is presented in table 7.

Table 7. Hypothesis test results

Variable	**N**	**Alpha (α)**	**Decision**
Science literacy	*67*	*0.000*	*Ho was rejected, Ha was accepted*

Based on the provided output, the Sig. (2-tailed) value of 0.000, which is less than 0.05, leads to the conclusion that there is a significant effect on students' scientific literacy results between the Learning Cycle 7E learning model and the Direct Instruction model.

Examining the first indicator, which involves identifying scientific questions or problems, the experimental class demonstrated a commendable 88% success rate, categorized as very good, while the control class achieved a 76% success rate, classified as good. This suggests that a majority of the experimental class exhibited a superior ability to select answers indicative of improved problem-solving skills compared to the control class.

In the second indicator, where the focus is on memory retention, the experimental class scored 94%, and the control class scored 88%, both falling within the very good criteria. However, the experimental class achieved a higher percentage, suggesting that students in this class were more adept at answering questions requiring strong memory recall. This aligns with the viewpoint presented by [18], stating that audio-visual media tools not only facilitate effective learning in a shorter time but also result in longer-lasting and better retention in memory.

The highest percentage is observed in the indicator of explaining scientific phenomena, while the lowest percentage in this study is associated with the indicator of using scientific evidence. This highlights a deficiency in students' ability to actively address problems stemming from presented phenomena. Consequently, in the learning process, the teacher, functioning as a facilitator, should frequently present problems derived from students' everyday experiences.

Upon analyzing the data, it is evident that the Learning Cycle 7E model has a positive impact on students' scientific literacy abilities. The calculated data, as presented in Tables 1 and 2, indicate the success percentages of scientific literacy ability indicators in classes applying the 7E Learning Cycle model compared to those using Direct Instruction. The graphical representation illustrates that the results for classes employing the 7E Learning Cycle model are consistently higher for each indicator when compared to the control class.

The initial indicator of scientific literacy involves the identification of scientific questions or problems through the utilization of the Learning Cycle 7E model. In the Elicit phase, students are prompted to recall and express their existing knowledge by responding to questions related to the material. Subsequently, students are guided to provide answers based on their knowledge. The Engagement phase also contributes to fulfilling this indicator, as it encourages students to construct their own knowledge by posing questions and actively seeking problems within the material.

The third indicator pertains to problem-solving, and within the Learning Cycle 7E model syntax, the Exploration phase supports the achievement of this indicator. During Exploration, students are directed to analyze new problems associated with the material, thereby facilitating the development of problem-solving skills. The third indicator involves problem-solving, and within the Learning Cycle 7E model syntax, support for the fourth indicator of scientific literacy comes from the Exploration phase. During Exploration, students are guided to analyze new problems related to the material, fostering the development of their problem-solving skills.

The second indicator focuses on explaining phenomena scientifically. The Learning Cycle 7E model, through its syntax, aids the fifth indicator of scientific literacy, which includes stages such as elaboration, evaluation, and extension. In these stages, students are tasked with explaining the investigations conducted. Each group is then required to present their explanations to the entire class, promoting a comprehensive understanding of the scientific phenomena explored.

The third indicator, involving the use of scientific evidence, aligns with the syntax of the Learning Cycle 7E model, which supports scientific literacy, particularly within the Exploration phase. During this phase, students are directed to analyze new problems related to the material. In this context, students engage in practical applications, utilizing PhET simulations to determine the quantity of remaining nuclei during decay, as outlined in their worksheets. This indicator's alignment with the Exploration phase of the Learning Cycle 7E model highlights the practical aspect of the learning process. The inclusion of hands-on activities, such as using simulations, not only facilitates a deeper understanding of scientific concepts but also contributes to students achieving significant learning outcomes during the exploration stages [19].

Furthermore, the data analysis indicates that video-assisted Learning Cycle 7E enhances learning activities by capturing students' interest and improving their understanding. This, in turn, fosters active participation in the learning process [20].

Based on the presented data and explanations, it can be affirmed that the Learning Cycle 7E has a positive effect on elevating students' scientific literacy. The results demonstrate that each scientific literacy indicator in classes applying the 7E Learning Cycle model exhibits superior outcomes compared to classes employing direct instruction. This positive outcome can be attributed to the Learning Cycle 7E model's ability to provide effective treatment, thereby enhancing students' scientific literacy skills. Consequently, students' knowledge is more robust, and they are better equipped to engage in interactive learning. Moreover, this process stimulates students to take an active role in the development of their knowledge [21][22].

4 Conclusion

Based on data analysis and discussion of the research results can be concluded that there was an effect of the 7E Learning Cycle model on scientific literacy skills in atomic nuclei and radioactivity. It proved that the Learning Cycle 7E model can improve scientific literacy skills in the high category for senior high school students'.

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