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Reading, Finding, Discussing, and Talking Learning Model with Socio-Scientific Issues and Islamic Values for Scientific Literacy

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Abstract: This study aims to develop a Reading, Finding, Discussing, and Talking (RFDT) learning model that encompasses socio-scientific issues and Islamic values to improve students' scientific literacy. This model is considered more comprehensive in developing students' knowledge and skills. The research method used is research and development (R&D) with the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The sample in the study amounted to 48 students taken using a simple random sampling technique. Data were collected through observation techniques, interviews, validation questionnaires, and scientific literacy tests, then descriptive analysis was carried out using normalized gain and inferential analysis using an independent t-test. The results showed that the developed model was considered very valid by experts with an average score of 4.43. The application of the model showed an increase in acquisition scores in the experimental class compared to the control class, although the t-test results did not show a significant difference ($p > 0.05$). Several possible causes for the insignificant t-test results include the small number of samples and teachers still in the adaptation stage to the model. However, this model received a positive response from students so it is suitable for use in integrative, contextual, and religious learning.

Keywords: Islamic values; Learning model; RFDT; Scientific literacy; Socio-scientific issues

Introduction

Science education is expected to cultivate universal scientific values, including honesty, objectivity, critical thinking, collaboration, responsibility, and evidence-based decision-making, in addition to developing conceptual knowledge (Dawson et al., 2024). These values enable learners to evaluate scientific evidence, construct logical arguments, and make informed decisions when addressing complex socio-scientific issues encountered in everyday life. Consequently, science learning should provide authentic opportunities for students to investigate problems, discuss alternative viewpoints, and communicate evidence-based solutions. Integrating these universal scientific values into instructional practices is fundamental for fostering comprehensive scientific literacy and preparing students to participate responsibly in solving contemporary societal and environmental challenges, particularly through learning contexts based on socio-scientific issues (Afriandi et al., 2025; Dawson et al., 2024; Kumar et al., 2024).

Scientific literacy is the ability to understand scientific concepts and processes, and to use scientific knowledge to solve problems (Pursitasari et al., 2025). Needs analysis conducted in Indonesian schools also indicates that students' scientific literacy remains at a moderate-to-low level, highlighting the urgent need to develop instructional media and learning approaches specifically designed to improve scientific literacy

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competencies (Fadlah et al., 2024). The measurement of scientific literacy carried out by PISA specifically aims to measure students’ abilities in engaging with issues that arise in society and are related to science as reflective citizens (OECD, 2023). This objective emphasizes that scientific literacy is not merely mastery of factual content, but also the ability to use that knowledge in social, ethical, and real-life contexts, known as applicative competence. Empirical evidence from Indonesian secondary schools also reveals that students' scientific literacy remains very low across the domains of scientific content, context, and competency, indicating that science instruction should place greater emphasis on applying scientific knowledge in authentic situations (F. A. Putri et al., 2023; Zulistina et al., 2022).

The results of the 2022 Programme for International Student Assessment (PISA) show that Indonesian students' science abilities are still dominated by low-level abilities (OECD, 2023). Indonesian students' science scores reached only 383 points, placing the country in a worrying position, ranking 6th out of 8 ASEAN countries participating in the assessment. This figure is far below the OECD average (485 points), strongly indicating a national science literacy crisis. This score indicates that the average Indonesian student's science ability is only at Level 1a. Level 1a is the most basic ability category, where students are only able to use science to identify simple scientific phenomena, identify very simple correlations, and interpret simple data (Ahdiat, 2024). Students at this level have significant difficulties evaluating evidence, explaining phenomena scientifically that require more than one step of reasoning, or reasoning in complex socio-scientific contexts. This stagnant and low data directly reflects the fundamental challenges in achieving the main goal of modern science education, namely Scientific literacy has become a fundamental competency that prepares individuals to participate critically and responsibly in societies increasingly shaped by science and technology (OECD, 2023; Zeidler et al., 2019).

To achieve these competencies, science learning should facilitate inquiry, experimentation, and active problem solving because these learning experiences contribute directly to improving students' scientific literacy (Pane et al., 2024). Students’ inability to reach Level 2 (where they begin to be able to use basic concepts to make evidence-based decisions) is a key indicator that the focus of learning has been too dominated by the transfer of factual content, rather than on developing scientific reasoning skills. Recent empirical findings also demonstrate that scientific literacy is positively associated with students' logical reasoning skills and academic achievement. Students who experience inquiry-oriented learning environments tend to demonstrate better scientific literacy than those who mainly experience teacher-centred instruction (Saputra et al., 2025). Similar findings have also been reported in Indonesian schools, where most students still demonstrate low scientific literacy, particularly in explaining scientific phenomena. This indicates the need for contextual science learning that is closely connected with students' real-life experiences (Kamila et al., 2024).

Therefore, to address low PISA scores, learning that incorporates socio-scientific issues (SSI) in society needs to be systematically implemented (Ashidiq et al., 2024). Various student-centred learning approaches have also been reported to improve scientific literacy (Yolida et al., 2021), by engaging students in authentic investigations, collaborative learning, and real-world problem solving, including SSI-based project learning and SSI-integrated problem-based learning. These findings indicate that innovative learning models are essential for strengthening scientific literacy competencies (Alfiah et al., 2025; Khairrunisa et al., 2025; Nurdiansyah et al., 2026; A. J. H. Putri et al., 2025). Socio-scientific issues (SSI) are authentic and controversial contexts that promote scientific reasoning, argumentation, and evidence-based decision making and have also been reported to improve scientific literacy, critical thinking, and scientific argumentation across various science learning designs (Dalaila et al., 2022; Nurhalimah et al., 2024; Viehmann et al., 2024; Yani & Afrianis, 2022; Zeidler et al., 2019). Recent evidence also indicates that socio-scientific issues (SSI) learning not only promotes scientific reasoning but also significantly improves students' critical thinking skills when integrated into science instruction (Dusturi et al., 2024). A major gap in the Indonesian curriculum is that the learning process often fails to fully integrate scientific knowledge (cognitive) with values (affective) and social skills (psychomotor). Traditional teaching models tend to neglect the ethical and social dimensions, which are key to scientific literacy as measured by PISA.

To address these complex scientific literacy challenges, this study adheres to a comprehensive framework. Graber et al. (2001) developed a scientific literacy model into three core aspects that must be integrated: 1) What do people know: Relating to the mastery of scientific knowledge (factual and conceptual content); 2) What do people value: Relating to a person's ability to have ethics and morals related to science, which encourages reflection and value-based decisions; and 3) What can people do: Includes procedural skills (doing science), communication skills, learning skills, and social participation in scientific issues (Holbrook et al., 2022; Wijaya et al., 2023). Graber et al. (2001) scientific literacy model is presented in Figure 1.

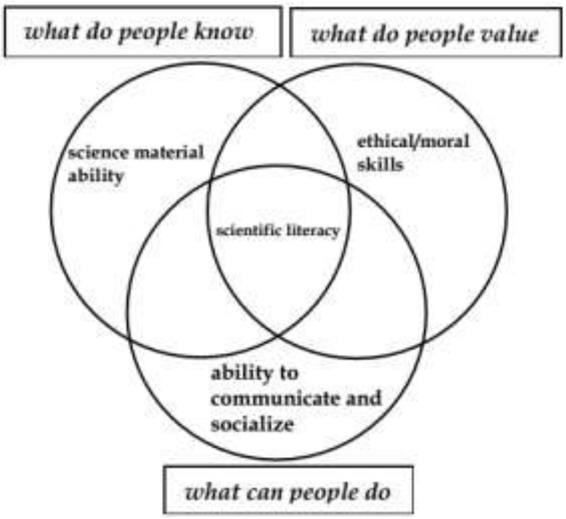

Figure 1. Graber et al.'s (2001) literacy model (Wijaya et al., 2023)

Graber's model provides a clear blueprint for which aspects of scientific literacy need improvement in Indonesia. Based on this framework, teachers can address the "What do people know" aspect (science material competence) by teaching comprehensive science materials. Meanwhile, the "What do people value" aspect (ethics or morals) can be addressed by integrating religious values related to science materials. This integration is crucial because religion often serves as a basic norm that serves as a guide for human behavior, particularly regarding morality and ethics in the context of the environment and technology. Integrating ethical and religious perspectives into science education can strengthen students' moral reasoning and scientific argumentation when discussing socio-scientific issues and may also improve literacy related to ethical and religious decision making (Erduran et al., 2022; Navilah et al., 2024; Rahmatika et al., 2022; Zarkasih et al., 2023). In the Indonesian context, which upholds religious values, linking science to a religious moral framework can strengthen the acceptance and ethical relevance of scientific content (Erduran et al., 2022).

The third aspect, namely what people can do related to scientific procedures, communication skills, learning, and socialization, requires the support of a learning model that can accommodate the development of these skills explicitly and structured. The main gap addressed by this research is that available learning models have not effectively integrated Graber's three aspects (Knowledge, Values, Action) simultaneously and within a Socio-Scientific Issues framework that is sensitive to the Indonesian context. Recent studies have shown that learning tools integrating socio-scientific issues are valid and practical for classroom implementation. However, these instructional designs mainly emphasize contextual and cultural dimensions and have not explicitly integrated religious values into a comprehensive scientific literacy framework. This condition indicates the need for a more holistic learning model that simultaneously develops scientific knowledge, values, and scientific action (Arifin et al., 2024)

Therefore, researchers identified the Reading, Finding, Discussing & Talking (RFDT) Model as an innovative solution with linear and potential stages. The RFDT Model is designed to increase student engagement and understanding through four main steps (Siswati et al., 2024): Reading: Reading socio-scientific texts or issues to build prior knowledge (What do people know), Finding: Finding and collecting scientific evidence or data relevant to the issues read (procedural skills), Discussing: Discussing to analyze issues from various perspectives (social and cognitive skills), Talking: Speaking or communicating, where students present results, argue, and reflect on ethical/value dimensions (What can people do and What do people value). Similar reading-oriented instructional models have also demonstrated positive effects on scientific literacy because they encourage students to read, formulate questions, and construct evidence-based answers (Ainin et al., 2026). Scientific argumentation is a core practice in science education because it supports evidence-based reasoning, communication, and critical thinking (Erduran et al., 2022). This learning process is consistent with previous findings that activities involving questioning, analysing, discussing, and communicating ideas effectively enhance higher-order thinking skills and scientific literacy simultaneously (Irdalisa et al., 2024; Santoso et al., 2026).

Based on the reasons that have been explained, including the low PISA scores, the need for integration of SSI and values, and the potential of the RFDT Model in bridging the three aspects of Graber's scientific literacy, the effort to develop an RFDT learning model that is integrated with socio-scientific issues and Islamic values is very important and significant. This model, which has never been found before, is expected to be a pedagogical solution that not only improves conceptual understanding, but also fosters character and ethical decision-making skills. With the background that has been explained, the objectives of this study are: Develop and test the effectiveness of the Reading, Finding, Discussing & Talking (RFDT) learning model that is integrated with socio-scientific issues and Islamic values to improve students' scientific literacy skills.

Recent instructional innovations supported by educational technology have also been shown to improve students' scientific literacy and critical thinking, while SSI-integrated project learning also supports students' digital literacy. This finding suggests that learning innovation plays an important role in strengthening scientific literacy in science education (Fatih et al., 2024; Purwianingsih et al., 2025; Subiantoro et al., 2021). Previous studies have demonstrated that appropriately designed science learning models can significantly improve students' scientific literacy. Therefore, developing innovative learning models remains one of the most promising strategies for improving science learning outcomes (Lestari et al., 2020).

The contribution of this important study is to present a culturally sensitive curriculum framework, which is theoretically assumed to be able to improve all three dimensions of scientific literacy simultaneously in the Indonesian educational context. Based on the reasons that have been explained, including the low PISA scores, the need for integration of SSI and values, and the potential of the RFDT Model in bridging the three aspects of Graber's scientific literacy, efforts to develop an RFDT learning model that is integrated with socio-scientific issues and Islamic values are very important and significant. This model is expected to be a pedagogical solution that not only improves conceptual understanding, but also fosters character and ethical decision-making abilities. With the background that has been explained, the objectives of this study are: Develop and test the effectiveness of the Reading, Finding, Discussing & Talking (RFDT) learning model that is integrated with socio-scientific issues and Islamic values to improve students' scientific literacy skills. The contribution of this study is to present a culturally sensitive curriculum framework, which is theoretically assumed to be able to improve all three dimensions of scientific literacy simultaneously in the context of Indonesian education.

The aim of this research, which is also a novelty, is to develop an effective teaching model to improve scientific literacy. The specific objectives of this research are to describe the resulting development model, determine its validity, and determine its effectiveness in improving scientific literacy.

Method

This type of research is field research. It employs a research and development approach, utilizing the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model developed by Dick and Carry. The ADDIE model provides a systematic framework for designing learner-centered instruction through the stages of analysis, design, development, implementation, and evaluation, thereby facilitating the development of effective learning experiences (Almelhi, 2021). The product resulting from the development in the form of a teaching model was then tested using a quantitative approach to test the hypothesis in order to determine its effectiveness (Sugiyono, 2021).

The research stages followed the ADDIE development model, which consists of five systematic phases—Analysis, Design, Development, Implementation, and Evaluation—for developing and validating educational products (Adeoye et al., 2024; Li et al., 2024). An overview of the research stages to be implemented is presented in Figure 2.

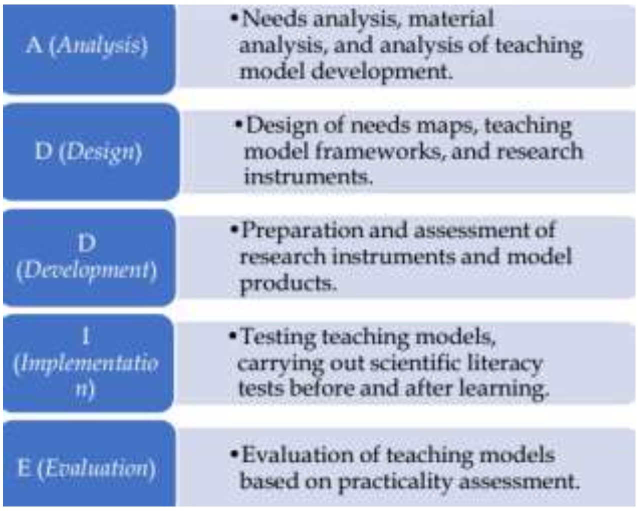

Figure 2. ADDIE development model

The trial was conducted using a Pretest Posttest Control Group Design research design in two classes, namely the control and experimental classes (Sugiyono, 2021). The trial design can be seen in Table 1. Table 1. Research Design Pretest Posttest Control Group Design classes (Sugiyono, 2021). The trial design can be seen in Table 1.

Table 1. Research Design Pretest Posttest Control Group Design

Group	Pretest	Treatment	Posttest
Control class	T1	Xa	T2
Experimental class	T1	Xb	T2

Information: Xa = Learning using conventional teaching models; Xb = Learning using the developed teaching model; T1 = Results of the science literacy test before learning; T2 = Results of the science literacy test after learning.

The research was conducted at SMP N 2 Kajen, Pekalongan Regency. The study was conducted in the odd semester of the 2025/2026 academic year. The population was grade VII students of SMP N 2 Kajen, Pekalongan Regency. The sample consisted of classes VII E and VII F. The sample was selected using a simple random sampling technique (Sugiyono, 2021).

Data collection techniques for product validity data were conducted using a mixed questionnaire technique with a questionnaire sheet instrument. Data collection techniques for science literacy were conducted using a test technique with a written question instrument. Meanwhile, data collection techniques for product practicality were conducted using a closed questionnaire technique with a questionnaire sheet instrument.

The validity test of the scientific literacy questions was carried out in two ways, namely content validity was carried out by reviewing the instrument by experts, and empirical validity was carried out using the Pearson product moment correlation formula with the help of the SPSS program. The product moment correlation formula with raw numbers is written in equation (1).

$$r_{xy} = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{\{N\sum X^2 - (\sum X)^2\}\{N\sum Y^2 - (\sum Y)^2\}}} \quad (1)$$

Information:
r_{xy} : correlation coefficient between X and Y
N : number of test participants
X : total item scores
Y : total score
X^2 : sum of squares of item scores
Y^2 : sum of the squares of the total score

Items with statistically significant Pearson correlation coefficients ($p < 0.05$) were considered valid (Akoglu, 2018).

The reliability of the scientific literacy questions was tested by calculating Cronbach's Alpha. Reliability testing is performed to measure the consistency of the research instrument. Reliability testing is performed by calculating Cronbach's Alpha using SPSS. The instrument was considered reliable if Cronbach's alpha was ≥ 0.70 (Sijtsma et al., 2021). The formula for calculating the reliability coefficient is written in equation (2).

$$r_{11} = \left[\frac{k}{k-1}\right]\left[1 - \frac{\sum\sigma^2 b}{\sigma^2 t}\right] \quad (2)$$

Information:
r_{11} = alpha reliability coefficient
k = number of question items
$\sum\sigma^2 b$ = number of grain variants
$\sigma^2 t$ = total variance

The validation results of the teaching model and module were analyzed using a five-point scale. The resulting teaching model and module were deemed feasible if they scored at least in the good category. Validation results included scores and notes or feedback. The average product assessment score was calculated using a five-point Likert scale, which provides an appropriate level of reliability and discrimination for educational measurement (Aybek et al., 2022). The resulting mean scores were then interpreted using predefined categories: Very Good, Good, Sufficient, Poor, and Very Poor. The categorization of the assessment scores for the teaching model devices is presented in Table 2.

Table 2. Conversion of Product Validation Scores by Validator

Mark	Score Interval	Category
A	4.05 < X	Very good
B	3.35 < X ≤ 4.05	Good
C	2.65 < X ≤ 3.35	Enough
D	1.95 < X ≤ 2.65	Poor
E	X ≤ 1.95	Very poor

Information: M = Mean (average); M = $\frac{1}{2}$ (Ideal maximum score + Ideal minimum score); S = Standard deviation; S = $\frac{1}{6}$ (Ideal maximum score − Ideal minimum score); X = Actual score.

Learning implementation data on the observation sheet was analyzed using percentage analysis techniques to measure the level of implementation of each activity indicator. The implementation percentage was interpreted using predetermined criteria: 81–100% (Very Well Implemented), 61–80% (Well Implemented), 41–60% (Moderately Implemented), 21–40% (Poorly Implemented), and 0–20% (Very Poorly Implemented) as shown in Table 3.

Table 3. Categorization of Percentage of Learning Implementation

Percentage (%)	Category
81–100	Very well implemented
61–80	Well implemented
41–60	Moderately implemented
21–40	Poorly implemented
0–20	Very poorly implemented

The categorization in Table 3 is used to assess the extent to which each activity component has been implemented according to the established indicators. Using this technique, observation data can be systematically processed, providing an empirical picture of which aspects are optimal and which still require improvement.

Data analysis on improving scientific literacy was conducted descriptively and inferentially. Descriptive data analysis was conducted using normalized gain data. The normalized gain calculation was obtained using the Hake (1998) formula written in equation (3).

$$\text{gain} = \frac{T2 - T1}{Is - T1} \quad (3)$$

Information:
T1 = Pretest score
T2 = Post-test scores

Is = Maximum pretest or posttest score

The normalized average gain data obtained from the control and experimental classes were then compared and categorized into low, medium, or high. The average gain value categories according to Hake are presented in Table 4.

Table 4. Categorization of Student Gain Scores

Interval	Category
0.70 = (g)	High
0.30 = (g) < 0.70	Medium
(g) < 0.30	Low

The average normalized gain value obtained is then converted into a percent scale (%). The estimated effectiveness categories of normalized gain according to Hake are presented in Table 5.

Table 5. Categorization of Normalized Gain Effectiveness Estimates

Percentage (%)	Interpretation
< 40	Ineffective
40-55	Less effective
56-75	Moderately effective
>76	Effective

Inferential data analysis was conducted to test the research hypothesis. The test used was an independent sample t-test on normalized gain data for both variables (Darmawan et al., 2020).

The gain score of students' scientific literacy skills was analyzed using the t-test using the SPSS 26 program. The purpose of the t-test was to determine the significance of the difference between the increase in scientific literacy skills of the control class and the experimental class.

The null hypothesis (Ho) and alternative hypothesis (Ha) in this study are:

H_0 : There was no significant difference in the improvement of scientific literacy skills between classes using the RFDT learning model containing socio-scientific issues and Islamic values and the conventional learning model.

H_a : There is a significant difference in the improvement of scientific literacy skills between classes using the RFDT learning model containing socio-scientific issues and Islamic values and the conventional learning model.

Acceptance or rejection of Ho can be seen through probability (significance), namely if the probability > 0.05 then Ho is accepted, and vice versa if the probability (significance) ≤ 0.05 then Ho is rejected.

Result and Discussion

Analysis

At this stage, researchers analyze the need to develop a teaching model and analyze its feasibility and development requirements. The analysis stages include two aspects: needs analysis and curriculum analysis.

The needs analysis was conducted by analyzing the level of scientific literacy skills and the availability of teaching models. Based on a preliminary study, students' scientific literacy skills were generally low. Regarding the availability of teaching models, there were no learning models that included socio-scientific issues and Islamic values. Based on the results of this needs analysis, the researchers felt the need to develop an RFDT learning model containing socio-scientific issues and Islamic values to improve scientific literacy.

The curriculum analysis was conducted by considering the suitability of the teaching model to be created with the curriculum implemented in schools, namely the independent curriculum. Based on the results of the analysis of the contents of the independent curriculum, the appropriate material to be implemented using the developed teaching model is the Ecology and Biodiversity of Indonesia material, in the sub-material "How Does the Environment Influence an Organism?" This material has a learning outcome, namely "students identify interactions between living things and their environment, and can design efforts to prevent and overcome pollution and climate change." Based on the results of the curriculum analysis, the developed teaching model is directed towards achieving these learning outcomes.

Design

Based on the results of the analysis that has been carried out previously, the next stage of design is carried out by determining the elements required in the teaching model and the instruments used to validate the teaching model that has been developed.

The design of the teaching model components consists of: (a) Rationale for Model Development; (b) Theoretical and Empirical Basis; (c) Model Objectives; (d) Syntax Design; (e) The Role of Teachers and Students; (f) Social System and the Principle of Reaction; (g) Support System (Media, Learning Resources); (h) Conformity with the Curriculum

The teaching model assessment sheet is prepared by considering the assessment aspects of the teaching model, namely the construction of the learning model, the appropriateness of the content, and the appropriateness of the presentation. The scientific literacy test design is based on the 2023 Organisation for Economic Co-operation and Development (OECD) indicators presented in Table 6.

Table 6. Science Literacy Indicators

Indicator
Ability to explain phenomena scientifically
Ability to interpret data and evidence scientifically
Evaluate and design scientific investigations

Open modules were developed to implement the learning model into instruction. General module components include information, initial competencies, Pancasila student profiles, facilities and infrastructure, student targets, learning models, learning outcomes, learning objectives, criteria for achieving learning objectives, understanding meaning, prompting questions, learning activities, assessments, enrichment and remedial learning, a glossary, and a bibliography.

A questionnaire sheet was used to collect student responses to the developed teaching model. The indicators for the questionnaire sheet included aspects of the model's attractiveness, ease of understanding, meaningfulness of learning, involvement and activity, and usefulness of the model.

Development

The development stage is the stage of realizing the product design and research instruments that were designed at the Design stage. The teaching model resulting from the development is shown in Table 7.

Table 7. Teaching Model Syntax Product

Stage	Activity
Reading	The teacher divides students into several groups; The teacher prepares science reading materials for students to read; Students read and study the prepared materials.
Finding	The teacher directs students to explore the internet through credible sources.
Discussing	The teacher directs students to discuss to explore and analyze the perspectives of the relationship between science material, socio-scientific issues, and Islamic values.
Talking	Students present the results of their discussions; Students receive feedback from other groups; The teacher confirms and draws conclusions.

The summary of the results of the validation of the teaching model by experts after being converted referring to Table 2 is presented in Table 8.

Table 8. Validation Results Score of Teaching Model by Validator

Expert I	Expert II	Expert III	Expert IV	Average
4.5	3.8	4.6	4.5	4.35

The validator's notes and input on the developed learning model serve as the basis for final revisions before implementation. These revisions aim to improve the developed learning model and align it with its development objectives.

The differences between the guidelines before and after revision according to input from the validator are shown in Table 9.

Table 9. Revision of the Teaching Model Guidelines

Before	After
The theoretical basis needs to be supplemented.	The theoretical basis of the teaching model has been supplemented.
The teaching model guidelines do not provide examples of Quranic verses related to the material.	The teaching model guidelines provide examples of Quranic verses related to the material.
The teaching model guidelines have not included teaching materials.	The teaching model guidelines have been supplemented with teaching materials.
The teacher's role in the model has not been explained in detail.	The teacher's role in the model has been explained in detail.
Student activities in the model have not been explained in detail.	Student activities in the model have been explained in detail.

The results of filling in the observation sheet for the implementation of the teaching module can be seen in Table 10. The percentage data for the learning implementation score presented in Table 10, according to the categorization in Table 3, falls into the very well implemented category. The validation results for the teaching module obtained a score of 4.53. The validator's notes and input on the research instrument are presented in Table 11.

Table 10. Results of Completing the Learning Implementation Observation Sheet

Observer I	Observer II	Average	Category
83%	83%	83%	Very well implemented

Table 11. Teaching Module Notes

Instrument	Notes
Teaching Module	The teaching module meets the eligibility criteria, including content, presentation, graphics, and language. However, improvements are needed in the terminology of core competencies (KI/KD) and learning indicators.

Implementation

The implementation phase is the application of the research instruments and teaching models that have been developed. The implementation phase consists of implementing the developed learning model, completing scientific literacy questions, and completing a student response questionnaire. The following data shows the scores obtained from the scientific literacy questions before and after using the developed teaching model, as well as the data obtained from the student response questionnaire.

The scores obtained from the scientific literacy questions in the pre-learning and post-learning stages of the control class are presented in Table 12.

Table 12. Science Literacy Score Achievement of Control Class

Students	Pretest Score	Postest Score	N Gain
1	70	65	-0.17
2	45	50	0.09
3	50	65	0.30
4	75	65	-0.40
5	25	25	0.00
6	50	45	-0.10
7	65	55	-0.29
8	45	55	0.18
9	50	60	0.20
10	35	35	0.00
11	40	55	0.25
12	50	60	0.20
13	65	60	-0.14
14	55	65	0.22
15	50	50	0.00
16	55	55	0.00
17	55	60	0.11
18	45	50	0.09
19	45	60	0.27
20	45	45	0.00
21	45	40	-0.09
22	50	50	0.00
23	50	35	-0.30
24	40	65	0.42
Average	50	53	0.04

The data obtained from the results of working on scientific literacy questions in the pre-learning and post-learning experimental classes are presented in Table 13. Data from the student response questionnaire is needed to determine the practicality of the developed teaching model and its acceptance of the learning process. Data from the respondent response questionnaire can be seen in Table 14.

Table 13. Scientific Literacy Score Achievement of Experimental Class

Students	Pretest Score	Postest Score	N Gain
1	45	50	0.09
2	25	40	0.20
	30	55	0.36
4	45	40	-0.09
5	30	45	0.21
6	60	60	0.00
7	55	45	-0.22
8	50	40	-0.20
9	35	55	0.31
10	50	65	0.30
11	55	55	0.00
12	20	40	0.25
13	40	45	0.08
14	35	35	0.00
15	50	45	-0.10
16	25	35	0.13
17	45	55	0.18
18	40	35	-0.08
19	50	40	-0.20
20	60	60	0.00
21	50	55	0.10
22	65	60	-0.14
23	20	40	0.25
24	45	40	-0.09
Average	43	47	0.06

Table 14. Results of Student Response Questionnaire on Teaching Models

Respondents	Score	Category
1	2.93	Sufficient
2	3.07	Sufficient
3	3.40	Good
4	3.00	Sufficient
5	4.20	Very good
6	2.53	Poor
7	3.13	Sufficient
8	4.47	Very good
9	2.73	Sufficient
10	4.00	Good
11	3.40	Good
12	3.27	Sufficient
13	4.40	Good
14	3.47	Good
15	4.27	Very good
16	3.27	Sufficient
17	3.53	Good
Average	3,47	Good

The developed scientific literacy questions were validated using two methods: expert validity and item validity. The scientific literacy questions obtained a score of 4.4, which, according to the 5-point scale category in Table 2, falls into the very good category.

Based on the content validity test, the questions used by the researchers to collect data on scientific literacy skills were obtained using five questions that were declared valid based on the results of the content validity test. Due to time constraints, the scientific literacy questions were not tested for reliability.

Validity of Teaching Modules

The validation results for the teaching module obtained an average score of 4.53. This score, when categorized on a scale of 5, as presented in Table 2, falls into the very good category.

Validity of the Teaching Model

The results of the validation of the teaching model with experts, as presented in Table 8, obtained an average score of 4.35. This score, if categorized on a scale of 5, as presented in Table 2, is included in the very good category.

Science Literacy Ability Score

The results of students' work on scientific literacy questions are presented in Figure 3.

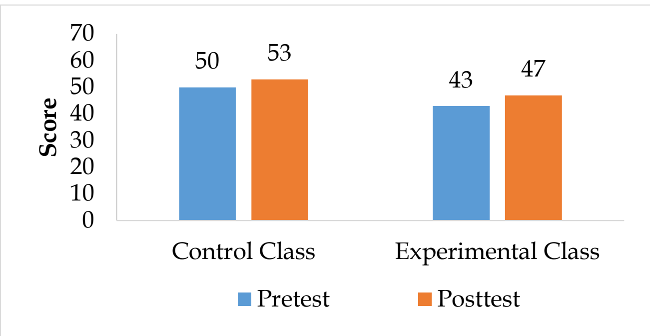

Figure 3. Bar Chart of Mean Pretest and Posttest Scores for Science Literacy

Based on Figure 3, the average score before learning did not differ significantly, with an average of 50 in the control class and 43 in the experimental class. The post-learning score in the control class was 53, while in the experimental class it was higher, at 47.

The normalized gain value of the science literacy ability scores before and after the learning was then calculated. The normalized gain value is an indicator of the improvement of students' science process skills. The average normalized gain value obtained was then converted into a percent scale (%) by multiplying by 100. Hake (2007) explains the interpretation categories of the normalized gain percentage into 4 categories, namely ineffective, less effective, quite effective and effective as presented in Table 5. The control class's score gain achievement was 4% and was included in the ineffective category, while the experimental class's score gain was 6% and was also included in the ineffective category. The achievement of the control and experimental class's score gain percentage can be seen in Figure 4.

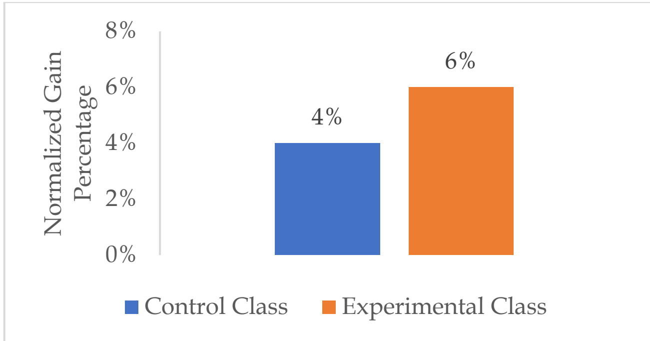

Figure 4. Bar Chart of Normalized Mean Gain of Science Literacy Score

Figure 4 shows that the level of effectiveness in achieving an increase in students' scientific literacy scores in the experimental class was higher than in the control class.

Inferential analysis was conducted by first conducting a prerequisite test, namely a normality test using the Shapiro-Wilk test. The results of the normality test are presented in Table 15.

Table 15. Results of the Normality Test of Science Literacy Scores

Data	Probability (Significance)	(p) Sig.	Description
Control class	0.768	$p > 0.05$	Normal
Experimental class	0.337	$p < 0.05$	Normal

Based on Table 15, the significance value obtained from the analysis of the control class's science literacy score data was 0.768, which means it is greater than 0.05 (Sig > 0.05), so it is concluded that the data is normally distributed. Meanwhile, the analysis of the experimental class's science literacy score data was 0.337, which means it is greater than 0.05 (Sig > 0.05), so it is concluded that the data is not normally distributed.

The second prerequisite test is the homogeneity test, which is conducted using Levene's test. The results of the homogeneity test are presented in Table 16.

Table 16. Results of the Homogeneity Test of Science Literacy Scores

Data	Probability(Significance)	(p) Sig.	Description
Scientific literacy score	0.670	$p > 0.05$	Homogeny

Based on Table 16, the significance value obtained from the analysis results is greater than 0.05 (Sig > 0.05) so it can be concluded that the nutritional awareness score data is homogeneous.

Hypothesis testing was conducted using a t-test. The t-test was conducted to examine the difference in gains between the control and experimental classes. The results of the t-test for science literacy scores can be seen in Table 17.

Table 17. Results of the Hypothesis Test on Science Literacy Score Gain

Data	(p) Sig
Scientific literacy score	0.706

Based on Table 17, the Sig. value (0.706) is greater than 0.05 (Sig > 0.05) so Ho is accepted so it is concluded that there is no significant difference between the gain scores of scientific literacy students in the control and experimental classes.

Evaluation

The evaluation stage involves analyzing the strengths and weaknesses of the developed teaching model. The primary evaluation material is student input regarding the implementation of the teaching model, as well as suggestions and input from experts.

Effectiveness of Models on Scientific Literacy

The results of the quantitative analysis indicate that the increase (N-gain) in scientific literacy skills in the experimental class (using the RFDT model) was descriptively higher than that in the control class (using the direct/conventional model). However, a key finding that needs to be underlined is that, based on the results of inferential tests (e.g., t-tests), there was no statistically significant difference between the improvement scores of the two groups. This leads to the conclusion that, although the RFDT model appears to be practically superior (on average), the difference in scientific literacy improvement between the two classes is still relatively equal at the tested confidence level. This phenomenon requires in-depth exploration regarding contextual and methodological factors that may limit the ability of statistical tests to detect the impact of the intervention (Hake, 1998; Sugiyono, 2019).

The inability of statistical tests to detect significant differences, despite the higher N-gain of the experimental class, can be interpreted through several implementation barriers. First, it relates to the excessively short duration of the RFDT model. The Reading, Finding, Discussion, and Talking model demands changes in students' mindsets and learning habits. The discussion and talking stages, in particular, require time to develop adequate scientific argumentation and scientific communication skills. This lack of time means students are not yet fully comfortable or proficient in expressing ideas and arguing based on evidence, so the model's optimal potential is not fully captured in post-test measurements. Second, the main problem lies in students' readiness for new approaches involving socio-scientific issues and Islamic values. The process of value internalization and analysis of controversial issues requires a longer cognitive and affective adaptation period to truly impact complex scientific literacy domains, such as evaluation and ethical reasoning skills (Edelsbrunner et al., 2024).

These findings are further supported by the theoretical framework that the effectiveness of learning interventions is highly dependent on consistent implementation and external factors. Theoretically, the RFDT model aligns with a constructivist pedagogical framework that has the potential to improve students' scientific literacy. Erduran et al. (2022) explain that the integration of science education with religious values (or morally charged values) can significantly strengthen students' argumentation skills and help them understand science in a broader moral and social context, an important component of scientific literacy. Furthermore, Viehmann et al. (2024) emphasized that the use of Socio-Scientific Issues (SSI) in science learning empirically encourages students to think critically, enhances contextual understanding, and connects scientific concepts to real-life applications. These theoretical principles support the potential of RFDT, but suboptimal performance in this study indicates that its implementation in practice does not fully meet its ideal theoretical assumptions (Trianto, n.d.), particularly regarding consistency and duration. Similar findings have also been reported in Indonesian classrooms where SSI-based learning significantly improves students' scientific literacy (Khairrunisa et al., 2025; Nur Azizah et al., 2021; Sukmawati et al., 2026).

The results of this study, which showed the potential of the new model (RFDT) but lacked statistical significance compared to the conventional model, align with a number of findings from the early stages of implementing educational innovations. Previous studies have shown that science learning approaches should first support students in developing a strong understanding of scientific concepts before engaging them in complex socio-scientific reasoning and argumentation (Viehmann et al., 2024). Therefore, the difference in improvement between contextual RFDT and structured direct models may not be statistically significant over a short period of time. Recent reviews indicate that SSI-based learning improves scientific reasoning, decision-making, and scientific literacy when implemented consistently over sufficient instructional time, including through guided inquiry-based SSI learning (Puspitasari et al., 2026; Viehmann et al., 2024). These differences reinforce the notion that intervention duration and facilitator/student adaptation are key differentiating factors between the results of this study and other successful SSI studies.

The main novelty of this study lies in the development and testing of an RFDT model that explicitly integrates SSI with Islamic values. Existing models, such as those discussed by Viehmann et al. (2024), generally focus on secular SSI. This study fills this gap by presenting a framework in which science-based decision-making is reinforced by an ethical and religious framework relevant to the context of Muslim learners in Indonesia. Although statistical significance has not been achieved, the finding of a higher N-gain descriptively provides initial evidence that the addition of the Finding element and the integration of Islamic values (in the form of talking from a moral perspective) in this model has the potential to be more effective in practice than direct instruction in fostering higher dimensions of scientific literacy attitudes and applications Culturally responsive SSI instruction has been shown to support scientific literacy, ethical reasoning, and citizenship education (Viehmann et al., 2024; Zeidler et al., 2019)

It should be acknowledged that this study has several limitations that may affect the inferential test results. The main factor is the small sample size (N). The number of students in the study sample was only 24 in the control class and 24 in the experimental class, which is well below the recommended threshold for a robust parametric statistical test. The limited statistical power of a sample of this size means that only relatively large intervention effects can be detected with adequate confidence (Lakens, 2022). Moderate intervention effects, which may have been generated by RFDT, tended to fall short of the significance threshold. Another limitation is that teachers or researchers, acting as facilitators, were still adapting to the model. The model's effectiveness is heavily influenced by teachers' skills in managing the learning phases, and these initial adjustments may have reduced the effectiveness of the RFDT model's implementation (Trianto, 2011). Edelsbrunner et al. (2024) asserts that non-significant results are often a reflection of design limitations, not the ineffectiveness of the intervention.

Despite the statistical limitations, the finding of a descriptively superior N-gain in the experimental class provides important practical implications. First, Practical Implications: The RFDT model still has strong potential for use in science learning, provided it is implemented over a longer period (e.g., a full semester) and supported by adequate teacher training to master the issue-based discussion phase and flexible value integration. Second, Theoretical Implications: these results reinforce the view that scientific literacy involves more than content mastery; it also requires the development of scientific reasoning, argumentation, decision-making, and positive attitudes toward science, which generally require sustained learning experiences to develop effectively (Badeo et al., 2022). It is recommended that further research using long-term quasi-experimental or mixed-methods designs be conducted to validate the practical effects of RFDT and measure changes in more subtle dimensions of scientific literacy, such as moral and ethical reasoning, which are at the heart of this model.

Conclusion

The development of the RFDT model, incorporating socio-scientific issues and Islamic values, was conducted through R&D with the ADDIE model, resulting in a learning model based on the syntax of Reading, Discovering, Discussing, and Speaking. This model was validated by experts and science teachers with a score of 4.5 (very good), making it suitable for use. Descriptively, scientific literacy in the experimental class was higher than in the control class, but inferentially, there was no significant difference in scientific literacy between the two classes. The novelty of this model lies in the integration of socio-scientific issues and Islamic values into the developed teaching model. This integration links the model with scientific literacy indicators, thus contributing to improving the scientific literacy skills of Indonesian students, which are still relatively low. Through the developed model, this research has direct implications for science teachers, encouraging them to utilize this learning model, which is expected to also contribute to improving the scientific literacy of the students they teach. Time constraints have hampered the long-term implementation of the RFDT learning model, resulting in suboptimal student adaptation to the learning syntax. The limited number of research subjects also hinders broad generalization of the results, necessitating testing on more diverse samples and school contexts. Furthermore, the involvement of teachers as implementers and researchers has the potential to introduce bias, while model validation is still dominated by expert judgment and lacks extensive empirical testing at various educational levels. Recommendations for future researchers include conducting further research involving a larger sample size, a longer implementation period, or different school contexts to obtain more comprehensive results regarding the effectiveness of the RFDT model integrated with religious values and contextual issues. The study could also be expanded by adding other variables, such as scientific argumentation skills or attitudes toward science, to enrich the findings.

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Author Contributions
Conceptualization, methodology, and data collection Z.A.; validation of Islamic values and data and administration requirements D.R.; data and administration A.O.

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Conflicts of Interest
The authors declare no conflict of interest.

References

Adeoye, M. A., Wirawan, K. A. S. I., Pradnyani, M. S. S., & Septiarini, N. I. (2024). Revolutionizing education: Unleashing the power of the ADDIE model for effective teaching and learning. *JPI (Jurnal Pendidikan Indonesia)*, *13*(1), 202–209. https://doi.org/10.23887/jpiundiksha.v13i1.68624

Afriandi, M., Widiyatmoko, A., & Astuti, B. (2025). Development of Booklets Integrated with Islamic Values Based on Socio-Scientific Issues to Improve Science Literacy. *Journal of Natural Science and Integration*, *8*(1 SE-Articles), 37–46. https://doi.org/10.24014/jnsi.v8i1.28782

Ahdiat, A. (2024, January). Kemampuan Sains Pelajar Indonesia Peringkat ke-6 ASEAN. *Databoks.Katadata.Co.Id*.

Ainin, Y. H. Q., Sa'adah, S., & Mas'ud, A. (2026). The Effectiveness of the Padlet-Assisted RQA Model on Scientific Literacy in the Ecosystem Material Integrated With Islamic Values. *Journal of Educational Sciences*, *10*(6 SE-Articles), 645–659. https://doi.org/10.31258/jes.10.6.p.645-659

Akoglu, H. (2018). User's guide to correlation coefficients. *Turkish Journal of Emergency Medicine*, *18*(3), 91–93. https://doi.org/10.1016/j.tjem.2018.08.001

Alfiah, M. H., Bramastia, & Sukarmin. (2025). Literature Review: The Impact of Project Based Learning on Scientific Literacy in Secondary Education. *Jurnal Penelitian Pendidikan IPA*, *11*(1 SE-Review), 1–9. https://doi.org/10.29303/jppipa.v11i1.8616

Almelhi, A. M. (2021). Effectiveness of the ADDIE model within an E-learning environment in developing creative writing in EFL students. *English Language Teaching*, *14*(2), 20–36. https://doi.org/10.5539/elt.v14n2p20

Arifin, A. A., Ramdani, A., & Andayani, Y. (2024). Development of Learning Tools Based on the Culturally Responsive Transformative Teaching Model with a Socio-Scientific Issues Approach : Evaluation of Validity and Practicality. *Jurnal Penelitian Pendidikan IPA*, *10*(11), 9141–9155. https://doi.org/10.29303/jppipa.v10i11.9188

Ashidiq, R. M., Amri, M. F., Rahmat, A., Winarno, N., & Hamdiyati, Y. (2024). Students' Perceptions of Socio-Scientific Issues in Biology Education: A Case Study in Indonesia. *Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah*, *9*(2 SE-Articles), 359–376. https://doi.org/10.24042/tadris.v9i2.20896

Aybek, E. C., & Toraman, C. (2022). How many response categories are sufficient for Likert type scales? An empirical study based on the Item Response Theory TT - How many response categories are sufficient for Likert type scales? An empirical study based on the Item Response Theory. *International Journal of Assessment Tools in Education*, *9*(2), 534–547. https://doi.org/10.21449/ijate.1132931

Badeo, J. M., & Duque, D. A. (2022). The effect of Socio-Scientific Issues (SSI) in teaching science: A meta-analysis study. *Journal of Technology and Science Education*, *12*(2), 291. https://doi.org/10.3926/jotse.1340

Dalaila, I., Widiyaningrum, P., & Saptono, S. (2022). Developing E-Module Based on Socio-Scientific Issues to Improve Students Scientific Literacy. *Journal of Innovative Science Education*, *11*(3 SE-Articles). https://doi.org/10.15294/jise.v10i1.54500

Darmawan, W., Kuswandi, D., & Praherdhiono, H. (2020). Pengaruh Blended Learning Berbasis Flipped Classroom Pada Mata Pelajaran Prakarya Terhadap Hasil Belajar Siswa Kelas X SMK. *Edcomtech Jurnal Kajian Teknologi Pendidikan*, *5*(2), 170–179. https://doi.org/10.17977/um039v5i22020p170

Dawson, C., Julku, H., Pihlajamäki, M., Kaakinen, J. K., Schooler, J. W., & Simola, J. (2024). Evidence-based scientific thinking and decision-making in everyday life. *Cognitive Research: Principles and Implications*, *9*(1), 50. https://doi.org/10.1186/s41235-024-00578-2

Dusturi, N., Nurohman, S., & Wilujeng, I. (2024). Socio-Scientific Issues (SSI) Approach Implementation in Science Learning to Improve Students' Critical Thinking Skills: Systematic Literature Review. *Jurnal Penelitian Pendidikan IPA*, *10*(3 SE-Review), 149–157. https://doi.org/10.29303/jppipa.v10i3.6012

Edelsbrunner, P. A., & Leucht, M. (2024). When is a non-significant result not a null result? An educational psychology perspective. *Educational Research Review*, *41*, 100552. Retrieved from https://www.research-collection.ethz.ch/bitstreams/34a8f7bc-8cf5-4d4d-8766-9520b6276726/download

Erduran, S., Guilfoyle, L., & Park, W. (2022). Science and Religious Education Teachers' Views of Argumentation and Its Teaching. *International Journal of Science and Mathematics Education*, *52*, 655–673. https://doi.org/10.1007/s11165-020-09966-2

Fadlah, U., Pursitasari, I. D., & Rubini, B. (2024). Needs Analysis to Develop Learning Media Based on Scientific Literacy. *Jurnal Penelitian Pendidikan IPA*, *10*(11), 9846–9852. https://doi.org/10.29303/jppipa.v10i11.9190

Fatih, M., Alfi, C., & Muqtafa, M. A. (2024). Science Learning Game (SLG) Based on Augmented Reality Enhances Science Literacy and Critical Thinking Students Skills. *Jurnal Penelitian Pendidikan IPA*, *10*(2 SE-Research Articles), 973–981. https://doi.org/10.29303/jppipa.v10i2.6107

Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics*, *66*(1), 64–74. https://doi.org/10.1119/1.18809

Holbrook, J., Chowdhury, T. B. M., & Rannikmäe, M. (2022). A Future Trend for Science Education: A Constructivism-Humanism Approach to Trans-Contextualisation. In *Education Sciences* (Vol. 12, Issue 6, p. 413). https://doi.org/10.3390/educsci12060413

Irdalisa, I., Akbar, B., Fuadi, T. M., Maesaroh, M., & Kartikawati, E. (2024). Ricosre Model with Question Formulation Technique (QFT): Enhancing Students' Higher Order Thinking Skills (HOTS) and Science Literacy. *Jurnal Penelitian Pendidikan IPA*, *10*(3 SE-Research Articles), 1175–1178. https://doi.org/10.29303/jppipa.v10i3.6764

Kamila, Wilujeng, I., & Rahmawati, L. (2024). Profile of Science Literacy and Cultural Awareness of Students and the Need for Science Teaching Materials Integrated with Local Potential of STEAM-PBL Based Petis in Sumenep. *Jurnal Penelitian Pendidikan IPA*, *10*(9 SE-Research Articles), 6677–6689. https://doi.org/10.29303/jppipa.v10i9.7578

Khairrunisa, A. N., Yusup, I. R., & Paujiah, E. (2025). Improving students' scientific literacy through a problem-based learning model integrated with socio-scientific issues on ecosystem learning. *Biosfer: Jurnal Pendidikan Biologi*, *18*(2 SE-Articles), 276–289. https://doi.org/10.21009/biosferjpb.55744

Kumar, V., Choudhary, S. K., & Singh, R. (2024). Environmental socio-scientific issues as contexts in developing scientific literacy in science education: A systematic literature review. *Social Sciences & Humanities Open*, *9*, 100765. https://doi.org/10.1016/j.ssaho.2023.100765

Lakens, D. (2022). Sample Size Justification. *Collabra: Psychology*, *8*(1), 33267. https://doi.org/10.1525/collabra.33267

Lestari, H., Setiawan, W., & Siskandar, R. (2020). Science Literacy Ability of Elementary Students Through Nature of Science-based Learning with the Utilization of the Ministry of Education and Culture's "Learning House." *Jurnal Penelitian Pendidikan IPA*, *6*(2 SE-Research Articles), 215–220. https://doi.org/10.29303/jppipa.v6i2.410

Li, R.-Y., & Sun, J. C.-Y. (2024). Identifying key factors of dynamic ADDIE model for instructional virtual reality design: an exploratory study. *Interactive Learning Environments*, *32*(10), 6984–6996. https://doi.org/10.1080/10494820.2023.2296519

Navilah, N., Nurdin, M. A., Cahyanto, T., & Windayani, N. (2024). Pengaruh Pendekatan Socio Scientific Issue dalam Materi Perkembangan Embrio (Balut) untuk Mengetahui Tingkat Literasi Halal Siswa. *Indonesia Journal of Halal*, *8*(1). https://doi.org/10.14710/halal.v8i1.24608

Nur Azizah, D., Irwandi, D., & Saridewi, N. (2021). Pengaruh Model Pembelajaran Problem Based Learning Berkonteks Socio Scientific Issues Terhadap Kemampuan Literasi Sains Siswa pada Materi Asam Basa. *Jurnal Riset Pendidikan Kimia (JRPK)*, *11*(1 SE-Articles), 12–18. https://doi.org/10.21009/JRPK.111.03

Nurdiansyah, D., Ramdany, D., & Saepuzaman, D. (2026). Enhancing Students' Scientific Literacy through Socio-Scientific Issues-Based Project-Based Learning in Physics Education. *Jurnal Pendidikan Fisika*, *14*(2 SE-Articles), 410–428. https://doi.org/10.26618/57rfvs81

Nurhalimah, S., Latip, A., & Purnamasari, S. (2024). Analisis Pendekatan Socio-Scientific Issues (SSI) dalam Pembelajaran IPA terhadap Literasi Saintifik. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, *9*(2), 1987–2000. https://doi.org/10.23969/jp.v9i2.13540

OECD. (2023). *PISA 2022 Results: The State of Learning and Equity in Education*. Paris: OECD Publishing.

Pane, E. P., Lubis, N. F., & Simarmata, G. (2024). Application of Interactive Virtual Lab Media Based on a STEM Approach in Improving Students' Scientific Literacy and Learning Motivation. *Jurnal Penelitian Pendidikan IPA*, *10*(12), 10736–10744.

https://doi.org/10.29303/jppipa.v10i12.8589

Pursitasari, I. D., Permana, I., Jaenudin, D., Suriansyah, M. I., Sumiati, E. S., & Aqilah, S. (2025). Digital Literacy and Scientific Literacy of Science Teachers and Student Learning Styles in Science Learning. *Jurnal Penelitian Dan Pembelajaran IPA*, *11*(1), 26. https://doi.org/10.30870/jppi.v11i1.30532

Purwianingsih, W., Olsiara, L., & Sriyati, S. (2025). The Socio-scientific Issues in PjBL: Impact on Digital Literacy of Senior High School Students. *Jurnal Inovasi Pendidikan IPA*, *11*(1 SE-Articles), 273–283. https://doi.org/10.21831/jipi.v11i1.76924

Puspitasari, T. R., & Ilhami, F. B. (2026). Peningkatan keterampilan literasi sains melalui pembelajaran inkuiri terbimbing berbasis socio scientific issue (SSI) pada materi struktur bumi. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, *11*(02), 249–259. https://doi.org/10.23969/jp.v11i02.48492

Putri, A. J. H., Susilowati, E., & Mulyani, S. (2025). Socio-Scientific Issue Application in the PBL Model: Is that Effective in Improving Chemical Literacy? *Jurnal Inovasi Pendidikan IPA*, *11*(1 SE-Articles), 296–307. https://doi.org/10.21831/jipi.v11i1.77351

Putri, F. A., & Mufit, F. (2023). Analysis of Students' Scientific Literacy on Work and Energy as Well as Momentum and Impulse. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 10583–10589. https://doi.org/10.29303/jppipa.v9i12.5990

Rahmatika, R., Amin, M., Al-Muhdhar, M. H. I., & Suwono, H. (2022). Scientific literacy refinement at Islamic junior high schools using socio-science spirituality learning model . *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *8*(1), 40–50. https://doi.org/10.22219/jpbi.v8i1.18989

Santoso, A. M., Hendarso, S. A., Yuliati, R., Pratama, A. T., Maulina, D., Primandiri, P. R., & Herawati, E. (2026). What motivates students to learn about ecosystems in the socio-scientific issues classroom? *Biosfer: Jurnal Pendidikan Biologi*, *19*(1 SE-Articles), 335–346. https://doi.org/10.21009/biosferjpb.63176

Saputra, W. T., Rustaman, N. Y., & Rusyati, L. (2025). Exploring the Relationship between Logical Reasoning Skills, Scientific Literacy, and Academic Achievement in Science Courses Among Secondary Students: A Mixed Method Study. *Jurnal Penelitian Pendidikan IPA*, *11*(1 SE-Research Articles), 303–315. https://doi.org/10.29303/jppipa.v11i1.9547

Sijtsma, K., & Pfadt, J. M. (2021). Part II: On the Use, the Misuse, and the Very Limited Usefulness of Cronbach's Alpha: Discussing Lower Bounds and Correlated Errors. *Psychometrika*, *86*(4), 843–860. https://doi.org/10.1007/s11336-021-09789-8

Siswati, B. H., & Hariyadi, S. (2024). Effectiveness of RFDT learning based on TPACK framework in improving the critical and creative thinking abilities of prospective biology teacher students. *BIO-INOVED: Jurnal Biologi-Inovasi Pendidikan*, *6*(3), 404–411. https://doi.org/10.20527/bino.v6i3.19563

Subiantoro, A. W., Handziko, R. C., & Wibowo, Y. (2021). A narrative inquiry of socio-scientific issues-based e-learning development in biology to promote student health literacy . *Biosfer: Jurnal Pendidikan Biologi*, *14*(1 SE-Articles), 132–143. https://doi.org/10.21009/biosferjpb.20373

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

Sugiyono. (2021). *Metode Penelitian Pendidikan (Kuantitatif, Kualitatif, Kombinasi, R&D dan Penelitian Pendidikan)*. Alfabeta.

Sukmawati, B. N., & Rahim, A. (2026). Pengaruh Penerapan Pendekatan Socio-Scientific Issue (SSI) dalam Materi Zat Aditif dan Zat Adiktif terhadap Literasi Sains dan Islam di Kelas VIII MTsN 1 Lumajang. *Jurnal Kajian Pendidikan IPA*, 233–245. https://doi.org/10.52434/jkpi.v6i2.43842

Trianto. (2011). *Mendisain Model Pembelajaran Inovatif-Progresif: Konsep, Landasan, dan Implementasinya pada Kurikulum Tingkat Satuan Pendidikan (KTSP)*. Jakarta: Kencana Prenada Media Group.

Viehmann, C., Fernández Cárdenas, J. M., & Reynaga Peña, C. G. (2024). The Use of Socioscientific Issues in Science Lessons: A Scoping Review. *Sustainability*, *16*(14), 5827. https://doi.org/10.3390/su16145827

Wijaya, I. K. W. B., Yasa, I. M. W., & Muliani, N. M. (2023). Menumbuhkan Literasi Sains Siswa Sekolah Dasar di Lingkungan Keluarga. *Jurnal Pendidikan MIPA*, *13*(4 SE-Articles). https://doi.org/10.37630/jpm.v13i4.1259

Yani, J., & Afrianis, N. (2022). Analysis of student scientific literacy using the socio-scientific issues (SSI) approach on reaction rate. *Jurnal Pendidikan Kimia*, *14*(1), 19–27. https://doi.org/10.24114/jpkim.v14i1.32665

Yolida, B., Marpaung, R. R. T., & Handini, R. (2021). Problem based learning model using vee diagrams on students' scientific literacy of environmental pollution material. *JPBIO (Jurnal Pendidikan Biologi)*, *6*(1), 55–63. https://doi.org/10.31932/jpbio.v6i1.834

Zarkasih, Z., Diniya, D., Permana, N. D., & Kirana, I. (2023). Development of Science E-Modules Based on Socio-scientific Issues Integrated with The Quran Verses to Establish Pancasila Student Profiles. *Journal of Natural Science and Integration*, *6*(1), 63–79.

https://doi.org/10.24014/jnsi.v6i1.21855

Zeidler, D. L., Herman, B. C., & Sadler, T. D. (2019). New directions in socioscientific issues research. *Disciplinary and Interdisciplinary Science Education Research*, *1*(1), 1–9. https://doi.org/10.1186/s43031-019-0008-7

Zulistina, H., & Sunarti, T. (2022). Analyzing Islamic Boarding School Students' Scientific Literacy Skills on Physics Material. *Prisma Sains : Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, *10*(2), 361–372. https://doi.org/10.33394/j-ps.v10i2.5094