

Development Of Science Literacy Learning Environment Instruments: Validity And Reliability

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Abstract

One of the factors that affect students' science literacy is the learning environment. The purpose of the research is to develop valid and reliable science literacy learning environment instruments. The instrument was developed from the science literacy competency at PISA 2025 and the What Is Happening in This Class (WIHIC) instrument resulting in 33 items. The quantitative research method is used, while the sampling technique is purposive. Data was collected from 339 grade 11 students at MAN 11 Jakarta and MAN 19 Jakarta. The instrument dimension consists of science communication, science investigation, use of scientific information, teacher support, and cooperation. Data analysis uses Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) to check validity. The EFA result shows that 5 dimensions are formed and the CFA result shows that 1 item is invalid. Reliability is measured using the alpha cronbach value on each dimension. The instrument is reliable because the test results show that the consistency and stability of the measurement are met. The results showed that 32 items were valid and reliable in measuring the science literacy learning environment.

Keywords: learning environment, science literacy, validity, reliability.

INTRODUCTION

PISA results related to science literacy skills show that the performance of Indonesian students is relatively low when compared to OECD countries and several friendly countries in Southeast Asia. Between 2006 and 2022, Indonesia's science literacy score pattern tended to remain unchanged and remained below average, which indicates a challenge in improving the quality of science literacy education. In PISA 2006, the average science literacy score of Indonesian students was around 393, and although there was some progress in 2015 which reached 403, this score is still very far from the expectations of international standards set by the OECD (Yusmar & Fadilah, 2023). The need for development to improve science literacy competencies (Hardinata et al., 2019; Nugraeni & Paidi, 2021).

The topic of science literacy skills was raised with the intention of improving science literacy skills through various approaches (Wulandari et al., 2021; Nugraeni & Paidi, 2021; Kang, 2022; Heliawati et al., 2022; Heliawati et al., 2020). These studies were conducted using a variety of approaches such as *Nature of Science* (NoS), discussion, culturally context-connected writing, problem-based learning, inquiry-based learning, learning that integrates ethnochemistry, and language-integrated learning. Previous studies have revealed ways to improve science literacy skills, but have not explained the measurement of learning environmental conditions.

The learning environment has a huge influence on the overall learning experience and academic outcomes of students. This includes various aspects, such as physical, social, and cultural aspects, that together contribute to the way students acquire knowledge. A positive and engaging learning atmosphere will stimulate cooperation, enthusiasm, and a sense of attachment among students, which ultimately has an impact on improving academic achievement (Arianti, 2017; Latief, 2023; Mariyana & Setiasih, 2018).

Piaget (1997) argues that social relationships provide an opportunity for students to understand their friends' point of view. A positive and supportive learning atmosphere is one of the crucial elements in improving science literacy skills. Dweck (2006) states that the learning environment is one that promotes a growth mindset. Zaturrahmi (2019) reveals that it is crucial to establish an educational atmosphere that promotes equality, respects cultural differences, and engages every student in learning activities. It's not just about gathering students, it's also about developing a learning experience that's valuable and open to all.

Social interaction between people and the surrounding community has a crucial role in the process of forming understanding and mental development. Students who work closely with their classmates can support each other to learn in a more effective and efficient way (Moed, 2015). In addition, a supportive educational atmosphere is crucial, where students work together to gain meaningful benefits from their learning experiences and growth.

These skills are indispensable to support interactions with others when facing social and emotional challenges (Khine et al., 2020; Hussain Malik & Abbas Rizvi, 2018).

The advantage of this study lies in the absence of a special measuring tool to measure the science literacy learning environment. Therefore, the main goal of this study is to develop an instrument that can measure a valid and reliable science literacy learning environment. This instrument is expected to make a significant contribution to improving understanding of learning conditions that support the development of science literacy, as well as being a useful tool for educators and researchers to assess and improve the existing learning environment.

METHODS

Participants

The determination of madrasah samples is based on *purposive techniques* with consideration of madrasah that have implemented science literacy learning. This study involved 339 grade 11 students at MAN 11 Jakarta and MAN 19 Jakarta.

Instruments

According to the National Research Council (NRC), mastery of science includes knowledge and understanding of scientific concepts and processes necessary to make personal decisions, participate in social and cultural life, and increase economic productivity (NRC, 1996). Science literacy refers to the ability of students to understand as well as use scientific ideas (Suárez-Mesa & Gómez, 2024). Science literacy according to PISA (OECD, 2023) It is defined as the ability to apply scientific knowledge, ask questions, and draw evidence-based conclusions to better understand and aid in decision-making regarding the nature and impacts of environmental changes due to human activities. Science literacy is also defined as the ability to utilize knowledge and information interactively. Science literacy includes an understanding of how science knowledge can affect the way individuals interact with the world and how that knowledge can be used to achieve broader goals. The science literacy competency measured refers to *framework* SAINS PISA 2025 (OECD, 2023) It covers three things, namely: (1) explaining phenomena scientifically, (2) drafting and evaluating designs for scientific investigation and critically interpreting scientific data and evidence, (3) researching, evaluating, and using scientific information for decision-making and action.

The first competency in the PISA 2025 science framework, explaining the phenomenon scientifically can be described as science communication. Science communication refers to the activities and methods by which scientific information is conveyed to the public, and aims to deepen the public's understanding of science. In the context of research presented by S. R. Davies (2021), science communication is considered very important for today's society and has various functions in social life. Science communication can be described as an effort to disseminate scientific information to the public efficiently and meaningfully (Fischhoff, 2013). This research paper investigates the characteristics of the communication function of science in the context of today's society (Evagorou et al., 2015).

The second competency in the PISA 2025 science framework, drafting and evaluating designs for scientific inquiry and critically interpreting scientific data and evidence can be described as science investigation. Science subjects are a sector of science that is aimed at exploring or obtaining information related to nature on a regular basis, not only focusing on mastering knowledge in the form of concepts, facts, or principles (Primary et al., 2024). Students' ability to conduct science research is a vital factor in improving science literacy, which involves applying insights through experimentation, theoretical testing, and information analysis. This method encourages students to think analytically, develop problem-solving skills, and formulate arguments supported by evidence (Khine et al., 2020). An environment that supports quality science literacy creates an atmosphere that encourages exploration, interactive learning, and the application of science principles in everyday life.

The third competency in the PISA 2025 science framework, researching, evaluating, and using scientific information for decision-making and action can be described as the use of scientific information. One of the main goals in teaching science to the next generation is to create individuals who are able to become individuals who are able to think critically about scientific information, who not only understand scientific issues, but also can evaluate the authenticity, relevance, and level of trust of the information in daily life (Henkel, 2024). In today's era marked by rapid technological developments, understanding science is becoming increasingly crucial. The ability to critically analyze and assess scientific information is indispensable to meet the challenges of an increasingly complex and technology-based society (Hanson, 2022). The concept of understanding scientific information needs to be seen as a tool to understand the influence of new media (Wang and Al., 2023).

The dimensions of the What is Happening in This Class (WIHIC) instrument used in this study consisted of teacher support and cooperation. Support from teachers is part of the WIHIC learning environment, where this support refers to the extent to which teachers provide assistance, act as friends, build trust, and show interest in students (Aldridge *et al.*, 1999). The results of the study show that teacher-guided science teaching has a great impact on student achievement (Eser & Aktan, 2021). Research results Hanfstingl *et al.* (2024) It shows that the more science teachers have special expertise in educational institutions, the higher the students' understanding of science and interest in the subject. Findings Lee (2023) strengthen the reasons for incorporating environmental topics into conventional science learning and emphasize cooperation between teachers in designing an interdisciplinary environmental science curriculum. Help from teachers can improve students' digital literacy skills, which in turn strengthens skills in online learning (Zheng *et al.*, 2024).

Cooperation is one aspect of the WIHIC learning environment, where cooperation is understood as the extent to which students collaborate with each other instead of competing in the learning process (Aldridge *et al.*, 1999). The dimension of cooperation has a significant influence on the total scale and subscale of WIHIC (Oo *et al.*, 2022). The cooperation dimension has a positive influence on students' perception of the learning environment (Cai *et al.*, 2022). In the process of knowledge development and cognitive development, social relations between individuals and society have a very crucial role. Learning takes place better and more efficiently when students collaborate with classmates (Moed, 2015).

Table 1. Blueprint Instrumen

Dimensions	Favourable Item	Unfavourable Item	Total	Percent
Science Communication (KS)	X1, X3, X4, X5, X6, X7, X8, X9, X10	KS2	10	30.30%
Science Investigation (IS)	IS1, IS2, IS3, IS4, IS5, IS6	IS7	7	21.21%
Use of Scientific Information (PI)	PI1, PI2, PI3, PI4	-	4	12.12%
Teacher Support (DG)	DG1, DG2, DG3, DG4, DG6, DG7, DG8	DG5	8	24.24%
Cooperation (KJ)	KJ1, KJ2, KJ4	KJ3	4	12.12%
Total			33	

Source: personal data (2025)

Data Collection

The determination of madrasah samples was based on *purposive techniques* and research of grade 11 students at MAN 11 Jakarta and MAN 19 Jakarta. The research was carried out in the even semester of 2024/2025 in June 2025 using a google form. Likert scales are used: 5 (always), 4 (often), 3 (sometimes), 2 (rarely), and 1 (never). The consideration of choosing Jakarta is because it is an urban city whose population is diverse from various regions so that it will produce a sample that represents the Indonesian student population. The selection of the high school level in favor of measuring instruments requires literacy skills in order to understand the items of the instrument.

Data Analysis

Factor analysis is a statistical method that is often applied to create measuring instruments that aim to assess the relationship between various variables. A factor is the grouping of test items that are considered as a whole. Construction is formed from interconnected items. Unrelated items are not included in the construction and must be removed from the group (Azwar, 2017). There are 2 (two) types of factor analysis approaches, *Exploratory Factor Analysis* (EFA) and *Confirmatory Factor Analysis* (CFA) are two methods of factor analysis used to evaluate the structure of a constructed being measured (Kyriazos, 2018).

EFA analysis requires conditions of normality and adequate data characteristics to carry out factor analysis. If the sample count exceeds 100, the data normality requirement is not required (Mishra *et al.*, 2019). Analysis *Keiser Meyer Olkin* (KMO) is used to find out if the data is suitable for factor analysis. The value of the KMO ranges from 0 to 1, where a higher value indicates that the data has an adequate correlation structure for factor

analysis, while a value of less than 0.5 indicates that the item needs to be corrected. Sample sufficiency check is reinforced by *Barlett's Test of Sphericity* to test that the observed correlation matrix is not an identity matrix (Fauzi *et al.*, 2022). *Barlett's Test Sphericity* significant at $p < 0.001$, indicating the presence of a relationship of at least several variables in the correlation matrix (Shrestha, 2021).

In EFA, to find out the number of factors, several variables will be extracted or reduced to fewer groups of factors or variables. According to Hair *et al.* (2022), the diversity percentage method (*Self-esteem*) can be used to calculate the number of elements that make up. After conducting EFA, a follow-up analysis was carried out, namely CFA. Before the CFA analysis is carried out, a model compatibility test is carried out. Model fit testing is an important step to ensure that the models offered are in accordance with empirical data. Model fit index, also known as *Goodness of Fit* (GoF), calculated based on the criteria listed in Table 2.

Table 2. Goodness of Fit Criterion

<i>Goodness of Fit</i>	Criterion	Interpretation
(χ^2/df)	<3 (Kline, 2016)	Fit
P value	> 0.05	Fit
<i>Comparative Fit Index</i> (CFI)	≥ 0.90 (Hu & Bentler, 1999)	Fit
<i>Tucker Lewis Index</i> (TLI)	≥ 0.90 (Hu & Bentler, 1999)	Fit
<i>Root Mean Square Error of Approximation</i> (RMSEA)	≤ 0.06 - 0.08 (Schreiber <i>et al.</i> , 2006)	Fit
<i>Standardized Root MeanSquare Residual</i> (SRMR)	≤ 0.06 - 0.08 (Schreiber <i>et al.</i> , 2006)	Fit

The value of the factor load that is considered acceptable depends on the context of the study, the underlying theory, and the sample size. The value of the load factor based on the sample, if the sample > 250, then a value above 0.35 is considered valid (Furr, 2022). The reliability coefficient reflects the reliability of a group of scores, being in the range between 0 to 1. If the reliability coefficient reaches 1, this means that the variation seen in the test score of the respondent is entirely consistent with the variation in the actual score. In contrast, a reliability value of 0 indicates that the variation in the visible test score does not reflect the actual variation in the score at all (Furr, 2022). The reliability in this study was used the alpha Cronbach value. Guilford (1965) categorize the reliability test into 4 categories: 0.80-1.00, very high reliability; 0.60-0.80, high reliability; 0.40-0.60, medium reliability, and 0.20-0.40, low reliability.

All analyses in this study were carried out using Jamovi software, which is an open source statistical software. Jamovi was chosen because it has a simple interface, is easy to understand, and provides a variety of statistical analysis features that are quite complete. In addition, its open source nature makes this software freely accessible without requiring license fees, so it strongly supports research and learning activities in the academic field.

RESULTS AND DISCUSSION

Descriptive Statistics

It can be seen in table 3 that of the 33 items have a minimum value of 1 and a maximum value of 5. The highest average on items KS1 and KS 10 with a value of 3.35 and the highest standard deviation on KJ4 with a value of 1.458. The lowest average was on IS6 items with a value of 2.83 and the lowest standard deviation on KS2 with a value of 1.058. It can be seen that almost all item averages are worth 3, and all standard deviation values are worth 1.

Table 3. Descriptive Statistics

Item	Minimum	Maximum	Mean	Std. deviation
KS1	1	5	3.35	1.097
KS2	1	5	3.34	1.058
KS3	1	5	3.32	1.151
KS4	1	5	3.27	1.096
KS5	1	5	3.23	1.116
KS6	1	5	3.24	1.115
KS7	1	5	3.29	1.072

KS8	1	5	3.34	1.143
KS9	1	5	3.31	1.075
KS10	1	5	3.35	1.087
IS1	1	5	2.92	1.103
IS2	1	5	2.88	1.174
IS3	1	5	2.86	1.143
IS4	1	5	2.91	1.110
IS5	1	5	2.94	1.172
IS6	1	5	2.83	1.146
IS7	1	5	2.86	1.102
PI1	1	5	2.90	1.351
PI2	1	5	2.95	1.377
PI3	1	5	2.86	1.389
PI4	1	5	2.91	1.302
DG1	1	5	3.20	1.221
DG2	1	5	3.09	1.208
DG3	1	5	3.19	1.181
DG4	1	5	3.15	1.225
DG5	1	5	3.20	1.265
DG6	1	5	3.09	1.149
DG7	1	5	3.20	1.207
DG8	1	5	3.10	1.184
KJ1	1	5	3.29	1.403
KJ2	1	5	3.27	1.419
KJ3	1	5	3.22	1.417
KJ4	1	5	3.10	1.458

Source: personal data (2025)

Validity

Factor analysis requires adequacy conditions that are checked by the Keiser-Meyer-Olkin (KMO) test. Keiser-Meyer-Olkin (KMO) is a measure used to assess the feasibility of data, measuring the proportion of variance in a variable that can be explained by factors. It can be seen in Table 4, that there is no KMO value less than 0.50, so that the KMO adequacy requirements are met.

Table 4. KMO Value

Item	KMO	Item	KMO	Item	KMO
KS1	0.774	IS2	0.731	DG2	0.767
KS2	0.699	IS3	0.675	DG3	0.735
KS3	0.716	IS4	0.718	DG4	0.775
KS4	0.720	IS5	0.738	DG5	0.792
KS5	0.770	IS6	0.740	DG6	0.793
KS6	0.767	IS7	0.667	DG7	0.802
KS7	0.775	PI1	0.578	DG8	0.725
KS8	0.751	PI2	0.625	KJ1	0.637
KS9	0.799	PI3	0.572	KJ2	0.554
KS10	0.729	PI4	0.633	KJ3	0.594
IS1	0.708	DG1	0.765	KJ4	0.634

Source: personal data (2025)

In addition, factor analysis also requires a sample spherical test that is examined with the Bartlett Sphericity Test. The results of the Bartlett Sphericity test are as shown in Table 5. This result means that there is strong evidence that the variance in the data differs significantly and that the variance between the data groups is not

homogeneous. Thus, factor analysis can be continued.

Table 5. Uji Barlett's Test

X2	df	P
1681	528	<0.001

Source: personal data (2025)

This measuring instrument consists of 5 dimensions: science communication, science investigation, use of scientific information, teacher support, and cooperation. The EFA analysis produces five groups of items and a *plot scree* graph as shown in Figure 1. The *scree plot* displays a visualization of the eigenvalue graph as the y-axis on each factor as the x-axis. From the *elbow point*, there are five points above the simulation data distribution.

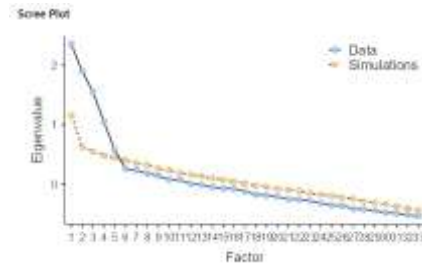
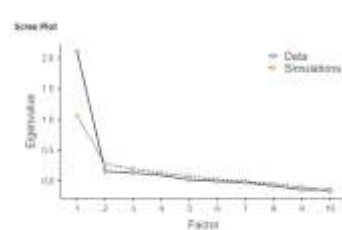
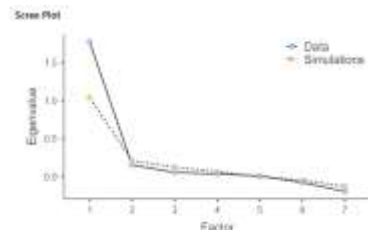


Figure 1. Scree plot on EFA

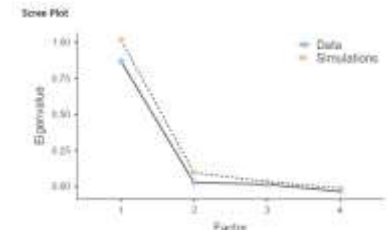
Next, it is necessary to test each of these dimensions to ensure that each dimension measures the same construct can be seen in Figure 2. It can be clearly seen that each dimension only measures 1 dimension.



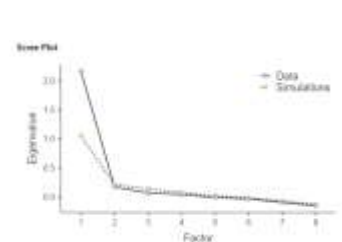
a. KS



b. IS



c. PI



d. DG e. KJ

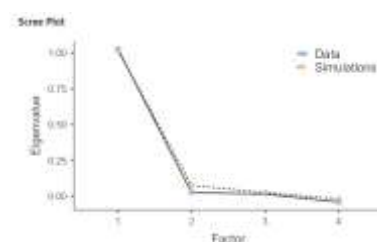


Figure 2. Scree the EFA plot on each dimension

After the EFA test shows that the instrument forms 5 dimensions, then a CFA test is carried out to see the loading factor value of each item. It can be seen in Table 6 that the loading factor value on KS2 is $0.336 < 0.35$, the KS2 item is invalid, so the KS2 item is discarded. The loading factor value of all other items > 0.35 .

Table 6. Loading Factor Values on CFA

Dimension	Item	Estimate	SE	Z	P	Loading Factor
KS	KS1	0.522	0.0662	7.89	< 0.001	0.477
	KS2	0.355	0.0654	5.42	< 0.001	0.336
	KS3	0.486	0.0702	6.92	< 0.001	0.423
	KS4	0.553	0.0657	8.42	< 0.001	0.505
	KS5	0.508	0.0675	7.54	< 0.001	0.457
	KS6	0.502	0.0676	7.43	< 0.001	0.451
	KS7	0.573	0.0638	8.98	< 0.001	0.535

	KS8	0.492	0.0696	7.07	< 0.001	0.431
	KS9	0.525	0.0646	8.13	< 0.001	0.489
	KS10	0.498	0.0658	7.56	< 0.001	0.459
IS	IS1	0.525	0.0681	7.71	< 0.001	0.477
	IS2	0.597	0.0724	8.24	< 0.001	0.509
	IS3	0.519	0.0713	7.28	< 0.001	0.455
	IS4	0.551	0.0686	8.04	< 0.001	0.497
	IS5	0.623	0.0716	8.71	< 0.001	0.532
	IS6	0.635	0.0705	9.01	< 0.001	0.555
	IS7	0.542	0.0678	7.99	< 0.001	0.493
PI	PI1	0.537	0.1014	5.30	< 0.001	0.398
	PI2	0.582	0.1044	5.57	< 0.001	0.423
	PI3	0.734	0.1097	6.69	< 0.001	0.529
	PI4	0.650	0.1020	6.37	< 0.001	0.500
DG	DG1	0.725	0.0705	10.28	< 0.001	0.595
	DG2	0.597	0.0715	8.34	< 0.001	0.495
	DG3	0.551	0.0701	7.86	< 0.001	0.468
	DG4	0.640	0.0721	8.88	< 0.001	0.523
	DG5	0.639	0.0744	8.58	< 0.001	0.506
	DG6	0.590	0.0674	8.76	< 0.001	0.515
	DG7	0.649	0.0707	9.18	< 0.001	0.538
	DG8	0.602	0.0699	8.61	< 0.001	0.509
KJ	KJ1	0.720	0.1001	7.19	< 0.001	0.514
	KJ2	0.640	0.1004	6.38	< 0.001	0.452
	KJ3	0.685	0.1004	6.82	< 0.001	0.484
	KJ4	0.830	0.1061	7.83	< 0.001	0.570

Source: personal data (2025)

In table 7 it can be seen that the value $\chi^2/df = 515/485 = 1.062 < 3$; CFI = 0.975 $\geq$ 0.90, TLI = 0.973 $\geq$ 0.90; SRMR = 0.0452 $\leq$ 0.06; RMSEA = 0.0135 $\leq$ 0.06, so the fit is concluded.

Table 7. Goodness of Fit

CFI	TLI	SRMR	RMSEA	X2	df
0.975	0.973	0.0452	0.0135	515	485

Source: personal data (2025)

As for the KS2 issued, then a re-CFA test was carried out, in table 8 it can be seen that the loading factor value of all items > 0.35 , so it was concluded to be valid.

Table 8. Loading Factor values on CFA without KS2

Dimension	Item	Estimate	SE	Z	P	Loading Factor
KS	KS1	0.526	0.0667	7.88	< 0.001	0.480
	KS3	0.489	0.0708	6.90	< 0.001	0.425
	KS4	0.558	0.0662	8.43	< 0.001	0.510
	KS5	0.509	0.0680	7.48	< 0.001	0.457
	KS6	0.492	0.0683	7.21	< 0.001	0.442
	KS7	0.560	0.0645	8.69	< 0.001	0.523
	KS8	0.495	0.0701	7.06	< 0.001	0.434
	KS9	0.532	0.0650	8.18	< 0.001	0.495
	KS10	0.501	0.0664	7.54	< 0.001	0.461
IS	IS1	0.526	0.0681	7.72	< 0.001	0.478

	IS2	0.597	0.0724	8.24	< 0.001	0.509
	IS3	0.519	0.0713	7.28	< 0.001	0.455
	IS4	0.551	0.0686	8.03	< 0.001	0.497
	IS5	0.623	0.0716	8.71	< 0.001	0.533
	IS6	0.635	0.0705	9.01	< 0.001	0.555
	IS7	0.541	0.0679	7.98	< 0.001	0.492
PI	PI1	0.536	0.1014	5.29	< 0.001	0.398
	PI2	0.582	0.1044	5.57	< 0.001	0.423
	PI3	0.735	0.1097	6.70	< 0.001	0.530
	PI4	0.650	0.1020	6.37	< 0.001	0.500
DG	DG1	0.724	0.0705	10.28	< 0.001	0.594
	DG2	0.597	0.0715	8.34	< 0.001	0.495
	DG3	0.551	0.0701	7.86	< 0.001	0.468
	DG4	0.640	0.0701	8.88	< 0.001	0.523
	DG5	0.639	0.0721	8.59	< 0.001	0.506
	DG6	0.590	0.0744	8.75	< 0.001	0.515
	DG7	0.649	0.0674	9.18	< 0.001	0.539
	DG8	0.602	0.0707	8.61	< 0.001	0.509
KJ	KJ1	0.721	0.1002	7.19	< 0.001	0.514
	KJ2	0.641	0.1005	6.38	< 0.001	0.452
	KJ3	0.685	0.1005	6.81	< 0.001	0.484
	KJ4	0.829	0.1061	7.82	< 0.001	0.570

Source: personal data (2025)

Table 9. Goodness of Fit without KS2

CFI	TLI	SRMR	RMSEA	X2	df
0.971	0.968	0.0456	0.0151	489	454

Source: personal data (2025)

In table 9 it can be seen that the value of $\chi^2/df = 489/454 = 1.077 < 3$; $CFI = 0.971 \geq 0.90$, $TLI = 0.968 \geq 0.90$; $SRMR = 0.0456 \leq 0.06$; $RMSEA = 0.0151 \leq 0.06$, so it is concluded fit.

Reliability

Table 10. Alpha Cronbach

Dimension	Alpha Cronbach
KS	0.717
IS	0.703
PI	0.520
DG	0.764
KJ	0.578

Source: personal data (2025)

The reliability in this study was used the alpha Cronbach value. In the dimensions of KS, IS, and DG, they are included in the category of high reliability; PI and KJ dimensions in the category of medium reliability.

Instruments

The final results of valid and reliable instruments can be seen in Table 11.

Table 11. Instrument Items

Item	Statement Item
KS1	I convey the results of my thoughts orally with the support of accurate evidence
KS3	I explained verbally how scientific knowledge can be applied in everyday life
KS4	I explained verbally how scientific knowledge can solve problems
KS5	I write evidence that supports the scientific research hypothesis using reliable references
KS6	I wrote about a research experiment model based on relevant theories

KS7	I wrote a research hypothesis about natural phenomena using a systematic structure
KS8	I present the results of scientific research into the form of interesting pictures
KS9	I present the results of scientific investigations in the form of an easy-to-understand table
KS10	I present the results of scientific research into an interesting graphic form
IS1	I ask questions that can be tested through scientific inquiry
IS2	I propose measures in scientific research
IS3	I evaluate the results of scientific investigations
IS4	I do an analysis of the results of scientific research
IS5	I compare the data with relevant theories
IS6	I drew the right conclusions while conducting scientific investigations
IS7	I ignore possible errors in the results of scientific research
PI1	I make use of valid information before drawing conclusions
PI2	I always filter information before taking action
PI3	I am responding to a less logical scientific argument
PI4	I support the decision with logical scientific arguments
DG1	Teacher presents informative video of scientific phenomena
DG2	The teacher invited me to do a practicum at school
DG3	The teacher took me to the library to collect learning materials
DG4	Teachers give examples of how to identify natural phenomena around the school
DG5	Master ignored my opportunity to conduct scientific investigation
DG6	The teacher guided me in completing a scientific investigation project
DG7	The teacher trained me in planning scientific research
DG8	The teacher gave me the opportunity to present the results of scientific investigations
KJ1	I work with friends to complete project tasks
KJ2	I share ideas with friends to improve my understanding of learning materials
KJ3	I pay less attention to my friend's opinions in group discussions
KJ4	I help a friend who is having difficulty understanding the material

CONCLUSION

The results of the study show that the development of science literacy learning environment instruments is valid and reliable. The validity test through Exploratory Factor Analysis (EFA) ensures that the instrument's factor structure is in accordance with the theoretical construct, while Confirmatory Factor Analysis (CFA) confirms the suitability of the measurement model with empirical data. This confirms that each instrument item is able to represent science literacy indicators accurately and relevantly, so it is suitable for measuring the conditions of the learning environment.

In addition, the results of the reliability test using Cronbach's Alpha showed reliability, indicating the internal consistency of the instrument in measuring the aspects in question. This good reliability proves that the instrument can be used repeatedly with stable and accurate results. Thus, the science literacy learning environment instruments developed are not only theoretically and empirically valid, but also reliable so that they are useful as research and learning evaluation tools to improve students' science literacy.

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