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Evaluating Indonesian upper secondary school students' information literacy in science learning: A Rasch model approach

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ABSTRACT

This study evaluates Indonesian upper secondary school students' information literacy across the cognitive, psychomotor and affective domains in science learning. The primary objectives were to validate an information literacy assessment covering all three domains and to classify both the difficulty level of test items and students' proficiency. A total of 727 students in the 10th, 11th, and 12th grades in Yogyakarta, Indonesia, participated in the study. Each domain was assessed through distinct paper-based tasks. The results indicated that the test demonstrated acceptable validity and reliability across all domains based on Rasch model parameters. Differential Item Functioning (DIF) analysis revealed that only one item in the cognitive domain showed slight to moderate DIF. No DIF was found in the affective domain, while several items in the psychomotor domain showed substantial DIF. Overall, students' information literacy skills were categorised as high, regardless of gender or grade level. Although female students have higher scores than male students, the difference was not statistically significant. Students performed best in the affective domain compared to the cognitive and psychomotor domains. This study also identified the relative difficulty of test items in each domain, offering a comprehensive analysis of students' information literacy skills.

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Introduction

Information literacy encompasses the essential abilities, understanding and learning required in today's world. It empowers individuals to be informed and discerning when creating, using and sharing information (Manhique & Casarin, 2025), finding and analysing information effectively (Smith & Sanger, 2023). Robust information literacy self-efficacy, which is a strong belief in one's ability to find, evaluate and use information effectively, is essential for successful learning (Prabowo et al.,

2024). But the processes of developing information-seeking questions and using information sources have received insufficient attention (Hossain & Sormunen, 2025). In addition, it underscores the pressing necessity of establishing and increasing educational opportunities explicitly designed to cultivate students' capacity for effective information utilisation (Chase, 2024). To improve students' information literacy, it is important to tackle the difficulties they face when searching for information (Adarkwa, 2024). These challenges are a result of a mix of issues related to technology, available resources and their skills.

Students need information literacy skills to evaluate information well. The development of information literacy skills is crucial, as they enable students to efficiently locate, access and critically evaluate the credibility of the information required for their learning (Nuraini et al., 2025). The increasing prevalence of information disorders—such as fabricated narratives, deceptive content and clickbait— requires so they have a skill set that goes beyond the application of a simple fake-news checklist (Katz, 2024). Educators must guide students on what information they need and how to use it to complete assignments (Vongkulluksn et al., 2024). Students additionally gain from having unnecessary content removed from their courses after instructors decided on the learning content (Olson et al., 2023). Following these steps, it is necessary for educators to reassess students' information literacy skills. Consequently, a valid, reliable and effective instrument is required to mitigate bias in research.

Assessments of students' information literacy levels reveal a need for explicit instruction. Intentional pedagogical strategies should be implemented to support students in the effective evaluation and use of informational media (Delmond et al., 2024). Most traditional information literacy instruction employs a direct instructional approach, wherein the primary emphasis for students is the rote memorization of predetermined information (Hwang et al., 2023). It has been confirmed that access to fundamental utilities, including electricity and internet connectivity, alongside the nature of the educational institution attended, demonstrates a correlation with elevated levels of attainment in information literacy (Turpo-Gebera et al., 2023). The evaluation of students' actual levels of information literacy should be conducted through task-based inquiries rather than perception-based assessments (Hussain et al., 2022). While considerable efforts have been dedicated to developing robust instruments for educational assessment, initiatives focused on establishing cognitive models to guide the investigation of human information processing are less prevalent (Locoro et al., 2021).

The development of literacy skills is a predictor of subsequent reading proficiency. Standard literacy assessments typically involve the measurement of distinct skills across various domains. The results of these assessments can be instrumental in identifying areas where instructional support may be most beneficial. However, when multiple areas of need are evident, determining the optimal prioritization of these skills can present a considerable challenge (Wackerle-Hollman et al., 2024). There are some instruments of information literacy such as the ALFAMED questionnaire (Ferrés & Piscitelli, 2012) and the IL-HUMASS questionnaire (Pinto, 2010). These assessment instruments exhibited robust psychometric properties, demonstrating both reliability and validity. Descriptive studies frequently utilised Likert-type attitude scales, which are valuable for identifying strengths and weaknesses. However, these scales may not always provide a comprehensive diagnostic assessment (Hernández-Marín et al., 2024). Despite the existence of various assessment instruments employing perception-based approaches, not all such tools are utilized for the evaluation of information literacy proficiency and associated competencies (Ibrahim et al., 2024). Therefore, there is a need for a test instrument that can evaluate students' information literacy on cognitive, psychomotor and affective aspects related to a particular subject.

A modern, holistic view of learning recognises the interplay between cognitive (knowledge), affective (emotions) and psychomotor (physical skills) domains. True information literacy isn't just knowing how to locate information; it is also about feeling confident in the process and possessing the physical dexterity to execute the search effectively (Burns, Gross, Melissa & Latham, 2019). Psychomotor indicators provide a way to measure the practical application and mastery of these

skills, offering a more complete picture of an individual's information literacy competence (Ahmad et al., 2018). The theory embodied cognition states in cognitive processes are not separate from our physical bodies and their interactions with the environment. In the context of information literacy, physical actions such as typing a search query, scrolling a webpage, or even physically flipping through a book are integral to the cognitive act of finding and understanding information. These physical movements aren't just a means to an end; they are part of the learning and searching process itself (Bowers, 2022). It's a physical, or psychomotor skill that allows us to capture, organize and create information. For example, by typing efficiently, we can effectively create a new text, such as a research paper or an email, using the information we've found (Buschek et al., 2021). Overall, research on information literacy indicates that the search process is not just about thinking. It also involves a range of feelings and physical actions that people experience at each stage.

Several studies have investigated information literacy in Indonesia. Information literacy currently has a limited impact on how employable individuals are. As a result, there is a need for a consistent information literacy education and training programme to strenghten the specific skills that Indonesian workers require in their jobs (Kodrat et al., 2024). There is a positive correlation between information literacy and local knowledge processes, which refer to the activities and practices through which local knowledge is generated, shared and applied within a community or culture, suggesting that strong information literacy skills can further promote and encourage local knowledge activities among Indonesians (Rahmah et al., 2024). Indonesian teachers use information literacy skills throughout their teaching process, from determining student learning needs and creating lesson plans to delivering instruction and assessing progress (Tasu'ah et al., 2023). Accordingly, they are in significant need of a valid, reliable and effective information literacy assessment instrument to measure their students' proficiency levels across all domains of student ability.

The Rasch model is a statistical technique that can be used to confirm if a measurement tool functions as expected. This conclusion is evidenced by the single-factor model demonstrating a good fit to the data and most of the individual items on the tool functioning as expected within acceptable statistical ranges (Al-Qerem et al., 2025). Rasch analysis is typically used to assess the quality of instruments designed to measure latent variables (Al-Qerem et al., 2024). It does this work examining how participants respond to the different parts (items) of the tool. By analysing patterns of responses across individuals and items, the Rasch model can validate whether the tool is measuring the intended construct in a consistent way (Avinç & Doğan, 2024). Specifically, it suggests that individuals with higher abilities are more likely to answer questions correctly; the Rasch model can predict these probabilities effectively (Darman et al., 2024). This research aims to evaluate the information literacy test and the abilities of students in Indonesia across the cognitive, affective and psychomotor domains through the application of the Rasch Model. The research questions for this study are:

1. How has the validity and reliability of the assessment instrument developed to measure the information literacy of Indonesian upper secondary school students across the cognitive, psychomotor and affective domains of science learning?
2. How can the difficulty level of test items and the proficiency level of Indonesian upper secondary school students be classified based on the Rasch model?
3. Is there a significant difference in information literacy performance across the cognitive, psychomotor and affective domains among Indonesian upper secondary school students?
4. How does the information literacy of Indonesian upper secondary school students differ in relation to gender and grade level?

Methods

Participants

This study employed a cross-sectional research design using a quantitative approach. Stratified random sampling was used to select 727 science students from 10th to 12th grade in senior

high schools across Yogyakarta Province, Indonesia. The information literacy test instrument developed is related to the topic of the kinetic theory of gases, which was studied by all participants. The demographic profile of the participants is presented in Table 1.

Table 1

Demographic profile of participants

Grade	N	Male	Female
10th	33	0	33
11th	457	117	340
12th	237	198	39
Total	727	318	412

Data Collection Tools and Instruments

Data collection was carried out in high schools using paper-based tests. Participants were given 90 minutes to complete the data and information literacy assessments under the supervision of their teachers. The test was designed to evaluate three skill domains: cognitive, affective and psychomotor (Anderson et al., 2001). The cognitive domain was assessed using a 15-item multiple-choice test, the psychomotor domain with a 20-item essay test scored on a scale of 0 to 3 and the affective domain with an 18-item questionnaire using a 5-point Likert scale. Content validity of the test was confirmed with a Content Validity Ratio (CVR) score of 1, based on evaluations by five expert validators. The indicators for each item within the data and information literacy test are presented in Table 2.

Table 2

The domain and indicators of the data and information skills items developed by authors

Domain	Indicators	Indicator code	Question Item Code
Cognitive	Evaluate data and information	KA	KA1, KA2, KA3, KA4, KA5
	Applying data and information	KB	KB1, KB2, KB3, KB4, KB5
	Analyze data and information	KC	KC1, KC2, KC3, KC4, KC5
Psychomotor	Displaying data and information in various forms	PA	PA1, PA2, PA3, PA4, PA5
	Collecting data and information	PB	PB1, PB2, PB3, PB4, PB5
	Confirming data and information	PC	PC1, PC2, PC3, PC4, PC5
	Communicating data and information in various media	PD	PD1, PD2, PD3, PD4, PD5
Affective	Critical of data and information	AA	AA1, AA2, AA3, AA4, AA5
	Objective in responding to data and information	AB	AB1, AB2, AB3, AB4
	Ethical in responding to data and information	AC	AC1, AC2, AC3, AC4, AC5
	Honest and responsible in citing data and information	AD	AD1, AD2, AD3, AD4

Data Analysis

Data analysis to evaluate the construct validity of test items was conducted using Winstep version 5.7.1.0 software, which applies Rasch measurement. The Rasch model, analysed using Joint Maximum Likelihood Estimation (JMLE), converts raw student scores into interval-level data on a logit scale ranging from negative to positive infinity (Soeharto & Csapó, 2022). Rasch parameters were used to assess both validity and reliability based on item and person fit criteria. Item fit was evaluated using mean-square outift (MNSQ), which is considered acceptable within the range of $0.5 < MNSQ < 1.5$ and outfit z-standardised (ZSTD) values, which should fall between -2.00 and +2.00. In addition, Point Measure Correlation (Pt Mean Corr.) values between 0.4 and 0.85 were considered acceptable (Boone et al., 2014; Riwayani et al., 2024; Sumintono & Widhiarso, 2015). Unidimensionality was assessed to confirm the test's ability to measure a single latent trait accurately (Wu et al., 2019). This

ensures that each domain captures a specific construct without overlap, thus improving the interpretability and validity of the results (Planinic et al., 2019). A Wright map was generated to visualize the distribution of student abilities alongside item difficulty levels. Differential Item Functioning (DIF) analysis was conducted to detect item bias based on gender, using three DIF levels: negligible, slight to moderate (|DIF| ≥ 0.43 logits) and moderate to large (|DIF| ≥ 0.64 logits) (Zwick et al., 1999). To further interpret the results, mean scores for each indicator in the cognitive, affective and psychomotor domains were calculated using a four-point scale, with Microsoft Excel used to assist in scoring. Additionally, Logit Value Person (LVP) analysis was employed to determine students' levels of information literacy. LVP values were also processed using Excel to minimize human error in calculations. The LVP categories used in this study follow the classification proposed by Chan et al. (2021) and can be seen in Table 3.

Table 3

Logit value person (LVP) category

Criteria	Category
Very high	LVP > *Mean logit* + 2SD
High	*Mean logit* + 2SD ≥ LVP > *mean logit*
Medium	*Mean logit* ≥ LVP > *mean logit* – 2SD
Low	LVP < *mean logit* – 2SD

Results

The information literacy test was content validated by 5 expert validators and was revised based on their suggestions.

Validity and Reliability of Information Literacy Test

Validity and reliability were analysed based on item and person parameters using Rasch model outputs. The mean item measure was 0.00, indicating that the average IL item across the cognitive, affective and psychomotor domains was moderately difficult or of moderate difficulty. In the psychomotor domain, the person's mean measure was below the logit value of 0.00, suggesting that student ability was lower than item difficulty (Sumintono & Widhiarso, 2015). The MNSQ outfit value was approaching its ideal value. If the MNSQ outfit value is closer to 1.00, the item is better (Andrich, 2017). The ZSTD value was close to its ideal value of 0.00. The results confirmed that the literacy test for data was valid based on Rasch parameters. High-quality items had an item separation index greater than 2 logits (Boone et al., 2014). The value item reliability was in the range of 0.97 - 0.99 for all items. The overall item reliability was shown to be excellent (Ndosi et al., 2024). The value of person reliability was in the range 0.65-0.92. The person's reliability was shown to be sufficient and excellent (Sumintono & Widhiarso, 2015). The range of Cronbach's alpha values between 0.61 and 0.77 for the entire test indicated that the reliability was sufficient (Taber, 2018). Cronbach's alpha values across the test ranged from 0.66 to 0.92, which also indicates sufficient to very good internal consistency. The overall test reliability was acceptable. Additionally, the raw variance explained by the measures exceeded the recommended threshold of 20%, confirming unidimensionality for each domain (Sumintono & Widhiarso, 2015). Overall, the information literacy test demonstrated acceptable reliability and validity, as detailed in Table 4.

Table 4

Summary of Rasch measurement

	Cognitive test		Affective test		Psychomotor test	
	Persons	Item	Persons	Item	Persons	Item
N	221	15	266	18	240	20
Mean						
Measure	0.09	0.00	0.79	0.00	-0.97	0.00
Outfit MNSQ	1.03	1.03	1.04	1.04	1.18	1.18
Outfit ZSTD	0.04	0.20	0.10	-0.05	-0.15	0.61
Standard deviation (SD)	0.86	1.04	0.40	0.38	1.20	1.22
Standard Error (SE)	0.07	0.28	0.03	0.09	0.08	0.28
Separation	1.36	6.38	1.56	5.85	3.34	12.23
Reliability	0.65	0.98	0.71	0.97	0.92	0.99
Cronbach's Alpha	0.66		0.87		0.92	
Raw Variance Explained by measures	30,2 %		24.7 %		65.7%	

Item fit was examined based on the criteria of outfit MNSQ value, outfit ZSTD and Pt Measure correlation (PTMA). The results of the item fit analysis are presented in Table 5. In the cognitive and affective domain, all items meet the criteria for the outfit MNSQ value (0.5 < MNSQ < 1.5) and PTMA value (0.4 < PTMA < 0.85). However, items KA5, KB1, AA4, AA5, AB4, AB5, AC1, AC2, AD1 and AD4 do not meet the outfit ZSTD value (-2.0 < ZSTD < +2.0). These items can still be maintained because they meet all criteria except one (ZSTD value). In addition, the ZSTD value is not giving reliable results if the sample is more than 200 participants (Chan et al., 2021; Ramadhani et al., 2024a; Maričić et al., 2025; Ramadhani et al., 2024b; Soeharto et al., 2024). In the psychomotor domain, items PD1, PD2, PD3, PD4 and PD5 are outside the outfit MNSQ and ZSTD acceptance interval values, but these items meet the PTMA interval value acceptance criteria. The item can still be maintained because the item is considered inappropriate if the three criteria (Outfit MNSQ, Outfit ZSTD and PTMA) are not met (Chan et al., 2021). While the other items are in the outfit MNSQ and PTMA acceptance interval values, except for items PA1, PA4, PA5, PC1, PC2, PC3, PC4, PC5 which are outside the outfit ZSTD acceptance interval values. These items can still be maintained and used (Sumintono & Widhiarso, 2015). Thus, all information literacy test items in the cognitive, affective and psychomotor domains are valid and can be used.

Table 5

Item Fit criteria

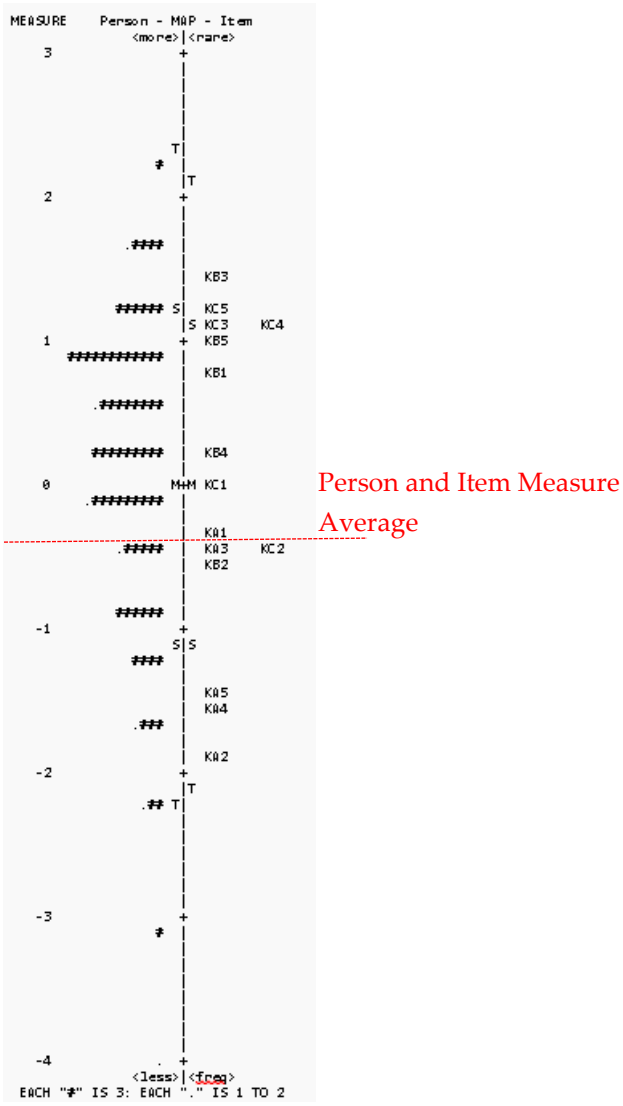
Cognitive test				Affective test				Psychomotor test			
Item	MNSQ	ZSTD	PTMA	Item	MNSQ	ZSTD	PTMA	Item	MNSQ	ZSTD	PTMA
KA1	1.19	-0.02	0.24	AA1	1.02	0.18	0.42	PA1	1.34	2.11	0.59
KA2	1.04	-0.29	0.37	AA2	0.87	-1.74	0.34	PA2	1.15	1.13	0.68
KA3	1.40	-1.05	0.29	AA3	1.09	0.92	0.50	PA3	1.25	1.85	0.65
KA4	1.09	-1.84	0.37	AA4	1.46	3.14	0.37	PA4	1.43	3.05	0.68
KA5	1.19	-2.10	0.28	AA5	1.47	4.49	0.32	PA5	1.35	2.69	0.72
KB1	1.34	2.38	0.26	AB1	0.84	-1.82	0.37	PB1	0.60	-1.05	0.33
KB2	0.91	-0.35	0.49	AB2	0.78	-2.73	0.55	PB2	0.97	0.02	0.35
KB3	0.98	1.44	0.45	AB3	0.58	-5.54	0.36	PB3	0.86	-0.61	0.55
KB4	1.00	-1.44	0.45	AB4	0.61	-5.46	0.52	PB4	0.72	-1.33	0.56
KB5	0.90	1.94	0.49	AC1	0.78	-2.63	0.40	PB5	0.66	-1.62	0.56
KC1	1.08	-0.18	0.43	AC2	1.46	2.95	0.32	PC1	0.72	-2.15	0.79
KC2	1.01	0.33	0.46	AC3	0.86	-1.46	0.32	PC2	0.54	-2.52	0.77
KC3	0.68	1.03	0.60	AC4	0.91	-0.86	0.40	PC3	0.50	-4.16	0.80
KC4	0.63	-0.22	0.60	AC5	0.99	-0.09	0.37	PC4	0.51	-4.20	0.81
KC5	0.95	-0.52	0.45	AD1	1.39	2.81	0.36	PC5	0.49	-4.24	0.80
				AD2	1.18	1.66	0.45	PD1	1.85	3.91	0.54
				AD3	1.12	1.16	0.49	PD2	2.57	6.62	0.47

	AD4	1.34	4.17	0.31	PD3	1.99	4.34	0.52
					PD4	2.42	6.15	0.48
					PD5	1.73	3.19	0.56

The results of the Wright Map analysis for the information literacy test in the cognitive domain are presented in Figure 1. The interaction between items and students indicated that all items appropriately spanned the range of student abilities. The analysis showed that three students demonstrated high ability, with a maximum logit value of +2.23, while two students had low ability, with a minimum logit value of -4.42. The most difficult item was KB3, with a logit value of +1.46, whereas the easiest item was KA2, with a logit value of -1.92. The mean person and item measures were aligned at 0.00 logits, indicating that, on average, student ability matched item difficulty. Thus, all information literacy test items across the cognitive, affective and psychomotor domains were found to be valid and suitable for use.

Figure 1

Wright map of data information literacy in the cognitive domain

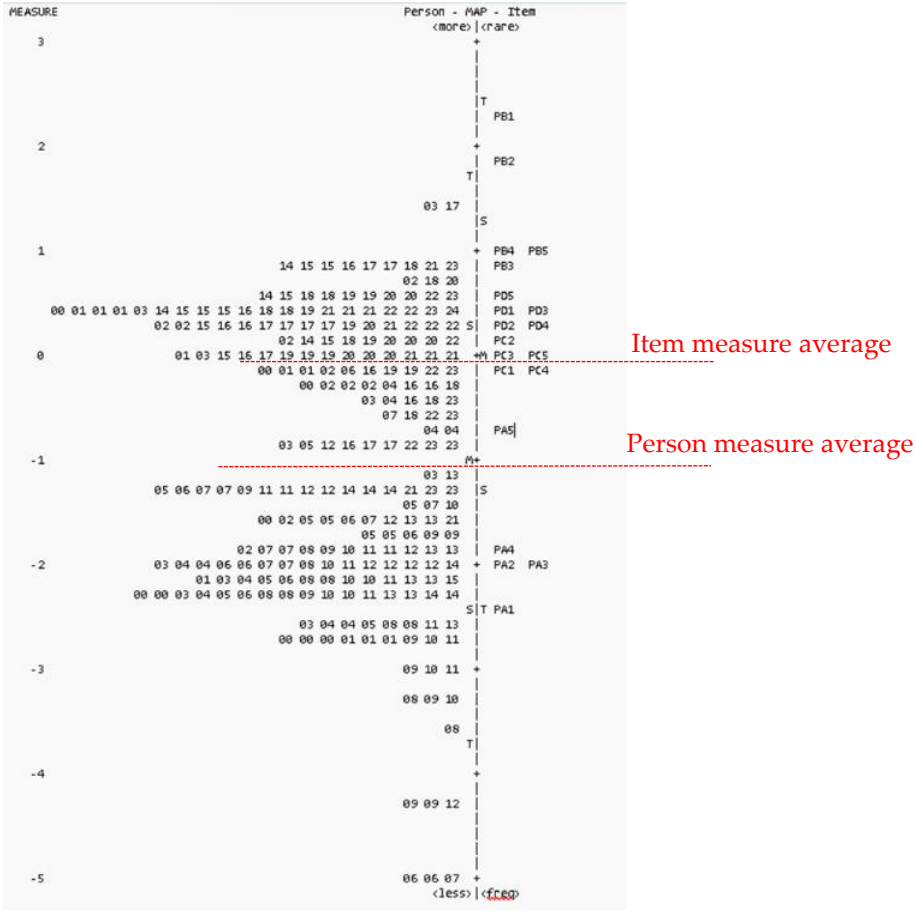


The results of the Wright Map analysis for the information literacy test in the psychomotor domain are presented in Figure 2. The analysis showed that two students demonstrated high ability,

with a maximum logit value of +1.47, while two students had low ability, with a minimum logit value of -5.40. The most difficult item was PB1, with a logit value of +2.28, whereas the easiest item was PA1, with a logit value of -2.38. The average person measure was -0.94 logits, which is below the average item measure, indicating that students' abilities were generally lower than the difficulty level of the test items. In other words, students' information literacy in the psychomotor domain falls within the low category.

Figure 2

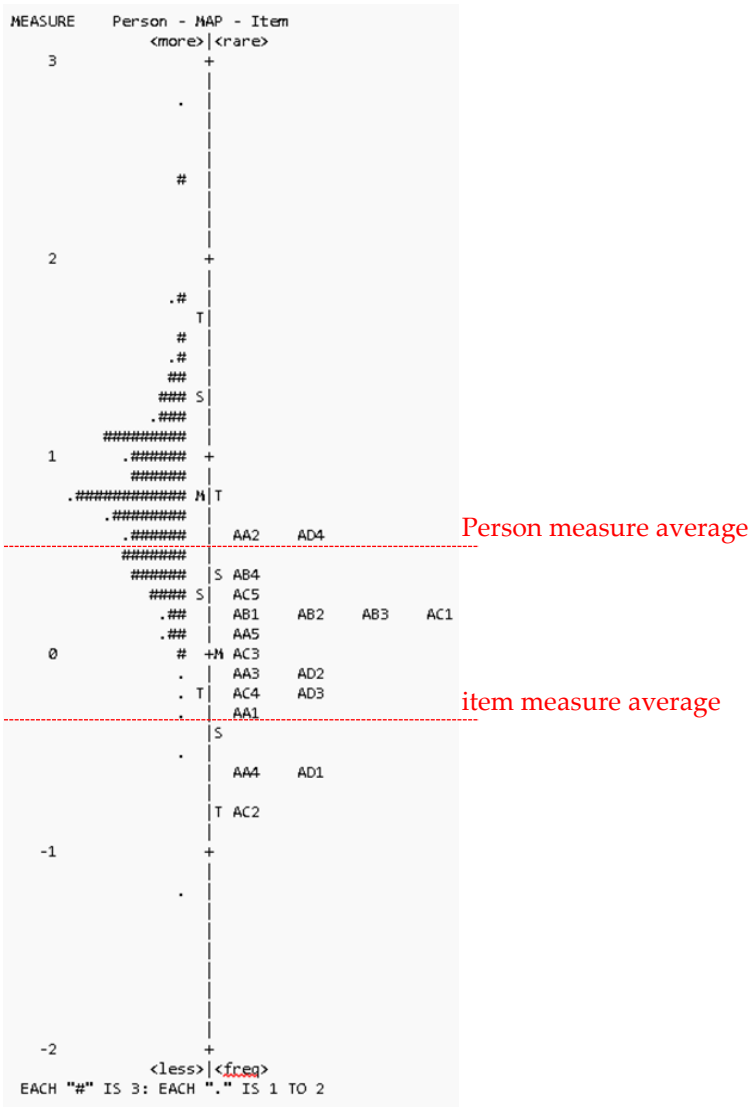
Wright map of data information literacy in the psychomotor domain



The results of the Wright Map analysis for the information literacy test in the affective domain are presented in Figure 3. The analysis showed that one student demonstrated high ability with a logit value of +2.76, while another student showed low ability with a logit value of -1.22. The most difficult items were AD4 and AA2, with logit values of +0.62 and +0.58, respectively. The easiest item was AC2, with a logit value of -0.77. The average person measure was +0.79 logits, which is above the average item measure, indicating that students' abilities exceeded the difficulty level of the items. In other words, students' information literacy in the affective domain falls within the good category.

Figure 3

Wright map of data information literacy in the affective domain

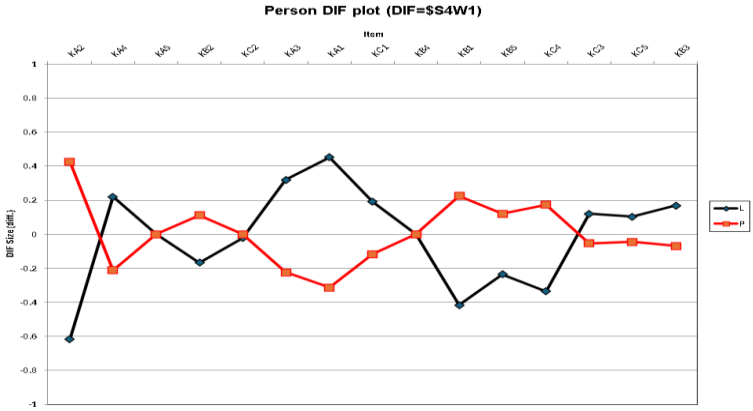


DIF Analysis between Male and Female

Identifying biased test items is essential in educational assessment. Differential Item Functioning (DIF) analysis can be used to detect whether individuals from different subgroups (e.g., male and female) respond differently to specific items after controlling for the overall level of the latent construct being measured (Wallin et al., 2024). The results of the DIF analysis for the cognitive domain are presented in Figure 4. The analysis revealed that some items displayed gender-based bias. Certain items were easier for female students to answer, while others were more accessible for male students. The DIF size curve graph was used to assess the degree of item bias (Sumintono & Widhiarso, 2015). In the cognitive domain, items KA2 and KA1 had DIF size values greater than 0.43 logits, placing them in the "slight to moderate" bias category. All other items were within acceptable limits. The DIF size graph further illustrates differences in performance between male and female students. Male students more easily answered seven items—KA1, KA3, KA4, KC1, KC3, KC5 and KB3—whereas female students performed better on five items—KA2, KB2, KB1, KB5 and KC4. These findings indicate the presence of minor item bias in the cognitive domain based on gender.

Figure 4

DIF analysis in the cognitive domain

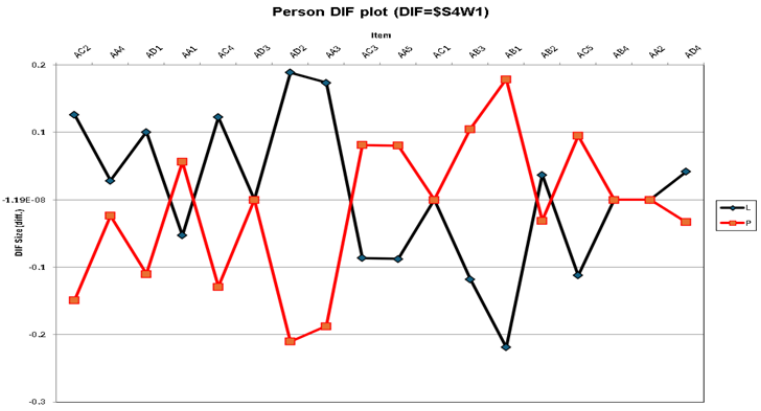


Note. (L = male, P = female)

The results of the DIF analysis on the affective domain are presented in Figure 5. The results of the DIF analysis reveal that the items still contain bias between male and female. In the affective domain, all items have a DIFF size value < 0.43 logit or negligible category. Thus, all items have no DIF issues across genders. Male students can more easily answer eight items, AC2, AA4, AD1, AC4, AD2, AA3, AB2 and AD4 than female students. Meanwhile, female students can more easily answer six items, AA1, AC3, AA5, AB3, AB1 and AC5 than male students.

Figure 5

DIF analysis in the affective domain

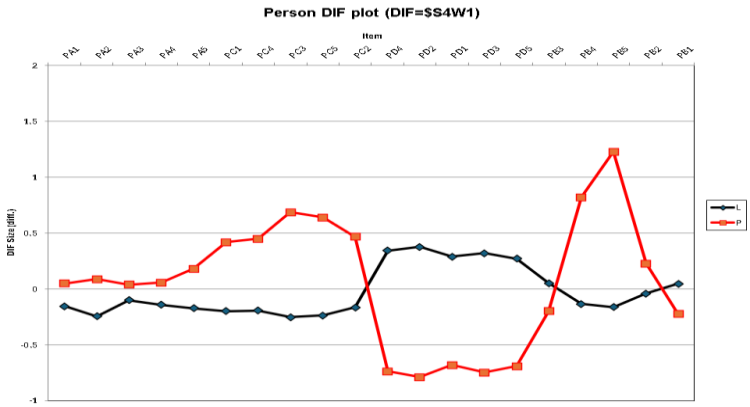


Note. (L = male, P = female)

The results of the DIF analysis for the affective domain are presented in Figure 5. The analysis shows that although there are differences in how male and female students responded to certain items, all items had DIF size values below 0.43 logits, which falls within the negligible category. Therefore, there are no significant DIF concerns across genders in this domain. Male students were more likely to answer eight items correctly: AC2, AA4, AD1, AC4, AD2, AA3, AB2 and AD4. In contrast, female students performed better on six items: AA1, AC3, AA5, AB3, AB1 and AC5. Despite these response patterns, the overall findings suggest that the items are unbiased and function fairly for both male and female students.

Figure 6

DIF analysis in the psychomotor domain



Note. (L = male, P = female)

Students' Information Literacy Abilities Across Gender and Grade Level in Indonesia

Analysing students' information literacy abilities across the cognitive, affective and psychomotor domains is essential. Student performance was evaluated based on the mean score for each indicator and domain. All mean scores were converted to a 4-point scale using Microsoft Excel. The results of this analysis are presented in Figure 7. Students achieved the highest mean scores on the AA, AC and AD indicators (3.2), which belong to the affective domain. In contrast, the lowest mean score was recorded on the PB indicator (0.5), part of the psychomotor domain.

Figure 7

Mean score of information literacy

Students' information literacy abilities can be categorized based on Logit Value Person (LVP) into four levels: very high (LVP > mean logit + 2SD), high (mean logit + 2SD ≥ LVP > mean logit), medium (mean logit ≥ LVP > mean logit – 2SD) and low (LVP < mean logit – 2SD) (Chan et al., 2021). The mean logit item is 0.05 logit and 1 SD is 1.14 logit in the cognitive domain. The distribution of students' information literacy abilities in the cognitive domain is presented in Table 6. The results indicated that 30 male students (36%) and 94 female students (69%) were in the high category. Additionally, 51 male students (61%) and 41 female students (30%) demonstrated medium abilities, while 3 male students (4%) and 2 female students (1%) were in the low category.

Based on grade level, 10 students in the 10th grade (63%), 99 students in the 11th grade (55%) and 15 students in the 12th grade (58%) had high ability. Medium ability was observed in 6 students in the 10th grade (38%), 76 students in the 11th grade (42%) and 10 students in the 12th grade (38%).

Meanwhile, 4 students in the 11th grade (2%) and 1 student in the 12th grade (4%) were in the low category. These findings indicate that students' information literacy skills in the cognitive domain are generally high.

Table 6

Logit Value Person (LVP) analysis in the cognitive domain

Demographic	Very High LVP > +2.33	High +2.33 ≥ LVP > 0.05	Medium 0.05 ≥ LVP > -2.33	Low LVP < -2.33
Gender				
Male	0	30	51	3
Female	0	94	41	2
Grade Level				
10th	0	10	6	0
11th	0	99	76	4
12th	0	15	10	1

Note. N = 221

Students' information literacy abilities in the affective domain are presented in Table 6. The mean logit item is 0.79 logit and 1 SD is 0.47 logit in the affective domain. The results of the study showed that 3 male students (3%) and 6 female students (4%) had very high abilities. And 32 male students (28%) and 81 female students (54%) had high abilities; in addition, 75 male students (65%) and 61 female students (42%) had medium abilities. Furthermore, 5 male students (4%) and 1 female student (1%) had low abilities. At the class level, 7 students in 11th grade (4%) and 2 students in 12th grade (2%) had very high abilities. There are 77 students in 11th grade (43%) and 36 students in 12th grade (41%) who have high abilities. In addition, 90 students in 11th grade (50%) and 48 students at 12th grade (55%) had medium abilities. Furthermore, 5 students in grade 11th (3%) and 1 student in 12th grade (1%) had low abilities. The results of this study indicate that students' information literacy skills in the affective domain are generally at a medium level of proficiency.

Table 7

Logit Value Person (LVP) analysis in the affective domain

Demographic	Very High LVP > +1.73	High +1.73≥ LVP > +0.79	Medium +0.79≥ LVP > -0.15	Low LVP < -0.15
Gender				
Male	3	32	75	5
Female	6	81	63	1
Grade Level				
11th	7	77	90	5
12th	2	36	48	1

Note. N = 266

Students' information literacy abilities in the psychomotor domain are presented in Table 6. The mean logit item is -1.02 logits and 1 SD is 1.34 logits in the cognitive domain. The results of the study indicated that 103 male students (89%) and 17 male students (14%) had high abilities. In addition, 13 male students (11%) and 101 male students (81%) had moderate abilities. Furthermore, 6 female students (5%) had low abilities. While at the class level, 7 10th grade students (41%), 4 11th grade students (4%) and 109 12th grade students (88%) had high abilities. Meanwhile, 10 10th grade students (59%), 89 11th grade students (90%) and 15 12th grade students (12%) had moderate abilities. In addition, 6 11th grade students (6%) had low abilities. The results of this study indicate that students' information literacy skills in the psychomotor are generally high abilities.

Table 8

Logit Value Person (LVP) analysis in the psychomotor domain

Demographic	Very High LVP > 1.66	High 1.66 ≥ LVP > -1.02	Medium -1.02 ≥ LVP > -3.70	Low LVP < -3.70
Gender				
Male	0	103	13	0
Female	0	17	101	6
Grade Level				
10th	0	7	10	0
11th	0	4	89	6
12th	0	109	15	0

Note. N = 240

Discussion

The results of the study indicated that the information literacy test is valid and reliable according to the Rasch parameters for measuring the cognitive, affective and psychomotor domains of students in grades 10, 11 and 12 in high schools. As previously stated (Zhu et al., 2019) develop an information literacy test based on the social cognitive theory that demonstrates validity and reliability among students in the 8th, 9th, 10th and 11th grades in China. Boh Podgornik et al. (2016) developed and tested the information literacy test based on thinking levels to assess students in Slovenia. The comprehensive analysis of the test results affirmed the suitable reliability and discrimination power of the information literacy test (Cronbach's alpha = 0.74; Ferguson's delta = 0.97). DIF analysis based on test method identified one item from the cognitive domain and three items from the psychomotor domain as having a slight to moderate DIF size. In addition, seven items from the psychomotor domain had a large DIF size. These results align with research (Siddiq, 2017) which found that the information literacy test developed had a large DIF size, indicating that the items were biased towards gender on the information literacy test.

Analysis of students' information literacy skills based on LVP identified that 69% of female students in the cognitive domain the cognitive and 54% of female students in the affective domain had high abilities. Meanwhile, 89% of male students had high abilities in the psychomotor domain. In other words, female students' information literacy skills are better than those of male students. These results are in line with research (Punter et al., 2017) on information literacy tests with participants from nine countries (Czech Republic, Poland, Norway, Netherlands, Germany, Slovak Republic, Croatia, Slovenia and Lithuania) that female students have better information literacy abilities than male students. The LVP analysis also identified that students' literacy abilities were in the low category in the cognitive (3%), affective (2%) and psychomotor (2%) domains. This finding is similar to Singh & Kumar (2019), where respondents only have basic skills, far below information literacy skills. Therefore, Liu et al. (2024) emphasize the need to enhance students' information literacy skills, particularly in the affective domain.

This study focuses on evaluating information literacy skills using the Rasch measurement model. A comprehensive analysis and application of this assessment contribute to expanding the practical use of objective measurement in education and encourage further research on information literacy across various contexts. By examining the interaction between individuals and test items, the study enhances the quality of the assessment tool and enables item-level comparisons. The test items are categorized by difficulty level and individual information literacy abilities are analyzed across different grade levels and genders. The study also provides group comparisons across four specific tasks and the overall test. Additionally, the Differential Item Functioning (DIF) analysis identifies potential biases or inconsistencies in item performance across groups.

Recognizing students' information literacy skills is essential, as these abilities are closely linked to academic success. In Indonesia, the development of information literacy is embedded within the national curriculum and such skills are often evaluated in job recruitment processes. Well-developed information literacy fosters cognitive development and supports the effective use of information. Therefore, it is crucial for educators to understand the importance of assessing and improving students' information literacy as an integral part of the educational process.

This study makes several key contributions to the field of educational research. First, it provides a validated, comprehensive assessment framework that goes beyond typical measures by evaluating information literacy across the cognitive, psychomotor and affective domains and offering a more holistic understanding of students' skills. Second, the research successfully validates this new instrument using the Rasch model and offers in-depth insights through Differential Item Functioning (DIF) analysis, which helps refine the tool for future use. Finally, the study offers valuable empirical data by providing a detailed profile of Indonesian high school students' information literacy, revealing that while their overall skills are high, there is a notable gap in performance between domains. This finding, along with the observation that gender differences are not statistically significant, provides crucial insights for educators and policymakers to develop more targeted and effective interventions.

Conclusion

The findings of this study contribute to the measurement of information literacy among upper secondary school students. The information literacy test, developed to assess the cognitive, affective and psychomotor domains, was found to be valid and reliable based on Rasch parameters. Therefore, this test can be applied more broadly in educational settings. The test items covered a wide range of difficulty levels, allowing them to effectively assess students with varying abilities. DIF analysis revealed no biased items in the affective domain and only one item in the cognitive domain fell into the slight to moderate bias category. Although several items in the psychomotor domain exhibited large DIF, all items in this domain were still valid and reliable.

This study also offers an understanding of the current state of information literacy among high school students in Indonesia. These findings are valuable for informing educational evaluations and policies aimed at improving students' information literacy skills. In an era of rapidly advancing information technology, it is crucial to train and enhance students' information literacy to ensure they can think critically and use information responsibly. To our knowledge, this is the first study in Indonesia to evaluate information literacy comprehensively across the cognitive, affective and psychomotor domains. However, this study has some limitations. First, the sample size is relatively small and does not represent the entire population of Indonesia. Future research should expand the sample to include a broader geographic area. Second, this study employed a cross-sectional design. Future studies are encouraged to use experimental designs to evaluate information literacy more comprehensively and to explore causal relationships.

Limitations

The findings can only reflect the conditions of science high school students in Yogyakarta. They may have unique characteristics, such as different local curricula, varying levels of access to technology, or different socioeconomic backgrounds that influence their information literacy. Educational environments across Indonesia are highly diverse. There are differences in teaching methods, school infrastructure and the availability of libraries or computer labs. All of these factors directly influence how students develop and apply their information literacy skills. The employment of paper-based evaluation methods also presents a constraint, as it may not comprehensively reflect students' information literacy proficiencies in the current digital era. Certain facets of information

literacy, such as the appraisal of online resources and the utilization of digital databases, are not effectively measured through paper-based means. This study thus provides a cross-sectional analysis of students' information literacy skills at a particular moment and does not account for their longitudinal development or the impact of educational initiatives.

Recommendations

1. Forthcoming studies might explore information literacy by including students from various regions throughout Indonesia to facilitate cross-cultural analyses.
2. Employing digital assessment tools and platforms could yield more thorough research findings regarding students' information literacy abilities in today's digital landscape, specifically examining measurable skills like online searching, website evaluation and the application of digital information resources.
3. Subsequent research could investigate factors impacting information literacy skills, such as instructional approaches, curriculum structure, technology availability and socio-economic status, with the aim of enhancing these skills.

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Declaration of Interest

The authors declare that there are no conflicts of interest.

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