Factor Influencing Students' Scientific Literacy: An Exploratory Factor Analysis

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Abstract
Knowing what influences students' ability to understand and apply science in their daily lives will help with intervention planning and better understanding of the factors that influence students' scientific literacy. Thus, this study aimed to develop an instrument to identify factors contributing to students' scientific literacy. Four phases were employed to develop the instrument: conduct content validity, administer a pre-test, conduct construct validity using exploratory factor analysis, and determine construct reliability. A 131-item questionnaire was administered to 350 form four students aged 16 years old in daily government schools. Three constructs were subjected to exploratory factor analysis: the constructivist learning environment (CLE), attitude toward science (ATS), motivation, and self-efficacy (MSE). The five subconstructs of CLE are personal relevance, uncertainty, critical voice, shared control, and student negotiation. ATS comprises of seven subconstructs: social implications of science, normality of scientists, attitude to scientific inquiry, adoption of scientific attitudes, enjoyment of science lessons, leisure interest in science, and career interest in science. Finally, MSE consists of three subconstructs: intrinsic motivation, extrinsic motivation, and self-efficacy. The instrument is expected to be useful in research and evaluation to measure factors influencing students' scientific literacy.
Keywords: Attitude, Motivation, Scientific Literacy, Factor Analysis

Introduction
A scientific literate person is someone who can understand, apply, and be involved with issues, problems or arguments related to science and technology (OECD, 2016). Acquiring scientific literacy reflects students' ability to solve everyday problems at the individual and community levels scientifically (Fives et al., 2014; Choi et al., 2011).

Students' achievement in scientific literacy, measured through Trends in International Mathematics and Science Study (TIMSS) dan Programme for International Student Assessment (PISA), acts as a benchmark to a country's achievement and effectiveness in

delivering the country's science education (MOE, 2013) against the other countries that participate in the international assessments. Malaysia participated in 1999, and Malaysia's ranking was above the international score in Mathematics and Science. However, Malaysia's participation in the latest TIMSS in 2015 saw that the performance of Malaysian students increased slightly compared to the previous year after two declines in 2007 and 2011.

Malaysia began participating in the PISA international examination in 2009. PISA assessed 74 countries and, once again, Malaysia's performance is dismal, ranking Malaysia in the bottom one-third of all participating countries. Malaysia's performance likewise falls short of the global and OECD averages. Malaysian students' science performance in PISA 2015 and 2018 improved slightly but remained below the OECD average (MOE, 2013; IEA, 2000, 2004, 2008, 2012, 2016).

Factors Influencing Students' Scientific Literacy

Factor 1: Science Knowledge. Science knowledge is a cognitive component emphasised while educating pupils to be scientifically literate (Halim, 2009 & Olubu 2015). According to the OECD (2018), scientific knowledge refers to the fundamental scientific concepts necessary for comprehending natural occurrences and the changes in nature caused by human activity. It encompasses both knowledge of science (knowledge of nature) and knowledge about science (knowledge of scientific processes). Scientific knowledge also includes the physical, biological, and chemical sciences and technology. Understanding the scientific process establishes the primary foundation for scientific inquiry. It entails the relevance of scientific theory, scientific investigation, quantitative and qualitative data measurement, and systematic steps for empirically and tentatively establishing evidence. Scientific knowledge is then created through scientific explanation, which involves presenting, arguing for, and generating new knowledge, methods, and concepts based on the data from scientific studies. Because it incorporates practical or hands-on science activities and experiments, the constructivist science laboratory learning environment is considered capable of developing students' scientific inquiry. According to Hofstein et al. (2004) and Moeed (2015), when these experiments or laboratory activities are designed effectively, the learning experience received by students can potentially improve their comprehension and knowledge of science, hence increasing students' scientific literacy.

Factor 2: Constructivist Learning Environment. The learning environment substantially impacts students' ability to enhance their scientific literacy (Techakosit & Wannapiroon, 2015). Students' roles have shifted in constructivist learning contexts, such as in science labs and 21st-century conceptual classrooms, from just receiving knowledge to building knowledge with the support of teachers (Halim, 2009 & Terhart, 2003). This learning environment teaches students to collaborate, take on various roles, advocate for ideas, and participate in decision-making. Teachers have a responsibility to conduct student-centred activities that will boost students' learning processes, develop their ability and critical thinking skills, and in turn, will improve their achievement (Terhart, 2003 & Bay et al., 2012). A constructivist learning environment produces active students who can plan effectively, solve issues, critique, and create practical connections in their daily lives (Terhart, 2003; Bay et a., 2012).

Factor 3: Attitudes Toward Science. Attitude is one of the factors influencing scientific literacy and the learning environment (Chionh & Fraser, 2009). According to Ajzen (2012), attitude plays a significant role in determining human behaviour. Most studies on scientific learning settings have discovered a correlation between science learning environments and attitudes toward science (Wahyudi & David, 2004; Telli et al., 2006). Students' attitudes toward science reflect their 'affective behaviours, including their acceptance, appreciation, and devotion to science. Research has established that the learning environment is a significant predictor of students' attitudes toward science (Aldoplhe et al., 2003; Karpudewan & Chong, 2017). Attitudes towards science are essential when considering scientific literacy (Bybee & McCrae, 2011). This attitude encompasses knowledge, emotion, and propensity for action. This component affects students' continuous interest in science and issues relating to science (Bybee & McCrae, 2011). Scientific literacy was the primary domain examined in the PISA 2009 assessment, and the assessment's definition of scientific literacy included features of individual attitudes toward science (OECD, 2010). However, research examining scientific literacy place a lesser emphasis on the attitude component as a primary component.

Factor 4: Motivation and Self-Efficacy. Research has also stressed the critical relationship between students' learning settings, science literacy, and motivation (Jackson & Davis, 2000; Aldridge et al., 2013). Motivation is a mental process that directs pupils' choices, efforts, and persistence. According to Pintrich & Schunk (2002), the learning environment provides students with a variety of options and loci of control to increase intrinsic motivation, increased levels of self-efficacy, goal orientation, and other types of motivation. Bandura's social cognitive theory of self-efficacy explains that students will take greater initiative to learn science if they can attain the required objectives (Bandura, 1986). Students who have a high sense of self-efficacy are more likely to exert considerable effort on a given task, monitor its progress, and employ self-regulation mechanisms (Schunk & Pajares, 2005). Students who appreciate science had a greater chance of achieving favourable learning outcomes and subsequent high results on scientific literacy examinations (McNeil, 2013) Additionally, studies demonstrate that groups of students who exhibit strong emotions toward science learning, such as enthusiasm, enjoyment, and involvement, achieve high levels of scientific literacy (Topcu et al., 2016).

Thus, this study aims to develop a questionnaire on factors that influence students' scientific literacy based on three primary constructs, namely constructivist learning environment (CLE), attitude toward science (ATS), motivation, and self-efficacy (MSE). At the same time, test questions will be used to measure constructs; science knowledge (SK) and scientific literacy (SL).

Method
In this study, the construction of the instrument of factors influencing students 'scientific literacy is based on the following four steps:
Phase 1: Conduct content validity
Phase 2: Administer a pre-test
Phase 3: Use exploratory factor analysis for construct validity
Phase 4: Determine construct reliability

Research Context

350 form four students from daily government schools aged 16 years old were randomly selected. The sample involved ten schools in the state of Johor, and they had characteristics that were very similar to the actual study population. Table 1 shows the distribution of the respondents.

Table 1.
Respondents' Background

Background		N	%
Gender	Male	136	38.9
	Female	214	61.1
	Malay	264	75.4
	Chinese	75	21.4
Race	Indian	10	2.9
	Other	1	0.3
Type of class	Science	201	57.4
	Art	149	42.6
Science	A	65	18.6
subject grade	B	73	20.9
in national	C	77	22.0
(PT3)	D	122	34.9
examination	E	10	2.9
	F	3	0.9

Instrument Development

Phase 1: Conduct Content Validity

Questionnaires will be used to measure construct constructivist learning environment (CLE), attitude toward science (ATS), motivation, and self-efficacy (MSE). In contrast, test questions will measure construct science knowledge (SK) and scientific literacy (SL).

Expert validity was conducted, with a lecturer from MOHE and two science educators from MOE serving as experts in science education. These experts verified the content of each item. They also verified the instrument's accuracy in terms of language and terminology, as it was adapted from the original survey and translated from English to Malay. Table 2 summarises the constructs examined in this study. study.

Table 2
Construct, Subconstruct And Examples Of Items In The Questionnaire

Adaptation Sources	Subconstruct	No. of item	Example of items
Constructivist Learning Environment (CLE)			
Constructivist Learning Environment Survey (CLES) Taylor & Fraser (1991)	Personal Relevance	6	• My new learning starts with problems about the world outside of school.
	Uncertainty	6	• I learn that science cannot provide perfect answers to a problem.
	Critical Voice	6	• It is OK for me to ask the teacher why I have to learn this?
	Shared Control	6	• I help the teacher to plan what I'm going to learn.
	Student Negotiation	6	• I explain my understandings to other students
Attitude Toward Science (ATS)			
Test of Science Related Attitude (TOSRA) Fraser (1981); Kamisah, Zanaton & Lilia (2007)	Social implications of science	10	• Scientific discoveries are doing more good than harm.
	Normality of scientists	10	• Scientists do have enough time to spend with their families.
	Attitude to scientific inquiry	10	• Doing experiments is more good than finding out information from teachers.
	Adoption of scientific attitudes	10	• I like repeating experiments to check that I get the same results.
	Enjoyment of science lessons	10	• I would like to belong to a science club.
	Leisure interest in science	10	• Science lessons are fun.
	Career interest in science	10	• I would like to be a scientist after I leave school.
Motivation and Self Efficacy (MSE)			
Motivated Strategies for Learning *Questionnaire* (MSLQ) Pintrich, Smith, Garcia & McKeachie (1991)	Intrinsic motivation	14	• In a class like this, I prefer course material that really challenges me so I can learn new things.
	Extrinsic motivation	9	• Getting a good grade in this class is the most satisfying thing for me right now.
	Self-efficacy	8	• I'm confident I can learn the basic concepts taught in this course.

As shown in Tables 3 and 4, experts were also asked to review each question to identify the type of knowledge for construct science knowledge and the type of competency for construct scientific literacy. The questions for science knowledge and scientific literacy was adapted from PISA scientific literacy assessment (OECD, 2013, 2016).

Table 3.
Expert Review For Construct Science Knowledge

No.	Theme	Question	Type of science knowledge			
			Biology	**Chemistry**	**Physics**	**Technology**
1	Biodiversity	1	E1/E2/E3			
		2	E1/E2/E3			
2	Cloning	1				E1/E2/E3
		2				E1/E2/E3
		3				E1/E2/E3
		4				E1/E2/E3
3	Coral teeth	1		E1/E2/E3		
		2		E1/E2/E3		
		3		E1/E2/E3		
4	Ultrasound device	1			E1/E2/E3	
		2			E1/E2/E3	

Table 4.
Expert Review For Construct Scientific Literacy

No.	Theme	Question	Type of scientific literacy competency		
			Identify scientific issues	Explain the phenomenon scientifically	Using scientific evidence
5	Drinking water	1		E1/E2/E3	
		2		E1/E3	E2
		3		E1/E2/E3	
		4		E1/E2/E3	
		5			E1/E2/E3
6	Stickleback behaviour	1	E1/E3		E2
		2			E1/E2/E3
		3			E1/E2/E3
7	Smoking tobacco	1	E1/E2/E3		
		2		E1/E2/E3	
		3			E1/E2/E3
		4			E1/E2/E3
8	Rat smallpox	1		E1/E2/E3	
		2	E1/E2/E3		
		3	E1/E2/E3		
9	Major surgery	1	E1/E2/E3		
		2		E1/E2/E3	
		3	E1/E2/E3		
		4			E1/E2/E3
10	Wind farm	1	E1/E2/E3		
		2		E1/E2/E3	
		3			E1/E2/E3
		4			E1/E2/E3

* E1: Expert 1; E2: Expert 2; E3: Expert 3

Phase 2: Administer A Pre-Test
A pre-test was administered on 46 respondents aimed to ascertain respondents' feedback on the items in the instrument. Students were briefed on the aims of the study and how to respond to the questions and questionnaire. It took 1 hour and 20 minutes to complete responding to all of the items.

Phase 3: Using exploratory factor analysis for construct validity
Exploratory Factor Analysis (EFA) is used to review the variety of indicators or subconstructs in the instrument. In this study, researchers have conducted EFA for CLE, ATS, and MSE instruments because these instruments have subconstructs to be tested. In exploratory factor analysis, (Hair et al., 2010) stated that items with a low factor loading ($\lambda < 0.5$) would be phased out. EFA is used to determine the structure of latent variables formed from a set of variables. This EFA was implemented before testing the hypothesis. This analysis focused on applying data breakdown techniques to several factors to distribute the items according to their factors (Hair et al., 2010). In this study, EFA was conducted to identify the internal structure of 131 items for the CLE, ATS and MSE

constructs. The process of designing an instrument involves exploring the subconstructs underlying the CLE, ATS and MSE.

Phase 4: Determine construct reliability

Cronbach's alpha values were used to determine the reliability of each construct. The interpretation of the total score mean was offered, which was adapted from Nunnally (1997) interpretation.

Findings

EFA for Constructivist Learning Environment (CLE)

This construct includes 30 items that comprise five subconstructs or indicators: personal relevance, uncertainty, critical voice, shared control, and student negotiation. Each subconstruct consists of six items that will be assessed using the EFA. The Kaiser-Meyer-Olkin (KMO) and Bartlett's test values for CLE was conducted. The KMO value before item removal is 0.888 greater than 0.5, while Bartlett's test value is 0.000, which is greater than 0.05. Thus, supporting the factorability of the correlation matrix and suitable for factor analysis.

Based on the scree plot in Figure 1. there are five primary factors that contribute significantly to the overall variance in CLE.
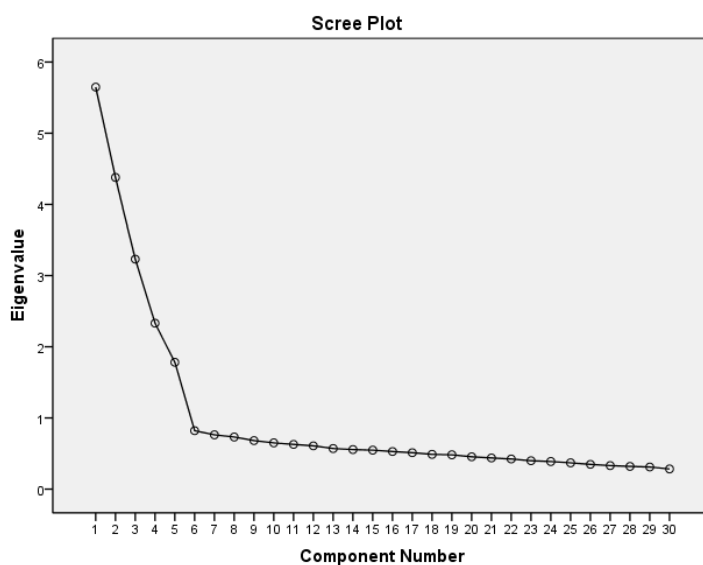
Figure 1. Scree plot for CLE

Five factors with eigenvalues greater than 1.0 were identified using principal component analysis. This factor contributes approximately 57.90% to the total number of the variance in construct CLE, as shown in the Table 5.

Table 5

Total Variance Explained For For Cle

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	5.648	18.826	18.826	5.648	18.826	18.826
2	4.379	14.597	33.422	4.379	14.597	33.422
3	3.231	10.770	44.193	3.231	10.770	44.193
4	2.330	7.768	51.961	2.330	7.768	51.961
5	1.782	5.939	57.900	1.782	5.939	57.900
6	.821	2.735	60.635			
.						
.						
30	.283	.944	100.000			

The Rotated Component Matrix demonstrated the relationship between the item and its factor after varimax rotation. Table 6 shows that the CLE variable contains five subconstructs, with all items belonging to their respective subconstructs and no items being confusing or belonging to other subconstructs. As a result, no items should be excluded from the CLE questionnaire.

Table 6
Rotated Component Matrix For Cle

No	Item	Component				
		Shared control	Uncertainty	Critical voice	Personel relevance	Student negotiation
1	Pka22	.813				
2	Pka20	.812				
3	Pka21	.808				
4	Pka23	.789				
5	Pka24	.786				
6	Pka19	.783				
7	Pke11		.816			
8	Pke9		.800			
9	Pke8		.796			
10	Pke12		.793			
11	Pke7		.792			
12	Pke10		.787			
13	Psu16			.749		
14	Psu14			.748		
15	Psu15			.745		
16	Psu18			.710		
17	Psu13			.699		
18	Psu17			.672		
19	Pre4				.734	
20	Pre3				.727	
21	Pre5				.723	
22	Pre2				.712	
23	Pre1				.702	
24	Pre6				.668	
25	Pru28					.715
26	Pru27					.697
27	Pru29					.686
28	Pru26					.674
29	Pru30					.642
30	Pru25					.633

Exploratory Factor Analysis for Attitude Towards Science

The attitude toward science includes 70 items comprising seven subconstructs as aforementioned. Each subconstruct consists of ten items that will be evaluated using the EFA. The KMO value for the ATS variable obtained was 0.934 which is greater than 0.50 indicating that the items are suitable for execution of factor analysis and the data have no problems with multicollinearity. The value of Bartlett's test of sphericity is 0.000, thus is significant at 0.05.

Based on the scree plot graph as shown in Figure 2 there are seven primary factors that contribute significantly to the overall variance in ATS.
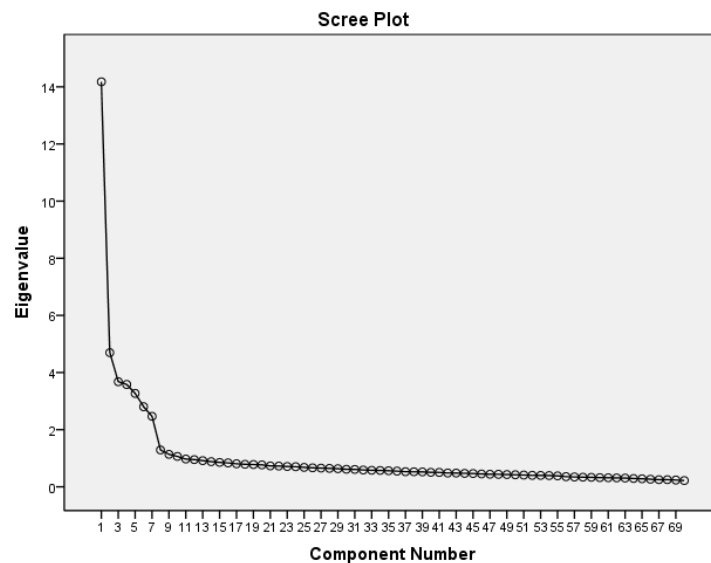
Figure 2. Scree plot for ATS

Table 7 shows the total variance explained for ATS by extracting it to seven main factors based on principal component analysis. The results of the seven-factor extract accounted for 49.53% of the overall variance change of the ATS variable.

Table 7
Total variance explained for ATS

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	**% of variance**	**Cumulative %**	**Total**	**% of variance**	**Cumulative %**
1	14.177	20.252	20.252	14.177	20.252	20.252
2	4.696	6.708	26.961	4.696	6.708	26.961
3	3.680	5.257	32.217	3.680	5.257	32.217
4	3.581	5.116	37.333	3.581	5.116	37.333
5	3.269	4.671	42.004	3.269	4.671	42.004
6	2.803	4.004	46.008	2.803	4.004	46.008
7	2.467	3.524	49.532	2.467	3.524	49.532
8	1.290	1.843	51.375			
.						
.						
70	.218	.311	100.000			

The Rotated Component Matrix showed the correlation between the item and its factor after varimax rotation. Table 8 shows seven constructs in the ATS variable where all items belong to their respective subconstructs, and no items are confusing or belong to other subconstructs. Therefore, no items should be excluded from the ATS questionnaire.

Table 8
Rotated component matrix for ATS

No	Item	Component						
		Normality of scientists	Career interest in science	Leisure interest in science	Enjoyment of science lessons	Attitude to scientific inquiry	Social implications of science	Adoption of scientific attitudes
1	Sno16	.785						
2	Sno58	.774						
3	Sno51	.753						
4	Sno9	.746						
5	Sno30	.732						
6	Sno65	.728						
7	Sno2	.725						
8	Sno44	.720						
9	Sno37	.719						
10	Sno23	.716						
11	Smk63		.737					
12	Smk49		.716					
13	Smk14		.714					
14	Smk56		.713					
15	Smk21		.704					
16	Smk42		.700					
17	Smk7		.677					
18	Smk70		.652					
19	Smk28		.650					
20	Smk35		.624					
21	Smi48			.752				
22	Smi55			.751				
23	Smi41			.701				
24	Smi13			.697				
25	Smi27			.675				
26	Smi34			.662				
27	Smi20			.657				
28	Smi6			.642				
29	Smi69			.623				

30	Smi62	.609			
31	Sks40		.724		
32	Sks47		.711		
33	Sks12		.707		
34	Sks26		.698		
35	Sks61		.695		
36	Sks68		.687		
37	Sks54		.669		
38	Sks5		.649		
39	Sks33		.632		
40	Sks19		.618		
41	Ssi52			.675	
42	Ssi24			.656	
43	Ssi59			.650	
44	Ssi31			.647	
45	Ssi17			.639	
46	Ssi66			.620	
47	Ssi3			.619	
48	Ssi10			.616	
49	Ssi38			.566	
50	Ssi45			.559	
51	Sim43				.657
52	Sim29				.644
53	Sim36				.636
54	Sim57				.613
55	Sim50				.594
56	Sim22				.593
57	Sim15				.585
58	Sim1				.583
59	Sim64				.575
60	Sim8				.560
61	Sad60					.706
62	Sad46					.604
63	Sad39					.590
64	Sad4					.590
65	Sad18					.581
66	Sad11					.578
67	Sad25					.566
68	Sad32					.556
69	Sad67					.551
70	Sad53					.504

Exploratory Factor Analysis for Motivation (MSE)

For the construct of MSE, there are 31 items that represent three subconstructs: intrinsic motivation, extrinsic motivation, and self-efficacy. Intrinsic motivation consists of 14 items, extrinsic motivation with 9 items, and self-efficacy consists of 8 items that will be screened using the EFA test. The KMO value was 0.920, which was greater than 0.50

and Bartlett's value was 0.000, which was smaller than 0.05, which indicated that the correlation between the items was suitable for factor analysis.

To determine the number of subconstruct in MSE, the researcher has referred to the scree plot graph as shown in Figure 3. According to the graph, there are three primary factors that contribute significantly to the overall variance in MSE.
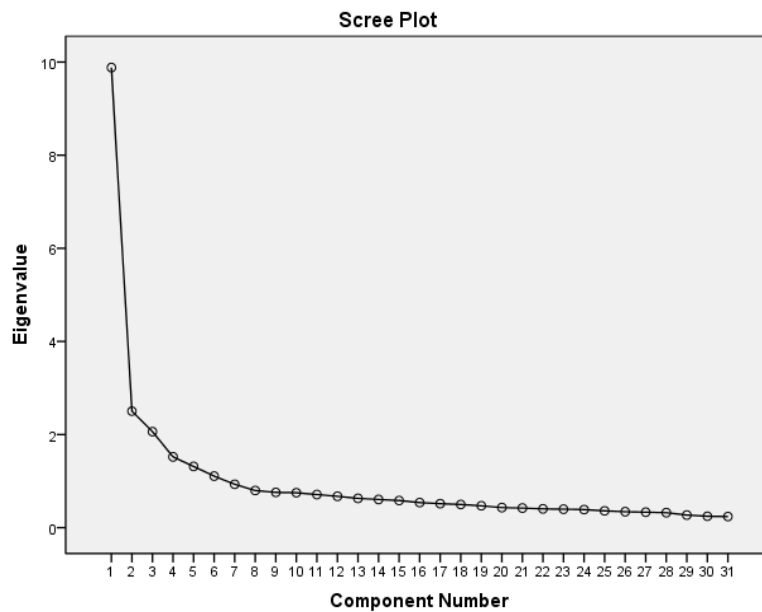

Figure 3. Scree plot for MSE

Table 9 shows the total variance explained for MSE by extracting it to three main factors using principal component analysis. The results of the three-factor extract accounted for 46.60% of the overall variance change of the MSE variable.

Table 9
Total variance explained for MSE

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	9.883	31.879	31.879	9.883	31.879	31.879
2	2.502	8.071	39.950	2.502	8.071	39.950
3	2.061	6.650	46.600	2.061	6.650	46.600
4	1.520	4.904	51.504			
.						
.						
31	.239	.771	100.000			

The Rotated Component Matrix showed the correlation between the item and its factor after varimax rotation. Table 10 shows that there are three subconstructs in the MEK variable where all items belong to their respective subconstructs. There are two items that are confusing or belong to other subconstructs, namely MiK4 and MiK25 items. Therefore, such items should be excluded from the MEK questionnaire.

Table 10.
Rotated Component Matrix For Mse

No	Item	Component		
		Intrinsic motivation	Self-efficacy	Extrinsic motivation
1	MiK23	.754		
2	MiK10	.721		
3	MiK27	.715		
4	MiK18	.686		
5	MiK17	.672		
6	MiK26	.662		
7	MiK16	.657		
8	MiK22	.644		
9	MiK2	.637		
10	MiK9	.625		
11	MiK4	.578	.315	
12	MiK25	.561		.302
13	MiK1	.551		
14	MiK24	.542		
15	EF20		.698	
16	EF15		.692	
17	EF29		.673	
18	EF5		.654	
19	EF6		.638	
20	EF21		.626	
21	EF31		.625	
22	EF12		.599	
23	Meks30			.431
24	Meks14			.732
25	Meks19			.732
26	Meks28			.732
27	Meks3			.666
28	Meks8			.611
29	Meks11			.541
30	Meks13			.486
31	Meks7			.359

Reliability Analysis

Each factor values of Cronbach alpha falls between 0.71 to 0.90. As seen in Table 11, each value indicated that all elements demonstrated good reliability.

Table 11
Cronbach's Alpha Value

Construct	Subconstruct	Bil. Item	Cronbach's alpha value
Constructivist learning environment (CLE)	Personal Relevance	6	0.84
	Uncertainty	6	0.89
	Critical Voice	6	0.85
	Shared Control	6	0.88
	Student Negotiation	6	0.83
Attitude toward science (ATS)	Social implications of science	10	0.83
	Normality of scientists	10	0.85
	Attitude to scientific inquiry	10	0.89
	Adoption of scientific attitudes	10	0.80
	Enjoyment of science lessons	10	0.89
	Leisure interest in science	10	0.90
	Career interest in science	10	0.89
Motivation and self-efficacy (MSE)	Intrinsic motivation	12	0.89
	Extrinsic motivation	9	0.78
	Self-efficacy	8	0.84
Scientific literacy	Identify scientific issues	15	0.71
	Explain the phenomenon scientifically	17	0.72
	Using scientific evidence	28	0.75
Science Knowledge		19	0.71

Interpretation of Total Score Mean

The questionnaire or instrument was based on a five-point Likert scale to gauge respondents' views on the three main constructs: constructivism learning environment, attitudes toward science, motivation, and self-efficacy. Mean scores for each construct were computed based on Nunnally and Bernstein (1994) interpretation of total score mean which were low (score mean: 1.00-2.00), medium-low (score mean: 2.01-3.00), medium-high (score mean: 3.01-4.00) and high (score mean: 4.01-5.00).

Discussion And Implication

This study developed a survey instrument to determine the factors influencing students' scientific literacy which was based on previous instruments Taylor and Fraser (1991), Fraser (1981), Osman et al. (2007) and Pintrich et al. (1991), while the test question instrument was based on PISA scientific literacy assessment (OECD, 2013, 2016). The study also adopted the Bandura's Social Cognitive Theory (Bandura, 1986) that was integrated with the Huitt's Teaching and Learning Model Huitt (2021) and PISA Scientific Literacy Model (OECD, 2013).

A total of 129 items for construct CLE, ATS, and MSE was developed. In the development of the instrument phase, validity and reliability analyses were performed on 131 items due to expert evaluations. The content validity was obtained from experts while construct validity was established through EFA. As a result of EFA, it was found that the construct CLE had five subconstructs, and it explained 57.90% of the total variance;

construct ATS had seven subconstructs, and it explained 49.53% of the total variance; while constructs MSE had three subconstructs that explained 46.60% of the total variance. The EFA results indicated that the scale had a valid structure. In addition, based on the Cronbach's alpha values that measure the internal consistency of items, it was concluded that the scale was reliable.

The developed instrument's validity and reliability will be improved in future studies if the identified factors are subjected to CFA analysis. A model of students' scientific literacy can be constructed using the findings of this study. Interventions aimed at improving students' scientific literacy should take these considerations into account when devising a strategy. Understanding the factors that influence students' scientific literacy will help us better understand how to enhance people's knowledge about science and apply science in their everyday lives.

Construct validity is a critical step in developing a scientific questionnaire measurement scale. Construct validity essentially grows over time, and this scale needs further adjustment to improve its reliability and ability to explain variance across contexts, cultures, and conditions. A suggestion for future research is to look into a random sample size, generalisation, and model validity.

Conclusion

Exploratory factor analysis was used to establish the validity of the proposed constructs. The developed instrument, based on the empirical data, comprised of validated measures of factors that influence students' scientific literacy in the context of science education research. This study offers several research implications and directions for academics and practitioners looking to learn more about the factors that influence students' scientific literacy. Overall, according to EFA, the CLE has five constructs, the ATS has seven constructs, and the MSE has three constructs with a total of 129.

Based on the exploratory factor analysis in the measurement model, it can contribute to providing additional research on the structural model of scientific literacy by supporting and confirming the variables found in Bandura's Social Cognitive Theory and supporting the claims that there is a reciprocal relationship between: (i) personal factors such as motivation and self-efficacy; (ii) attitude toward science; and (iii) a constructivist learning environment. The factors that affect scientific literacy are also in line with the PISA Scientific Literacy Model, which shows how important factors like students' attitudes, knowledge, and the learning environment they are in affect their scientific literacy. For example, if teachers want to improve students' attitudes toward science, they must carry out activities that apply scientist characteristics, activities that pique students' interest in science, adapt scientific attitudes, and carry out investigational activities. Teachers must address these factors to develop students with scientific literacy ability.

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