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Testing the Construct Validity and Reliability of the Student Learning Motivation Scale Using Confirmatory Factor Analysis (CFA)

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Abstract: Constructivist learning environments are created by utilizing constructivist theory to raise teaching standards and motivate students to learn more. The low level of student motivation in the learning process is caused by several problems that occur. Thus, learning motivation is very important in the progress of learning, namely to encourage enthusiasm during the learning process. This research aims to measure students' learning motivation. The sample for this research was fourth grade elementary school students. This research uses a quantitative approach designed using measuring instruments in the form of questionnaires. The results of the research show that these four aspects are: the desire and desire to succeed, the appreciation for learning, the desire to be interested in learning, and optimism. There is one indicator that does not meet the criteria, namely the reward aspect of learning. Therefore, the three aspects that have been described are proven to meet the criteria of goodness of fit, validity and construct reliability. Therefore, the scale developed is suitable for use in collecting data to measure student learning motivation.

Keywords: Confirmatory Factor Analysis (CFA); Construct Validity; Motivation Scale; Reliability

Introduction

Create a pleasant learning and learning atmosphere with the aim of students being able to develop their potential both spiritually, religiously, self-control, personality, intelligence, noble morals, and the skills needed by themselves and society (Pristiwanti et al., 2022). Meanwhile, according to Umardianti et al. (2023), education as an effort plays a major role in improving the quality of human resources. Through education, certain individuals are motivated to develop attitudes, knowledge and skills to be better and more advanced than before. Regarding developing one's potential, science learning in elementary schools has an important role in solving everyday life problems (Sakila et al., 2023; Narut & Supardi, 2019; Pratiwi et al., 2019). In line with opinion Dolong (2016), science learning is a learning that emphasizes understanding direct experience for students with the aim of developing the ability to explore and understand the natural environment naturally. In line with opinions Veronica et al. (2018), stated that science learning in elementary schools should provide freedom for students to create an idea or an interpretation of something in a lesson in order to design and discover something independently.

Science learning in learning must stimulate children's activity and creativity, be effective and interesting for students, but in fact science subjects are not in great demand and receive less attention (Purwaningtyas et al., 2021). Science learning is one of the subjects taught at all levels of education starting from elementary school (SD) to university (Gumilar & Permatasari, 2022; Kholidah & Sari, 2023). Science learning is related to how to find out about nature systematically so that it requires mastery of a collection of knowledge in the form of facts, concepts, principles

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and the process of discovery (Amikratunnisyah & Fatonah, 2023; Julianto et al., 2024). According to opinion Benanane & Mekkakia (2021) revealed that the science learning process in elementary schools discusses basic science learning concepts and materials which will help students with science learning materials at a further level. Therefore, it is very important for teachers to determine the right learning method to properly instill science learning material from elementary school (Mystakidis & Christopoulos, 2022).

Teachers and students have the ability to master concepts. The concept in question is learning material that is interrelated so that students can understand other concepts if students understand one concept correctly (Sari et al., 2024). The aim of learning science at the elementary level is to improve the creative abilities of elementary school students in creating things. The main goal of science learning is to increase students' understanding of scientific concepts and their application in everyday life so as to foster a positive disposition to overcome challenges in the surrounding environment (Nur'ariyani et al., 2023; Odja, 2023). Based on interviews and observations conducted in class IV of SD Kalasan Baru, SD Muhammadiyah Dhuri, SDN Karangnongko 1, and SDN Karangnongko 2, Kalasan District in September 2022, in science learning there were several problems, namely as follows: low learning motivation of students; teacher-centered learning results in passive learning; inadequate facilities and infrastructure. Seeing the extent of this problem, researchers limited the problem to students' low learning motivation.

Based on this explanation, learning motivation greatly influences learning. Learning motivation is a driving force that makes someone interested in learning so that they will learn continuously (Pratama et al., 2019). The novelty of this research lies in the development of a student learning motivation instrument using CFA factor loading. Even though there is a lot of research on motivation to learn science in grade IV, research conducted in Kalasan District is still limited. Therefore, researchers conducted research on learning motivation instruments for science learning at Kalasan Baru Elementary School, Muhammadiyah Dhuri Elementary School, Karangnongko 1 Elementary School, and Karangnongko 2 Elementary School.

Method

This research uses a quantitative approach designed using measuring instruments in the form of questionnaires. This research sample was obtained from eight elementary schools in Kalasan District which were the research locations and data collection places. The sample for this research was 300 respondents, randomly selected participants. Based on opinion Kyriazos et al. (2018) states that the sample size for factor analysis is 50 very poor, 100 poor, 200 fair, 300 fair, 500 good, and 1,000 very good. Therefore, the sample used by researchers of 300 respondents can be said to be good in carrying out factor analysis. The following research procedures can be seen in Figure 1.

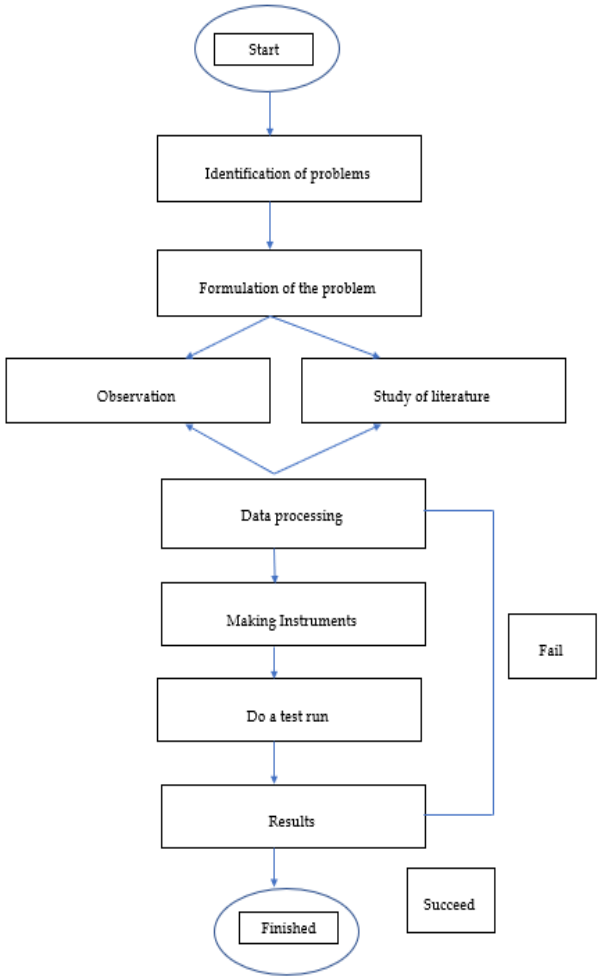

Figure 1. Research Procedures

The variable examined in this research is learning motivation in elementary school students. Researchers measured the learning motivation variable with four aspects and 20 items. These four aspects consist of; there is a desire and desire to succeed, there is appreciation for learning, there is an interesting desire to learn, and optimism. Each aspect is measured with 5 items. The following table explains the distribution of indicators and items measuring learning motivation.

Table 1. Distribution of learning motivation indicators and items

Indicator	Measurement Items	Code
There is passion and desire to succeed	I am enthusiastic about doing tasks without needing to be reminded by people.	A1
	I am lazy about doing assignments even though my parents have reminded me.	A2
	I am not interested in doing practicum during ongoing science learning.	A3
	I feel calm if my task is completed before the specified time.	A4
	When I don't do my assignments I feel normal and not embarrassed by my friends.	A5
There is appreciation in learning	I feel happy to receive praise and support from my father/mother when my science grades are good.	B1
	I feel unhappy when a friend gets it appreciation from teachers.	B2
	When I received an award from my teacher, I acted arrogantly to friends.	B3
	I feel angry when I don't get appreciation from teachers and parents When I succeed in doing something well.	B4
	I felt happy to get applause from the teacher because I dared to do practical work in front of the class.	B5
There is an interesting desire to learn	I don't like when there are games in learning IPA.	C1
	I am happy when before learning to do ice breaking (game so you don't get bored easily).	C2
	I like it when the teacher explains material about static and dynamic electricity using interesting learning media.	C3
	I feel bored if the teacher only explains electricity by telling stories.	C4
	I pay attention to the teacher when explaining static and dynamic electricity material.	C5
Optimistic	I don't give up easily if I don't understand the material about static and dynamic electricity.	D1
	I easily give up when I have difficulty practicing static and dynamic electricity material.	D2
	I feel capable of answering quizzes on the static and dynamic electricity material given by the teacher.	D3
	I easily get discouraged if I don't understand static and dynamic electricity.	D4
	I feel capable of getting a perfect score in science subjects.	D5

Data collection was carried out by distributing learning motivation questionnaires to students. Data was obtained from 300 respondents who filled out the survey. The learning motivation questionnaire used is in accordance with the research variable construct which consists of 20 items from four aspects. This questionnaire uses a Likert scale; strongly agree, agree, disagree, disagree and strongly disagree.

Data Analysis

The two main requirements in instrument development are the validity and reliability of a research model (Samuel, 1989). Therefore, this study uses second order confirmatory factor analysis (2nd order CFA). According to O'Rourke & Hatcher (2013) states that CFA is suitable for determining the construct validity and reliability of instruments. Besides that, Black et al. (2010) states that CFA can be used to test not only construct validity, but also establish reliability. Hill & Hughes (2007) states that CFA allows factors, variances and relationships between latent constructs to be reviewed. In this case, it allows the establishment of convergent validity and discriminant validity.

Result and Discussion

Factor Loading

The two results of second-order confirmatory factor analysis (CFA) are the determination of factor loadings (λ) of each item and the factors that develop the scale. Researchers provided four factors consisting of 20 items, but after initial analysis it was found that only 13 items were valid.

According to Tentama (2018) construct validity and reliability of the indicators (items) forming the latent construct by conducting Confirmatory Factor Analysis (CFA). Testing the validity and reliability of the instrument is carried out so that when conducting research using confirmatory factor analysis, valid and reliable data is obtained. The 2nd Order CFA test was carried out by looking at the factor loading values (> 0.5) and the calculated t value (> 1.96). A factor loading weight of 0.50 or more is considered to have strong enough validity to explain the latent construct. The weakest acceptable factor loading is 0.40. Therefore, researchers used factor loadings of 0.40 in determining factor loadings. According to the results of the second order confirmatory factor analysis in Figure 1, it was found that all items and factors showed factor loadings > 0.4. Thus, 13 items out of the initial 20 items were significant and suitable for use in data collection.

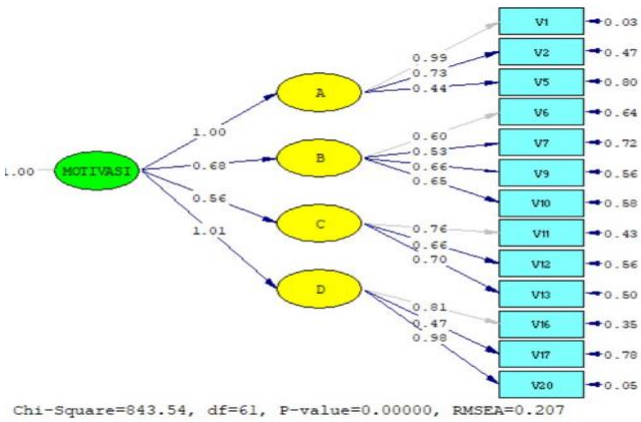

Figure 2. Factor and item loadings

Construct Validity

Construct validity is a validity that assesses how far test items are able to measure what they really want to measure in accordance with a specific concept or conceptual definition that has been determined. Construct validity as an approach to ensuring that a set of variables represents the theoretical latent construct being measured. Fornell & Larcker (1981) noted that the construct validity of confirmatory factor analysis includes two main tests, namely the convergent validity test and the discriminant validity test. Campbell & Fiske (1959) explains that convergent and discriminant validity are important requirements for every instrument development to obtain data that can be accounted for psychometrically. Thus, this study reports convergent and discriminant validity.

Convergent Validity

Convergent validity aims to test the magnitude of the correlation between indicators and latent variables (Junianto & Sabtohadi, 2020). Recommends average variance extracted (AVE) as a measure of convergent validity because AVE can explain the extent to which items are shared between constructs in structural equation modeling (SEM) where an AVE of 0.5 or more is acceptable as convergent validity. The following AVE values are presented in Table 2.

Table 2. Convergent Validity

Aspect	Item	ƛ	ƛ^2	1- ƛ^2	AVE (ω)	DIS (√^2)
A	A1	0.99	0.98	0.01	0.56	0.75
	A2	0.73	0.53	0.46		
	A3	0.44	0.19	0.80		
Σ		2.16	1.79	1.29		
B	B1	0.60	0.36	0.64	0.45	0.67
	B2	0.53	0.53	0.34		
	B3	0,66	0.43	0.56		
	B4	0.65	0.42	0.57		
Σ		2.44	1.74	2.12		
C	C1	0.76	0.57	0.42	0.50	0.70
	C2	0.66	0.43			
	C3	0.70	0,49			
Σ		2.12	1.50			
D	D1	0.81	0.65	0.34	0.61	0.78
	D2	0.47	0.22	0.77		
	D3	0.98	0.96	003		
Σ		1.45	1.83	1.16	1.45	

The development of the scale in this research involved four constructs, namely the desire and desire to succeed, the appreciation for learning, the desire to be interested in learning, and optimism. The research results show that the AVE values for the four constructs are: 0.56, 0.45, 0.50, 0.61 respectively. In the figure, constructs A.C AND D exceed the threshold AVE value > 0.50, it is concluded that they can measure latent variables. Therefore, they meet the criterion of convergent validity. Meanwhile, construct B does not exceed the AVE value but has a large discriminant.

Discriminant Validity

Discriminant validity aims to determine the principle that measurements of different constructs should not be highly correlated. Each indicator will be said to be able to explain its variable compared to other variables if the cross-loading value between the indicator and its latent variable is > than the cross-loading value between the indicator and the other latent variable. That discriminant validity can be established by correlating one construct with other constructs. If the correlation value of the two constructs is lower than 0.85, it means that discriminant validity exists. Additionally it argues that discriminant validity exists if a latent variable shows more variance in its associated indicator variables than it shares with other constructs in the same model.

Table 3. Discriminant validity

Aspect	Item	ƛ	ƛ^2	1- ƛ^2	AVE (ω)	DIS (√^2)
A	A1	0.99	0.98	0.01	0.56	0.75
	A2	0.73	0.53	0.46		
	A3	0.44	0.19	0.80		
Σ		2.16	1.79	1.29		
B	B1	0.60	0.36	0.64	0.45	0.67
	B2	0.53	0.53	0.34		
	B3	0,66	0.43	0.56		
	B4	0.65	0.42	0.57		
Σ		2.44	1.74	2.12		
C	C1	0.76	0.57	0.42	0.50	0.70
	C2	0.66	0.43			
	C3	0.70	0,49			
Σ		2.12	1.50			
D	D1	0.81	0.65	0.34	0.61	0.78
	D2	0.47	0.22	0.77		
	D3	0.98	0.96	003		
Σ		1.45	1.83	1.16	1.45	

The results presented in Figure 2 inform that the four latent constructs each have a square root AVE: 0.75, 0.63, 0.70, 0.78. The square root of the AVE of the four latent constructs is greater than the inter-construct correlation. Thus, the four latent constructs have met the criteria for discriminant validity.

Reliability Test

Reliability testing is carried out with the aim of measuring the internal consistency of the measuring instrument. The reliability test can be used with the Cronbach's alpha method. Cronbach's alpha is a measurement of the lower limit of the reliability value.

The role of thumb of Cronbach's alpha is that greater than 0.6 is still acceptable.

Table 4. Cronbach's alpha value Reliability Statistics

Cronbach's Alpha	N of Items
0.876	20

Based on the results of these data tests, it can be seen that the Cronbach's alpha value of each latent variable analyzed meets the reliability test criteria. It can be seen that Cronbach's alpha is 0.8 which is greater than 0.6. Thus, the instrument for measuring the latent variable in this variable is reliable.

Discussion

The same is true of the opinion expressed by Cook & Artino (2016). Learning motivation is the driving force that motivates and maintains students to be involved in learning activities, thereby enabling them to achieve learning goals. The existence of high learning motivation and interest in learning from students can influence high student learning outcomes (Ananga, 2020; Lin et al., 2017; Tamba et al., 2023). The higher the student's learning motivation, the more happy and interested they will be when doing something, and vice versa (Haryani & Nursanti, 2022). Thus, learning motivation is very synonymous with the level of interest in learning (Asmawiyah, 2021). In line with opinion Simamora & Simamora (2022), whether the learning provided by the teacher is interesting or not can determine the motivation of students to be more enthusiastic in participating in learning.

Simple things to increase learning motivation such as students feeling respected and cared for by the teacher, then this has an effect on their motivation so that learning will greatly improve. Educators need to strive to increase students' enthusiasm for learning by providing support in the form of appreciation and reinforcement for academic achievement and attention to their studies, providing feedback that makes students feel capable (Almomani et al., 2023). In line with opinions Yanti et al. (2013) that learning motivation can be raised by a conducive classroom atmosphere, close relationships between friends and friendly teacher treatment. Motivation from teachers, the school environment, and the family environment influence students' thinking abilities and curiosity so that they can grow and develop well (Irwandi et al., 2024). According to Nasrah (2020), motivation is someone's encouragement to change behavior in a better direction to achieve their goals.

Motivation to learn can arise due to intrinsic factors, in the form of desire and desire to succeed and encouragement of the need to learn, hope for ideals. Meanwhile, the extrinsic factors include awards, a conducive learning environment, and interesting learning activities. Zimmerman & Schunk (2013) suggests that intrinsic motivation arises from within the individual, comes from internal rewards and not from external ones such as grades or money. Intrinsically motivated students derive pleasure from the task itself or from satisfaction in completing and completing a task. However, student motivation, academic performance, and achievement can never be fully understood without considering environmental influences. In line with opinions Do et al. (2023), constructivist learning environments are created by utilizing constructivist theory to raise teaching standards and motivate students to learn more. The low level of student motivation in the learning process is caused by several problems that occur. Thus, learning motivation is very important in the progress of learning, namely to encourage enthusiasm during the learning process.

Thus, to obtain data on the quality of student learning motivation, an assessment is needed. In the assessment for learning view, assessment is the core of the teaching and learning process. Assessment is the process of assigning grades based on measurement results based on criteria with certain quality values. Learning assessment aims to close learning gaps by improving performance through providing feedback durin Assessment is a series of activities to obtain, analyze and interpret data about the student learning outcomes process which is carried out systematically and continuously so that it becomes meaningful information in making decisions. In line with opinion of the learning process.

Assessment is a series of activities to obtain, analyze and interpret data about the student learning outcomes process which is carried out systematically and continuously so that it becomes meaningful information in making decisions. Assessment in education is an important component in the learning process. Assessment is a process of collecting, analyzing and interpreting information to determine the level of achievement of students' learning objectives. Therefore, assessment instruments are very necessary. This research aims to develop an instrument for student learning motivation by testing construct validity and reliability.

Conclusion

Based on this discussion, it can be concluded that these four aspects are: the desire and desire to succeed, the appreciation for learning, the desire to be interested in learning, and optimism. There is one indicator that does not meet the criteria, namely the reward aspect of

learning. Therefore, the three aspects that have been described are proven to meet the criteria of goodness of fit, validity and construct reliability. Therefore, the scale developed is suitable for use in collecting data to measure student learning motivation.

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Author Contributions
G. G: drafter and original author of the manuscript starting from the introduction to the bibliography. H. S and H: research supervisors and article writing.

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Conflicts of Interest
The author declares that there is no conflict of interest regarding the publication of this manuscript.

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