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

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Abstract: Learning interest is one of the determining factors of student learning success. The low interest of students in learning process is caused by several problems that occur. Thus, learning interest is very important in learning progress, namely to bring out students' interest and activeness in learning. To support learning and increase students' interest in learning, teachers should not only master the material but also create interesting learning to help arouse curiosity, enjoyment and interest in learning in them. This study aims to test the validity and reliability of the construct of the developed learning interest scale. A researcher needs 250 to 500 respondents. This study involved 300 random samples of fifth grade elementary school students in Berbah District, Sleman, Yogyakarta, Indonesia. Data were analyzed with second-order confirmatory factors assisted by IBM SPSS version 26 software. This study measures the validity and reliability of elementary school students' interest in learning science. So the data analysis in this study measures validity and reliability. So this study uses second order confirmatory factor analysis (nd order CFA). The results showed that the developed learning interest scale had met the criteria of suitability, convergent validity, discriminant validity, construct reliability. Therefore, the developed scale is feasible to use.

Keywords: Confirmatory factor analysis; Construct reliability; Convergent validity; Discriminant validity; Learning interest scale

Introduction

Learning outcomes will come if students have a great will and attention to always learn and do exercises. Interest or passion in learning plays an important role as a driver of learning activities to achieve learning goals. This is because interest is closely related to a person's feelings that cause involvement in learning activities. Interest is not a single form but a multidimensional one that consists of several aspects that change according to the flow and are semi-stable (Rotgans & Schmidt, 2017). The greater a student's interest in learning, the greater the learning outcomes and achievement of learning goals (Andayani, 2022). The level of interest in learning can be seen based on the willingness of someone to be involved in an activity to direct them to a choice (Purnami, 2022). Activities in learning interest can be in the form of feelings of interest or curiosity to follow. The existence of learning interest can be known if it has been manifested in the form of attitudes that are displayed.

Learning interest will also affect the reasons for learning and how they learn. Interest is considered important to have in order to understand, absorb knowledge, which will affect the results and achievements of learning (Andira et al., 2022). Students who have a high interest in learning will tend to show seriousness in learning in class and learning activities. One of the attitudes shown when someone has an

interest in learning is activeness and participation in learning activities. Interest in learning if defined conceptually is the desire, interest, or motivation that someone has to explore, understand, and learn something. Interest in learning can affect various aspects that are displayed such as emotional, cognitive, and behavioral that encourage active involvement in the learning process. Individuals will be motivated to learn if it is in accordance with what they need (Yuwanita et al., 2020). Other research groups interests into two, namely situational (conditional) interests and individual (personal) interests depending on stability in various conditions (Hidi, 2006). According to Schraw and Lehman (Lee et al., 2023), conditional or situational interest is a spontaneous reaction that is specific in a certain context, which is accepted mentally, and is temporary in nature, whereas individual interest is a form of knowledge and attitude that persists in various situations.

Situational or condition-based interest is believed that this type of interest is triggered by the presence of direction intervention therefore this situational interest can motivate students and become an important topic in designing direction. Instructional activities are in the form of discussions, practices, peer learning, and various forms of learning that trigger student interaction which are directly recommended to give rise to situational interest (Linnenbrink-Garcia et al., 2013). Thus, to support learning and increase students' interest in learning, teachers should not only master the material but also create interesting learning to help arouse curiosity, pleasure and interest in learning in themselves. Related to learning interest based on the results of pre-research observations conducted in several schools in Yogyakarta State Elementary Schools, interest in learning science still needs to be improved. This is because science subjects are included in subjects that are considered quite difficult for students because the scope of this material is very broad and requires concentration and analytical thinking as well as great attention during the implementation of learning.

Science learning is one of the subjects taught in elementary schools. Science is one of the disciplines that solves problems related to nature that are systematically arranged. Science in its learning requires students to be active in learning because science is a learning that provides the opportunity to experience and discover for themselves the meaning of the material being taught (Lusidawaty et al., 2020). Science lessons taught in elementary schools are subjects that contain natural knowledge which includes: living things, humans, plants, animals and things related to growth or development in living things and things related to nature. Apart from that, the use of media and teacher creativity in learning will influence students' interest in

learning science. In relation to teacher creativity in learning, one of the factors that influences a person's interest in learning is external factors. There are actually two factors that influence students in learning, namely internal and external. According to Bandhu et al. (2024), Internal factors include physical development, mental, talent and intelligence and motivation while external factors are social factors in the form of family and school, or non-social (facilities and infrastructure and learning approaches). The learning approach and creativity of teachers make interesting media have a role in increasing students' desire or interest in learning. Interest in learning will grow if the learning environment and learning activities can attract students' attention (Suwanto, 2022).

The implementation of teaching and learning by teachers must be able to create interesting learning activities. The way is not only by applying learning models and various methods, teachers who are creative in making media are also those who can attract students' attention to follow the lesson. This is in line with what was conveyed by Permatasari et al. (2019), that by varying learning using learning models and media can affect students' interest or interest in learning. Developing students' interest in learning also has aspects that can build it. The aspects of interest in learning are put forward by several experts. The aspect of interest in learning has four aspects, namely: having a liking for learning, having an interest in learning, having attention, having student involvement in following the learning process. Also delivered by Yunitasari et al. (2020), the aspect of learning interest consists of four aspects including, feelings of interest and pleasure in learning, active student participation, a tendency to pay attention, having positive feelings and a willingness to learn, and comfort in learning. Other aspects of students' interest in learning are: having feelings of pleasure, interest, active participation, attention, willingness to learn and comfort in learning. This aspect of learning interest will later be used as a guideline in compiling indicators for learning interest. In addition to the aspect of learning interest, there is also assessment as a measuring tool in learning.

According to Schildkamp et al. (2020), assessment is a systematic and continuous process or activity to collect information about the process in order to make decisions based on certain criteria and considerations. Forsell et al. (2020), groups the assessment function in educational and teaching evaluation activities, namely to find out the progress and development and success of students after experiencing or carrying out learning activities for a certain period of time., to find out the level of success of the teaching program. Teaching as a system consists of several components that are interrelated with each other. In addition, according to Zekarias (2023), the

assessment process must be an inseparable part of the learning process, not a separate part of the learning process (part of, not a part of instruction), assessment must reflect real-world problems (real world problems), not the school world (schoolwork-kind problems), assessment must use various measures, methods, and criteria that are in accordance with the characteristics and essence of the learning experience, and assessment must be holistic, covering all aspects of learning objectives (knowledge, affective, and sensory-motor). Indicators or benchmarks for learning interest are showing a feeling of pleasure when starting a lesson and showing readiness to follow the learning, showing interest in following the learning and showing an enthusiastic attitude in learning, showing activeness in learning by asking and answering questions and showing active participation in learning, both group discussions and independently, showing a great desire to follow the learning and showing seriousness in following the learning.

Method

This study uses a quantitative approach. This study is to measure the scale of interest in learning science that meets the criteria of validity and reliability. The design of this study is experimental, namely using quasi-experiments. The design of this study uses nonequivalent control group design. The design of this study is described in the following table.

Table 1. Research Design

Class	Pretest	Treatment	Posttest
Experiment	O1	XT	O2
Control	O3	XC	O4

Description:
O1: Pretest of experimental class
O2: Posttest of experimental class
O3: Pretest of control class
O4: Posttest of control class
XT: Experimental class treatment (learning applies Project Based Learning model).
XC: Control class treatment (learning applies direct learning model).

This study was conducted in an elementary school in Berbah District, Sleman Regency, which is the location where the researcher took the data. The research sample was taken as many as 300 respondents who were selected randomly or random participants. The sample size in this study is a concern for researchers because of advances in statistical approaches and modeling and the ease of operating software that results in requirements for various sample sizes in testing a model. According to, to achieve the right calculation with CFA, a researcher needs 250 to 500 respondents. While according to, it is suggested that respondents must meet around 500 respondents. In addition, according to Comley & Lee, determining a sample size of 50 is very lacking, 100 is lacking, 200 is sufficient, 300 is good, 500 - very good and 1000 - very good. Based on this definition, the sample size used by the researcher of 305 respondents can be said to be good for conducting factor analysis. The variables studied in this study were the interests of elementary school students in learning science. The researcher measured the variables with 4 aspects and several indicators. This study aims to develop a scale of interest in learning science, namely validity and reliability.

Table 2. Aspects and Indicators of Learning Interest

Aspects	Indicators	Statement Item	Code
The joy of learning	Showing a feeling of joy when starting learning	I always follow the learning with enthusiasm	A1
		I am happy when the learning has started	A2
	Showing readiness to follow learning	I study without being told by the teacher and parents	A3
		When the teacher asks questions, I just keep quiet	A4
	Showing interest in learning	I am interested in the learning material taught by the teacher	B5
Interest in learning		I write down what I learn in the learning	B6
		I am enthusiastic about listening and following the learning	B7
	Showing an enthusiastic attitude in learning	I have a high curiosity in understanding how to write a good short story	B8
Attention/concentration in learning	Showing a great deal of attention in following learning	I pay attention to the teacher when explaining the learning material	C9
		I can concentrate and focus well when the teacher explains the learning material	C10
		I note down important things from the teacher's explanation related to the learning material	C11
	Showing seriousness in learning	I do the assignments given according to the teacher's instructions	C12
		I reread the results of the assignments I have done	C13
		I repeat the lessons given by the teacher at home.	C14

Aspects	Indicators	Statement Item	Code
	Showing awareness of the importance of learning	I study at night before attending the lesson the next day	C15
Involvement in learning	Showing activeness in asking questions	I actively ask and answer questions from the teacher related to the learning material	D16
		I am lazy if I have to work together in a group during learning	D17
		I prefer to play rather than follow the learning	D18
		I am happy when participating in group work activities.	D19
		I like to daydream in class during learning	D20

Data collection in this study was conducted by distributing a questionnaire on learning interests to students. Data were obtained from 300 respondents who filled out the survey. The learning interest questionnaire used was in accordance with the construct of the research variables consisting of 20 statement items from four aspects. This questionnaire uses a Likert scale: very good, good, less good, and not good.

Data Analysis

Two requirements in developing an instrument are the validity and reliability of a research model. This study measures the validity and reliability of elementary school students' science learning interests. So, the data analysis in this study measures validity and reliability. So, this study uses second-order confirmatory factor analysis (second order CFA). CFA is very appropriate

for determining construct validity and reliability in an instrument. In addition, according to Hill et al. (2007), it states that CFA allows factors, variances, and relationships between latent constructs to be reviewed. In this, it can be interpreted that CFA allows the formation of convergent and discriminant validity.

Result and Discussion

The results of this study are as follows:
Factor Loading

The results of the second-order confirmatory factor analysis (CFA) are the determination of the loading factor (λ) of each item and factor using the scale. Initially, the researcher provided four factors involving 20 items, but after the initial analysis, 13 valid items were found. This can be seen in the following table:

Table 3. Factor Loadings and Items

Indicators	No	Statement Item	Λ	AVE	DIS (√^2)
Shows a feeling of joy when starting learning	1	I always follow the learning with enthusiasm	0.62		
	2	I am happy when the learning has started	0.71	0.72	0.84
Shows interest in learning	3	I study without being told by the teacher and parents	0.77		
	4	When the teacher asks questions, I just keep quiet	0.77		
Shows a great deal of attention in following learning	5	I am interested in the learning material taught by the teacher	0.21		
	6	I write down what I learn in the learning	0.75		0.80
	7	I am enthusiastic about listening and following the learning	0.80	0.64	
Indicators	8	I have a high curiosity in understanding how to write a good short story	0.80		
Shows a feeling of joy when starting learning	9	I pay attention to the teacher when explaining the learning material	0.16		
Shows interest in learning Shows a great deal of attention in following learning	10	I can concentrate and focus well when the teacher explains the learning material	0.21		
	11	I note down important things from the teacher's explanation related to the learning material	0.68	0.57	0.75
	12	I do the assignments given according to the teacher's instructions	0.75		
	13	I reread the results of the assignments I have done	0.75		
	14	I repeat the lessons given by the teacher at home.	0.70		
	15	I study at night before attending the lesson the next day	0.72		
Indicators	16	I actively ask and answer questions from the teacher related to the learning material	0.55		
	17	I am lazy if I have to work together in a group during learning	0.73	0.66	0.81
	18	I prefer to play rather than follow the learning	0.79		
	19	I am happy when participating in group work activities.	0.67		
	20	I like to daydream in class during learning	0.59		

Loading factor is the correlation of each variable and its factor. Loading factor is also a way to interpret the role of each variable in defining its factor. Therefore, a larger loading factor will load more representative variables for that factor. It was also stated by Cheung et al. (2024) that loading factor> 0.50 is practically significant. So based on the table above, the results of the CFA factor analysis assisted by IBM SPSS version 26 software found that there were 17 items that were declared valid and suitable for use, while 3 items were declared invalid or did not meet the significance of 0.50.

Construct Validity

According to Zhang et al. (2014), construct validity is a validity that questions how far the test items are able to measure what is really to be measured according to the concept and has been determined. In addition, it is also said that construct validity refers to the extent to which the measurement score reflects the latent construct to be measured. Agarwal (2013), that construct validity is a confirmatory factor analysis that includes two main tests, namely discriminant and convergent validity tests. In addition, construct validity is an important requirement in an instrument to obtain data that can be accounted for psychometrically. Therefore, this study uses discriminant and convergent validity.

Convergent Validity

Convergent validity ensures that the variables are included in the latent construct to be measured. In additions according to Smiderle et al. (2020), this validity is based on the correlation between the responses of different variables in measuring the same construct. Furthermore, the variables must be closely related to the latent construct. The magnitude of the loading factor is also an important consideration in determining convergent validity (Rönkkö & Cho, 2022). Dash et al. (2021) recommends that AVE (average variance extracted) as a measure of convergent validity because it can explain the extent to which items are divided between constructs in structural equation modeling (SEM) where AVE 0.50 or more can be accepted as convergent validity. Similar things were also conveyed by Igbaria et al. (1997) that a variable is said to be good if its latent variable shows a loading factor > 0.50. The development of the scale in this study involved four constructs, namely Showing a feeling of pleasure when starting learning, showing interest in learning, Showing the level of attention in following learning, and Showing activeness in asking questions. The results of the study showed that the AVE for the four constructs were respectively 0.72, 0.64, 0.57, 0.66. because all constructs exceeded the threshold value of AVE > 0.50, it was synthesized that they could measure latent variables and meet the criteria for convergent validity.

Discriminant Validity

According to Ab Hamid et al. (2017), the discriminant validity test is part of the requirements in developing an instrument involving latent variables. In addition, this validity also aims to prove that one construct is different from other constructs (Rogers, 2024). Latent constructs in discriminant validity should not be highly correlated with other latent constructs. This will be fulfilled if the two latent constructs are not correlated theoretically and empirically proven from the scores that indicate one construct is higher than the other. Franke et al. (2019) stated that discriminant validity can be determined by correlating one construct with another construct. It was also conveyed by Roemer et al. (2021) stating that if the correlation value on both constructs is lower than 0.85, it means that the construct has discriminant validity. The same thing was also conveyed by Fornell et al. (1981), stating that discriminant validity exists if the latent variable shows more variance in the related variable than sharing with other constructs in the same model. Discriminant variables are indicated by correlations between constructs that are not too high or low covariance factors. The following are the results of discriminant validity shown in table 3.

Table 3. Discriminant validity

Aspect	Λ	AVE	DIS ($\sqrt{}$^2)
A	0.62		
	0.71		
	0.77	0.72	0.84
	0.77		
	0.21		
B	0.75		
	0.80		
	0.80	0.64	0.80
	0.16		
	0.21		
C	0.68		
	0.75		
	0.75	0.57	0.75
	0.70		
	0.72		
D	0.73		
	0.79		
	0.67	0.66	0.81
	0.59		

The results presented in the table above confirm that the four factors or latent constructs each have AVE square root results of 0.84, 0.81, 0.81, 0.75. The AVE square root of the four latent constructs is greater than the correlation between constructs. So it is synthesized that the four latent constructs have met the criteria for discriminant validity.

Reliability or Reliability Test

In the previous section, the validity of discriminant and convergent constructs has been described, so in addition to validity, reliability is also needed to measure a scale. Reliability is a measuring instrument that shows the degree of measurement error cannot be determined with certainty but can only be estimated (Hu & Wansbeek, 2017). The reliability coefficient indicates the stability of the score obtained by the individual, which reflects the process of score reproduction, where the score is said to be stable if the score obtained at one time and at another time has relatively the same result. Another meaning of reliability in stability terminology is that the subject subjected to measurement will occupy a relatively similar ranking in separate testing with equivalent test instruments (Esmaily et al., 2017; Tashie-Lewis & Nnabuife, 2021).

In addition, an instrument is said to be stable or reliable if the instrument can measure the same phenomenon repeatedly with relatively consistent results. A construct reliability coefficient higher than 0.70 is acceptable, this is because a high coefficient indicates high internal consistency (Gefen et al., 2000). In this study, reliability testing was carried out with the aim of measuring the internal consistency of the measuring instrument using Cronbach's alpha. The results of the reliability test on the four latent constructs using IBM SPSS version 26 software are described in the following table.

Discussion

The success of learning is influenced by factors from within the students themselves and from external students. One of the factors that influences students in learning is interest in learning. Interest is an attraction, attention, and greater desire that someone has for something, a sign of existence (Mariqueo-Russell, 2023). In addition, it was also conveyed by Nurlia et al. (2017), that interest is a psychological symptom that shows that interest in understanding the subject of the object attracts attention and creates feelings of pleasure so that it tends to the object. In the teaching and learning situation, students who are interested in a particular subject will tend to focus their attention continuously during the teaching and learning process (Darling-Hammond et al., 2020). For that, interest is basically one of the factors that influences learning achievement. The things that underlie student interest in learning are the activeness of the teacher where the teacher has an important role in the learning process. The main task of the teacher, apart from being a facilitator, the teacher must also be able to make students understand and be able to do something in a formal way (Anggraeni et al., 2023).

In addition, adequate facilities and infrastructure also help in the learning process which makes learning interesting so that students every day will feel happy, interested and concerned about the learning that is being carried out. Someone who has a high interest in learning has characteristics, namely having a tendency to stay focused and pay attention to something continuously, so that they get satisfaction from what they like, contributing to learning activities (Liu et al., 2024). For this reason, students with a high interest in learning will usually play an active role in learning activities, so that it will have an influence on learning outcomes. Based on the findings that have been described, there is a lack of student interest in learning caused by several problems that occur. Thus, interest in learning is an important thing to be developed and owned by students during the learning process. For this reason, an assessment is needed.

According to Setiadi (2016), assessment has a major role in determining educational success, in addition, good assessment has an impact on the learning process. In addition, according to the Minister of National Education in 2007 No. 20, in order for the assessment process to run well, the assessment must be valid, objective, fair, integrated, open, comprehensive and continuous, systematic, criteria-based, and accountable. In addition, assessment is a series of activities to obtain, interpret, and analyze data on student learning outcomes that are carried out in a structured and continuous manner so that they become meaningful information in decision making.

Meanwhile, the following also describes the reliability of the overall latent, namely.

Table 5. Reliability Test Results

	Reliability Statistics
Cronbach's Alpha	N of Items
.915	17

From the results of the reliability test per factor item, the scores are 0.82, 0.84, 0.79, 0.82. While the results of the reliability test in table 5 show a score of 0.91. Referring to the CR coefficient threshold of 0.70, it can be synthesized that each variable in this study is reliable and suitable for use. Thus, the instrument for measuring latent variables in this variable is reliable.

Conclusion

Based on the discussion, it can be synthesized that the four aspects of learning interest that need to be considered in the implementation and development of interest are a sense of pleasure in learning, interest in learning, attention and concentration, and student

involvement in learning activities also affect learning interest and learning outcomes. This study states that the four aspects that have been described and measured meet the criteria and can be used, only there are 3 statements that are development indicators that cannot be used, namely codes B5, C9 and C10. Apart from that, other scales that have been developed are suitable for use in collecting data to measure students' learning interest.

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

References

Ab Hamid, M. R., Sami, W., & Mohmad Sidek, M. H. (2017). Discriminant Validity Assessment: Use of Fornell & Larcker criterion versus HTMT Criterion. *Journal of Physics: Conference Series*, *890*, 012163. https://doi.org/10.1088/1742-6596/890/1/012163

Agarwal, V. (2013). Investigating the convergent validity of organizational trust. *Journal of Communication Management*, *17*(1), 24–39. https://doi.org/10.1108/13632541311300133

Andayani, S. A. (2022). Meningkatkan Minat dan Hasil Belajar Bahasa Indonesia melaui Penerapan Belajar Kelompok Siswa Kelas IX.A SMP Negeri 17 Mataram. *Junal Pendidikan Dan Sosial Budaya YASIN*, *2*(6), 871–879. https://doi.org/10.58578/yasin.v2i6.1213

Andira, P. A., Utami, A., Astriana, M., & Walid, A. (2022). Analisis Minat Siswa Terhadap Hasil Belajar Siswa Dalam Pembelajaran IPA. *Pionir: Jurnal Pendidikan*, *11*(1). https://doi.org/10.22373/pjp.v11i1.13087

Anggraeni, P., Dadang Sunendar, Bunyamin Maftuh, Wahyu Sopandi, & Ryan Dwi Puspita. (2023). What do Elementary School Teachers Think About 6Cs? *Mimbar Ilmu*, *28*(1), 96–105. https://doi.org/10.23887/mi.v28i1.55857

Bandhu, D., Mohan, M. M., Nittala, N. A. P., Jadhav, P., Bhadauria, A., & Saxena, K. K. (2024). Theories of motivation: A comprehensive analysis of human behavior drivers. *Acta Psychologica*, *244*, 104177. https://doi.org/10.1016/j.actpsy.2024.104177

Cheung, G. W., Cooper-Thomas, H. D., Lau, R. S., & Wang, L. C. (2024). Reporting reliability, convergent and discriminant validity with structural equation modeling: A review and best-practice recommendations. *Asia Pacific Journal of Management*, *41*(2), 745–783. https://doi.org/10.1007/s10490-023-09871-y

Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied Developmental Science*, *24*(2), 97–140. https://doi.org/10.1080/10888691.2018.1537791

Dash, G., & Paul, J. (2021). CB-SEM vs PLS-SEM methods for research in social sciences and technology forecasting. *Technological Forecasting and Social Change*, *173*, 121092. https://doi.org/10.1016/j.techfore.2021.121092

Esmaily, M., Svensson, J. E., Fajardo, S., Birbilis, N., Frankel, G. S., Virtanen, S., Arrabal, R., Thomas, S., & Johansson, L. G. (2017). Fundamentals and advances in magnesium alloy corrosion. *Progress in Materials Science*, *89*, 92–193. https://doi.org/10.1016/j.pmatsci.2017.04.011

Fornell, C., & Larcker, D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*, *18*(1), 39. https://doi.org/10.2307/3151312

Forsell, J., Forslund Frykedal, K., & Hammar Chiriac, E. (2020). Group Work Assessment: Assessing Social Skills at Group Level. *Small Group Research*, *51*(1), 87–124. https://doi.org/10.1177/1046496419878269

Franke, G., & Sarstedt, M. (2019). Heuristics versus statistics in discriminant validity testing: A comparison of four procedures. *Internet Research*, *29*(3), 430–447. https://doi.org/10.1108/IntR-12-2017-0515

Gefen, D., Straub, D., & Boudreau, M.-C. (2000). Structural Equation Modeling and Regression: Guidelines for Research Practice. *Communications of the Association for Information Systems*, *4*. https://doi.org/10.17705/1CAIS.00407

Hidayat, P. W., & Widjajanti, D. B. (2018). Analisis kemampuan berpikir kreatif dan minat belajar siswa dalam mengerjakan soal open ended dengan pendekatan CTL. *Pythagoras: Jurnal Pendidikan Matematika*, *13*(1), 63–75. https://doi.org/10.21831/pg.v13i1.21167

Hidi, S. (2006). Interest: A unique motivational variable. *Educational Research Review*, *1*(2), 69–82. https://doi.org/10.1016/j.edurev.2006.09.001

Hill, C. R., & Hughes, J. N. (2007). An examination of the convergent and discriminant validity of the Strengths and Difficulties Questionnaire. *School Psychology Quarterly*, 22(3), 380–406. https://doi.org/10.1037/1045-3830.22.3.380

Hu, Y., & Wansbeek, T. (2017). Measurement error models: Editors' introduction. *Journal of Econometrics*, 200(2), 151–153. https://doi.org/10.1016/j.jeconom.2017.06.001

Igbaria, M., Zinatelli, N., Cragg, P., & Cavaye, A. L. M. (1997). Personal Computing Acceptance Factors in Small Firms: A Structural Equation Model. *MIS Quarterly*, 21(3), 279. https://doi.org/10.2307/249498

Lee, Y., Cho, Y. H., Park, T., & Choi, J. (2023). Situational interest during individual reading and peer reading activities using PALS: its relationship to students' reading skills and reading motivations. *Educational Studies*, 49(5), 842–860. https://doi.org/10.1080/03055698.2021.1898341

Linnenbrink-Garcia, L., Patall, E. A., & Messersmith, E. E. (2013). Antecedents and consequences of situational interest. *British Journal of Educational Psychology*, 83(4), 591–614. https://doi.org/10.1111/j.2044-8279.2012.02080.x

Liu, M., Zhao, G., Zhong, Z., Ma, J., & Wang, W. (2024). Theoretical Foundations for Blended Learning. In M. Li, X. Han, & J. Cheng (Eds.), *Handbook of Educational Reform Through Blended Learning* (pp. 1–44). Springer Nature Singapore. https://doi.org/10.1007/978-981-99-6269-3_1

Lusidawaty, V., Fitria, Y., Miaz, Y., & Zikri, A. (2020). Pembelajaran IPA Dengan Strategi Pembelajaran Inkuiri Untuk Meningkatkan Keterampilan Proses Sains Dan Motivasi Belajar Siswa Di Sekolah Dasar. *Jurnal Basicedu*, 4(1), 168–174. https://doi.org/10.31004/basicedu.v4i1.333

Mariqueo-Russell, A. (2023). Desire and motivation in desire theories of well-being. *Philosophical Studies*, 180(7), 1975–1994. https://doi.org/10.1007/s11098-023-01966-y

Nurlia, N., Hala, Y., Muchtar, R., Jumadi, O., & Taiyeb, M. (2017). Hubungan Antara Gaya Belajar, Kemandirian Belajar, dan Minat Belajar dengan Hasil Belajar Biologi Siswa. *Jurnal Pendidikan Biologi*, 6(2). https://doi.org/10.24114/jpb.v6i2.6552

Permatasari, B. D., Gunarhadi, & Riyadi. (2019). The influence of problem based learning towards social science learning outcomes viewed from learning interest. *International Journal of Evaluation and Research in Education*, 8(1), 39–46. https://doi.org/10.11591/ijere.v8i1.15594

Purnami. (2022). Upaya Mengembangkan Minat Menulis Siswa Melalui Gawai Menuju New Normal. *Jurnal Ilmiah WUNY*, 3(2). https://doi.org/10.21831/jwuny.v3i2.42634

Roemer, E., Schuberth, F., & Henseler, J. (2021). HTMT2–an improved criterion for assessing discriminant validity in structural equation modeling. *Industrial Management & Data Systems*, 121(12), 2637–2650. https://doi.org/10.1108/IMDS-02-2021-0082

Rogers, P. (2024). Best practices for your confirmatory factor analysis: A JASP and lavaan tutorial. *Behavior Research Methods*. https://doi.org/10.3758/s13428-024-02375-7

Rönkkö, M., & Cho, E. (2022). An Updated Guideline for Assessing Discriminant Validity. *Organizational Research Methods*, 25(1), 6–14. https://doi.org/10.1177/1094428120968614

Rotgans, J. I., & Schmidt, H. G. (2017). Interest development: Arousing situational interest affects the growth trajectory of individual interest. *Contemporary Educational Psychology*, 49, 175–184. https://doi.org/10.1016/j.cedpsych.2017.02.003

Schildkamp, K., Van Der Kleij, F. M., Heitink, M. C., Kippers, W. B., & Veldkamp, B. P. (2020). Formative assessment: A systematic review of critical teacher prerequisites for classroom practice. *International Journal of Educational Research*, 103, 101602. https://doi.org/10.1016/j.ijer.2020.101602

Setiadi, H. (2016). Pelaksanaan penilaian pada Kurikulum 2013. *Jurnal Penelitian Dan Evaluasi Pendidikan*, 20(2), 166–178. https://doi.org/10.21831/pep.v20i2.7173

Smiderle, R., Rigo, S. J., Marques, L. B., Peçanha De Miranda Coelho, J. A., & Jaques, P. A. (2020). The impact of gamification on students' learning, engagement and behavior based on their personality traits. *Smart Learning Environments*, 7(1), 3. https://doi.org/10.1186/s40561-019-0098-x

Suwanto, E. (2022). Membangkitkan Minat Belajar Matematika dengan Media Pembelajaran Interaktif. *SCIENCE : Jurnal Inovasi Pendidikan Matematika Dan IPA*, 2(1), 10–16. https://doi.org/10.51878/science.v2i1.918

Tashie-Lewis, B. C., & Nnabuife, S. G. (2021). Hydrogen Production, Distribution, Storage and Power Conversion in a Hydrogen Economy—A Technology Review. *Chemical Engineering Journal Advances*, 8, 100172. https://doi.org/10.1016/j.ceja.2021.100172

Yunitasari, R., & Hanifah, U. (2020). Pengaruh Pembelajaran Daring terhadap Minat Belajar Siswa pada Masa Covid 19. *Edukatif : Jurnal Ilmu Pendidikan*, 2(3), 232–243. https://doi.org/10.31004/edukatif.v2i3.142

Yuwanita, I., Dewi, H. I., & Wicaksono, D. (2020). Pengaruh Metode Pembelajaran Dan Gaya Belajar Terhadap Hasil Belajar IPA. *Instruksional*, 1(2), 152.

https://doi.org/10.24853/instruksional.1.2.152-158

Zekarias, A. P. (2023). Contributions and controversies of self-assessment to the development of writing skill. *Journal of Research in Instructional*, *3*(1), 13–30. https://doi.org/10.30862/jri.v3i1.94

Zhang, H. M., Peh, L. S., & Wang, Y. H. (2014). Servo Motor Control System and Method of Auto-Detection of Types of Servo Motors. *Applied Mechanics and Materials*, *496–500*, 1510–1515. https://doi.org/10.4028/www.scientific.net/AMM.496-500.1510