

VALIDITY OF INSTRUMENT MEASURING SECONDARY SCHOOL STUDENTS LEARNING DIFFICULTIES IN PHYSIC EDUCATION

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Abstract

In learning physic, students might experience learning difficulties that could hinder the knowledge transfer and the efficiency of the learning. It's caused by a limited number of instruments that are valid to measure students' learning difficulty in physical education. Therefore, the current research aims to validate physic learning difficulty scale for secondary school students in Indonesia. This research used a survey design. The current research participants were 388 students in Nusa Tenggara Barat, Indonesia. Two procedures were used to analyse the data: exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The results show that EFA with comprehensive techniques that compromise parallel analysis yielded a 3-factor solution: environment factor, metacognitive factor and emotional factor. The three factors solution was confirmed through CFA with the value: Chi Square=1.922, goodness of fit index (GFI)=.936, adjusted goodness of fit index (AGFI)=.913, Tucker–Lewis index (TLI)=.895, comparative fit index (CFI)=.913, root mean square error of approximation (RMSEA)=.049, and Standardized Root Mean Residual (SRMR)=.079. Therefore, based on psychometric analysis, the scale is valid and reliable to be used in measuring students physic learning difficulty of Indonesian secondary school students. The current research's novelty is that it provides a valid and reliable instrument to measure student's difficulty in physic education. The use of the current instrument can ensure the accuracy, reliability, and credibility of research related to student difficulty in physic education.

Keywords: Confirmatory Factor Analysis, Exploratory Factor Analysis, Learning Difficulty, Physic Learning.



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INTRODUCTION

One of the purposes of education and learning is to fill and provide for human needs (Hidayatullah et al., 2021; Tanti et al., 2021; Nasution, Wijaya, & Dalimunthe, 2026). In this case, any science discipline will be beneficial for the human being, including physics education. According to Bao and Koenig (2019), physics education is considered a pioneer in education with influential outcomes. For example, physics education is a school subject heavily influenced by natural science, which is very beneficial in combating pain and disease (Aartun et al. 2020; Tanti et al., 2020). Other than the wide benefits of physics education, learning physics is also beneficial for students. As stated by Astalini et al. (2019), physics learning shapes the students' critical thinking skills because it makes them able to acquire everyday life experience, solve problems, and generate conclusions. Hidayatullah et al. (2021) emphasized that physics education taught students to analyse concepts and principles, solve scientific problems, investigate based on scientific inquiry, and apply knowledge in everyday life contexts. Other than that, physics education is teaching the student to understand their everyday life phenomena. Habibi et al. (2019) stated that human life is surrounded by physics phenomena, and the learning material in physics education has been integrated with everyday life phenomena.

In regard to the importance of physics education for the human being and student's skills, research related to learning difficulties in physics should be emphasized in order to support the students' learning process. According to Abdillah et al. (2020), in education, students might experience learning difficulties that could be caused by the student itself, the educator, or the environment. The learning difficulties can make the students have a minor achievement at the end of the learning process or fail to understand the concept being delivered. It is because the learning difficulties disturb the students' learning process in understanding the learning materials (Bahar et al., 2021; Tanti et al., 2021). Learning difficulties are also described as several obstacles perceived by the students in participating in the learning process (Diezmann et al., 2016; Tanti et al., 2025). In the end, it leads the student to fail in attaining the specific learning objective (Damayanthi et al., 2021). It was emphasized by Rettob et al. (2021), who stated that students said they had learning difficulties when they failed to grasp the concepts, ideas, or theories given in the learning process. Therefore, Shakir & Sharma (2018) stated that the learning difficulties faced by the students create a gap or distance between the expected academic achievement and the actual academic achievement obtained by the students. It is important to notice since the learning process aims to make the students understand the concept, so implementation and utilization of the concept can be beneficial.

However, the learning difficulties are not only related to the students' cognitive aspects. Siregar et al. (2023) stated that there is a misconception regarding learning difficulties where students who obtained low scores are judged to have learning difficulties, but maybe the students' failure is caused by their inability to handle their problem during the learning process. Therefore, learning difficulties are not only related to the students' cognitive aspects but also to the school environment, economic condition, culture, and psychological condition (Benavides-Varela et al., 2020). In this case, Albelbisi and Yusop (2019) stated that there are internal and external factors contributing to learning difficulties. The internal factors were the students' problem solving, intelligence, learning motivation, mindset of subjects, personality. And the external factors were lecturer performance, family support, school environment, and learning methods. Elastika et al. (2021), in their research found that the most influential factors affecting the students' learning difficulties in Indonesia were school environment, family environment, community environment, and seating. Sabila and Putrie (2023) also found that the factors contributing to learning difficulties among students in Indonesia were: motivation, school environment, attitude, psychological condition, interest, parental support, health factors, and social factors.

It was emphasized that the learning difficulties were not only related to the cognitive factors of the students. However, the current practice in Indonesia for examining and analyzing students' learning difficulties only uses a cognitive-based instrument. As stated by Wijaya et al. (2019), the teachers in Indonesia only focus on the topics of the materials in diagnosing the students' learning difficulties. For example, Pramesti and Retnawati (2019), in analyzing Indonesian students' learning difficulties, used a test examining the students' understanding of the problem, understanding the meaning of the variable, and understanding the operational of the material. Darmayanti et al. (2023) analyzed the Indonesian students' learning difficulties using the material test question, which analyzed the students' understanding of the concept of the symbol, understanding the students' tendency to use the procedure in answering the question, understanding how the students used the relationship and pattern of the variable, and understanding the students' ability to analyze the graphical meaning given. Rahmi and Azra (2023)

examine the Indonesian students learning difficulties using the material test with four-tier multiple-choice questions and analyzing the students understanding of the concept of the materials. It can be concluded that the practice of diagnosing students learning difficulties in Indonesia is limited to diagnosing the students cognitive aspect or their understanding of the materials. This model of research is mainly conducted as a summative assessment, which only explores the students learning difficulties after the learning process is done. The outcome can be used to understand in which aspect of material the students have weaknesses.

Therefore, it can be stated that research regarding the students learning difficulties in Indonesia did not explore why the students experience learning difficulties, for example, in terms of psychological factors such as motivation and interest or in terms of external factors such as the school environment, teacher performance, and social support. It means less attention has been given to the possible role of the student's emotions in their learning difficulties (Sainio et al., 2019; Kurniawan et al., 2022). It might happen because there is no valid and reliable research instrument in terms of the students learning difficulties for physics learning which explore the reason why the students having difficulties in their learning. It is because no research validated the instrument measuring the students learning difficulties in physics education in Indonesian students. In filling this gap, research have conducted. For example by Habibi et al. (2019) identify students learning difficulties in Indonesia based on the self-regulation skill; however, the research was carried out with the participants of preservice physic teachers in Indonesia, and did not directly involved the students. Other than that, Permana et al. (2022) developed and tested the diagnostic test of students learning difficulties for specific material in physics, namely Newton`s law. However, this instrument is in the form of a multiple-choice question, which only examines the students cognitive understanding of Newton`s law.

Furthermore, research related to the instrument validation for learning difficulties associated with any learning materials was carried out in Indonesia. For example, Lutviana et al. (2019) conducted research to validate the learning difficulties instrument related to chemistry learning. Kusumah et al. (2021) developed and tested the students mathematic learning difficulties among preservice teachers in Tangerang, Indonesia. Budiman et al. (2020) test the validity and reliability of the movement learning difficulties for primary school students in Bandung, Indonesia. Septiawan & Hadi (2018) explore the construct validity of a diagnostic test in the mathematic learning difficulties of elementary school students in Yogyakarta, Indonesia. It means that research which validate a learning difficulties instrument is yet to be conducted in the context of physic educaiton.

Since no specific instrument for secondary school students learning difficulties in physics learning in Indonesia was validated, this research aims to validate the learning difficulties instrument in physics learning for high school students in Indonesia. A valid and reliable instrument is important for testing, it is because an invalid instrument may impact the overall finding of the instrument (Aziz et al., 2021). It means an invalid instrument measuring the students learning difficulties might lead to misconceptions and incorrect conclusions in mitigating the students strengths and weaknesses in physical learning. Therefore, invalid information was obtained. Other than that, instruments commonly used in research test the conceptual model framed by the researcher. Sürücü and Maşlakçı (2020) stated that an instrument with good qualities, such as validity and reliability, is needed in order to achieve a beneficial result from the research. Therefore, the current research aims to provide a valid and reliable instrument that can be used to obtain valid data regarding the students learning difficulties in physical education in Indonesia.

RESEARCH METHOD

The current research is quantitative research in the form of a cross-sectional survey research design aimed at examining the structure of the physical learning difficulties scale for secondary school students in Indonesia. According to Hidayat et al. (2024), a cross-sectional study investigates a group of people at one specific period in time to reveal the attitudes, viewpoints, behaviors, or features of the population. This research design is significant in research that validates an instrument since it allows researchers to acquire preliminary information regarding the psychometric features of an instrument within a diverse sample (Ghazali et al., 2024). Furthermore, this design captures data in one time, which makes researchers directly assess the phenomena, yielding robust data relevant to the population of interest (Zangirolami-Raimundo et al., 2018).

The population of the current research is a secondary school students which typically in the age of 12 to 18 years old. This population often faces difficulty caused by several aspect including tye nature

of their developmental changes, peer relationship and external pressure. A key concern noted by educators is the difficulties students have in managing social connections within the school setting, feelings of isolation can lead to substantial social anxiety (Liang et al., 2024). Therefore, supporting this population to deal with their academic challenges is significance and one way to do that is providing a valid and reliable instrument to analyse their academic challenges. The sample comprised in the current research is the group of secondary school students in West Nusa Tenggara, Indonesia. They were selected based on convenience sampling method due to the nature of the research. Through this sampling technique the total of 388 students were participated in the current research. the ratio of the sample with the items of the instrument was 18:1 exceeds the acceptable ratio for factorial analysis suggested by Watkins (2018). Making sure the ratio of the number of samples with the number of items is necessary as it can ensure the suitability of the data for factor analysis and contribute to the stability of the factor scores (Shrestha, 2021; Schreiber, 2020). Among the sample, 60.2% of them were female and 39.8% were male.

The data was gathered through survey, researcher directly came to school and gave students questionnaires. the questionnaires consist of two part; the demographic information and the physic learning difficulty questionnaires consisting. The physic learning difficulty instrument consist of 21 items measuring the student physic learning difficulties of a 5-likert scale (1 = strongly disagree, 5= strongly agree). The items were developed and adopted from several research (Bray & Williams, 2020; González et al, 2017; Siqueira et al, 2020; Ornek et al, 2008; Reddy & Panacharoensawad, 2017; Lodge et al, 2018; Zeitlhofer et al, 2023; Abdelrahman, 2020; Nava, & Camarao, 2017; Wangchuk et al, 2023). The full items and the instrument grid were displayed in table 1.

Table 1. List of Items

| No | Items |
|----|---|
| 1 | I find it difficult to understand the physics concepts taught in class |
| 2 | I often experience difficulties in applying mathematical concepts in solving physics problems |
| 3 | I have a hard time imagining or describing physical phenomena visually. |
| 4 | I have a high interest in physics subjects |
| 5 | I see a connection between physics and my everyday life |
| 6 | I have high expectations for my achievements in physics |
| 7 | I feel anxious when I have to use mathematics to understand physics |
| 8 | I feel interested when studying physical phenomena |
| 9 | I feel satisfied after studying physical phenomena |
| 10 | The teacher's teaching helps me understand physics concepts well |
| 11 | Friendly teachers make me excited to learn physics |
| 12 | Complete laboratory equipment facilitates me in understanding physics concepts |
| 13 | Comprehensive physics resources help me understand physics concepts |
| 14 | Collaboration and discussions with friends or teachers help me understand physics concepts |
| 15 | I have my own effective learning strategy in studying physics |
| 16 | By reading the text I easily understand physics |
| 17 | By taking notes or visual sketches I easily understand physics |
| 18 | I easily learn physics using learning strategies to do practice questions |
| 19 | I easily understand the concept of physics by doing experiments or practicum |
| 20 | I easily understand physics concepts by learning from learning videos |
| 21 | I am aware of areas or concepts of physics that are difficult for me |

The purpose of the current research is to validate the physical learning difficulties scale for secondary school students. Therefore, two factorial analyses were performed, namely exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The EFA was executed in SPSS 27.0, and the CFA was executed in AMOS. To begin with, researchers test the appropriateness of the dataset to be used in factorial analysis. In this case, two analyses were considered, namely Kaiser-Meyer-Olkin (KMO) and Barlett's test of sphericity (Gao et al. 2020; Hidayat et al., 2024). The KMO examined the adequacy of the dataset to be performed in factorial analysis; in this analysis, the value ranged from 0 to 1, with a value greater than 0.5 indicating the adequacy of the dataset to be performed in factorial analysis;

therefore, the threshold of the KMO for the current research is exceeding 0.5 (Gao et al., 2020; Goretzko et al., 2019). Other than that, Barlett’s test of sphericity should be significant (<0.05), as recommended by Shrestha, (2021).

In this study, the primary aim of EFA was to define the number of components to keep and to examine the intercorrelation between the variables (Finch, 2019; Shrestha, 2021). The conclusion will be emphasized with parallel analysis in terms of the number of components to maintain, eigenvalue larger than 1, and Scree plot also will be evaluated. The parallel analysis will be the primary focus of this study because it is said to be more efficient in selecting the number of components to keep. According to Taherdoost et al (2014), parallel analysis is 92% accurate 92% of the time and has low fluctuation and susceptibility to diverse circumstances. Varimax rotation was used after establishing the number of factors to make the factors more interpretable (Rohe & Zeng, 2023; Akbar et al., 2024). This extraction method increases the difference between a factor's squared pattern structure coefficients (Shrestha, 2021). Furthermore, the scale's structure is framed by communalities and factor loading. As a result, principle component analysis with a fixed number based on the retained factor was performed. Communality is important because it indicates the total amount of the original variable that was shared with all other variables (Ogunsanya et al., 2019; Handrianto et al., 2023). The scale for communality ranged from 0 to 1. If the values are near, the extracted factor explains the item variation adequately. According to Di Lorenzo et al. (2019), communality between .20 and .80 is considered low; .20 to .80 is considered exhaustive; and .60 to .80 is considered high. Aside from that, factor loading, which is the association between the item and the factor, must be considered (Tavakol & Wetzal, 2020; Jusoh et al., 2023).

The CFA confirmed the structure of the scale framed in the EFA. According to Knekta et al., (2019), CFA tests the hypothesised number of variables as well as the correlation between the construct and the item. In CFA, a model of fit indices was constructed to assist researchers in confirming the scale's structure. Because the values of these indices were not designed to serve as the benchmark for binary decisions, it is recommended to employ at least two independent indices (Knekta et al., 2019). Among the goodness of fit measurements considered are comparative fit indices (CFI) (>.90). The root mean square error of approximation (RMSEA) and Tucker-Lewis Index (TLI) should both be greater than 0.90 (>.0.90). Aside from that, Dash and Paul (2021) limits the criterion for the absolute fit indices to CMIN (5) and SRMR (.05).

RESULTS AND DISCUSSION

Exploratory Factor Analysis

Before the dataset used in factorial analysis, the data was checked for its appropriateness to be used in factorial analysis. In this case, the dataset was checked through Kaiser-Meyer-Olkin and Bartlett’s test of sphericity. The result can be seen in table 2. The result indicated that the Kaiser-Meyer-Olkin was .815 and the Bartlett’s test of sphericity was significant confirming the appropriateness of the dataset to be used in factorial analysis.

Table 2. The Result of KMO and Bartlett’s test

| | | |
|--|--------------------|----------|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .815 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 1722.806 |
| | Df | 210 |
| | Sig. | .000 |

After testing the appropriateness of the dataset, researcher further analyse the data to explore the factor retention. For the current research, the parallel analysis was used. Table 3 show the result of the initial eigenvalue and the parallel analysis.

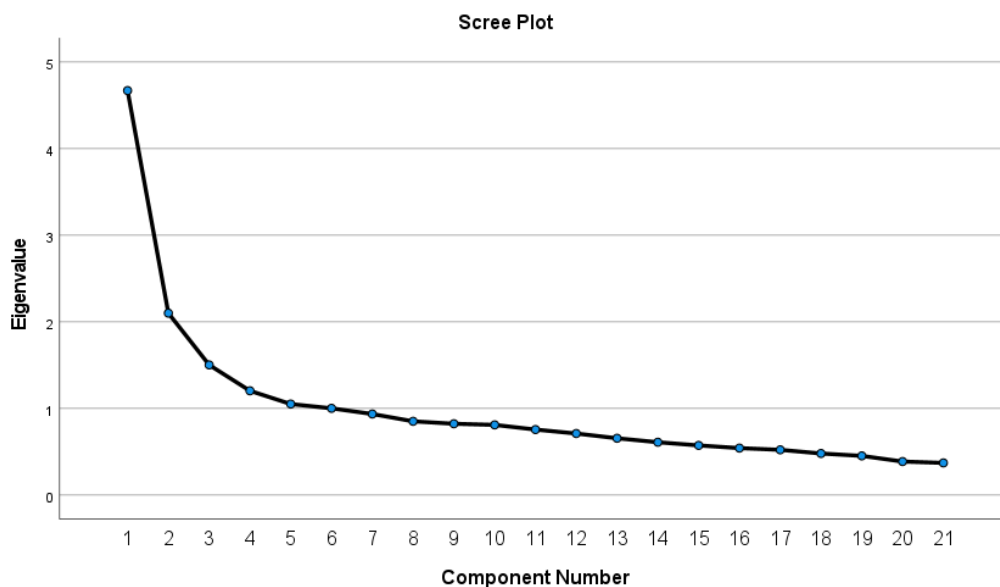
Table 3. Initial Eigenvalue and Parallel Analysis

| Components | Initial eigenvalue | | Simulated eigenvalue at 95 th percentile | |
|------------|--------------------|---------------|---|------------|
| | Total | % of Variance | Means | Percentile |
| 1 | 4.670 | 22.237 | 1.437064 | 1.509361 |
| 2 | 2.100 | 10.000 | 1.359367 | 1.408895 |
| 3 | 1.502 | 7.153 | 1.301052 | 1.337686 |
| 4 | 1.203 | 5.730 | 1.250413 | 1.291893 |

| Components | Initial eigenvalue | | Simulated eigenvalue at 95 th percentile | |
|------------|--------------------|---------------|---|------------|
| | Total | % of Variance | Means | Percentile |
| 5 | 1.050 | 5.002 | 1.210425 | 1.245120 |
| 6 | 1.001 | 4.766 | 1.164134 | 1.200350 |
| 7 | .935 | 4.454 | 1.126731 | 1.161192 |
| 8 | .851 | 4.052 | 1.089160 | 1.115520 |
| 9 | .823 | 3.918 | 1.053720 | 1.115520 |
| 10 | .810 | 3.856 | 1.019261 | 1.050310 |
| 11 | .756 | 3.598 | .985512 | 1.015305 |
| 12 | .710 | 3.381 | .954016 | .981591 |
| 13 | .655 | 3.120 | .921733 | .948458 |
| 14 | .609 | 2.902 | .889409 | .919999 |
| 15 | .573 | 2.727 | .852905 | .879185 |
| 16 | .542 | 2.579 | .822628 | .848984 |
| 17 | .522 | 2.484 | .786312 | .815014 |
| 18 | .480 | 2.283 | .754249 | .785337 |
| 19 | .452 | 2.152 | .716319 | .747491 |
| 20 | .386 | 1.840 | .678166 | .714439 |
| 21 | .371 | 1.766 | .627425 | .675165 |

In the table 3, the initial factor analysis reveal six factor explaining 54.888% of the variances. The scatterplot also indicate six items with eigenvalue greater than 1 (figure 1). However, the parallel analysis confirmed three factors to be retained. When we compare the means of the parallel analysis with the initial eigenvalue, the fourth column in the parallel analysis is greater than the fourth column in the initial eigenvalue (parallel analysis: 1.250413, initial eigenvalue: 1.203). furthermore, the fourth column in the percentile parallel analysis is greater than the fourth of the initial eigenvalue (parallel analysis: 1,291893, initial eigenvalue: 1.203). it means that the parallel analysis is suggested three factor to retain in the current analysis. Therefore, three factors was retained in the current analysis.

Figure 1. ScreePlot of the items



After confirming the number of factors, researcher examine the factor loading and communalities of each items in order to locate the items in specific factors. In the current research, principle component analysis with a fixed number of three factors, rotated with varimax rotation, and suppressed coefficient to the absolute value of .30 was executed. The result of factor loading and communalities can be seen in table 4.

Table 4. Exploratory Factor Analysis

| Dimension | Items | Questionnaires | Communalities | Component | | |
|---------------|-------|---|---------------|-----------|------|------|
| | | | | 1 | 2 | 3 |
| Environment | N5 | I see a connection between physics and my everyday life | .243 | .371 | | |
| | N8 | I feel interested when studying physical phenomena | .327 | .456 | | |
| | N9 | I feel satisfied after studying physical phenomena | .387 | .500 | | |
| | N10 | The teacher's teaching helps me understand physics concepts well | .443 | .642 | | |
| | N11 | Friendly teachers make me excited to learn physics | .554 | .738 | | |
| | N12 | Complete laboratory equipment facilitates me in understanding physics concepts | .487 | .683 | | |
| | N13 | Comprehensive physics resources help me understand physics concepts | .430 | .600 | | |
| | N14 | Collaboration and discussions with friends or teachers help me understand physics concepts | .453 | .655 | | |
| Metacognitive | N19 | I easily understand the concept of physics by doing experiments or practicum | .345 | .497 | | |
| | N4 | I have a high interest in physics subjects | .339 | | .537 | |
| | N6 | I have high expectations for my achievements in physics | .169 | | .303 | |
| | N15 | I have my own effective learning strategy in studying physics | .443 | | .665 | |
| | N16 | By reading the text I easily understand physics | .353 | | .567 | |
| | N17 | By taking notes or visual sketches I easily understand physics | .390 | | .471 | |
| | N18 | I easily learn physics using learning strategies to do practice questions | .426 | | .596 | |
| | N20 | I easily understand physics concepts by learning from learning videos | .345 | | .617 | |
| Emotion | N1 | I find it difficult to understand the physics concepts taught in class | .513 | | | .704 |
| | N2 | often experience difficulties in applying mathematical concepts in solving physics problems | .542 | | | .700 |
| | N3 | I have a hard time imagining or describing physical phenomena visually. | .446 | | | .665 |
| | N7 | I feel anxious when I have to use mathematics to understand physics | .345 | | | .580 |
| | N21 | I am aware of areas or concepts of physics that are difficult for me | .225 | | | .384 |

Table 4 showed the value of communalities and factor loading of each items. The items with communalities below .30 eliminated in the current analysis. Several items were removed such as items N5 (communalities: .243), item N6 (communalities .169), and N21 (communalities .225). Therefore, the structure of the scale as follow; the first factor named as environment with 8 items, the factor loading was

ranged from .371 to .738. the second factor named as metacognitive with 6 items, the factor loading ranged from .303 to .665. the third factor named as emotion with 4 items, the factor loading ranged from .580 to .704.

Confirmatory Factor Analysis

Exploratory factor analysis revealed the primary structure of the scale which consist of three-factor structure. The first factor named as environment with eight items, the second factor named metacognitive with six items, and the third factor named as emotion with four items. The structure then confirmed through confirmatory factor analysis. The combination of these two analysis is significance as stated (Norris & Lecavalier, 2010). Patil et al (2008) stated that CFA without EFA does not produce superfluous factors; as a result, the psychometric properties of the physic learning difficulty scale in this research were tested through robust psychometric testing, namely EFA and CFA (Trigueros et al, 2019). For the current research, two models of CFA were conducted. The first order model which showed in figure 2 consist of three factors of difficulty in physic learning. For the current analysis, several model fit indices considered in order to examine the model. The result of the first-order model are as follow; CMIN = 1.792, GFI= .937, AGFI= .916, TLI =.910, CFI =.924, RMSEA =.045 and SRMR =.053. Other than that, the factor loading ranged from.447 to.670. based on the result, the model fit indices was achieved the threshold given.

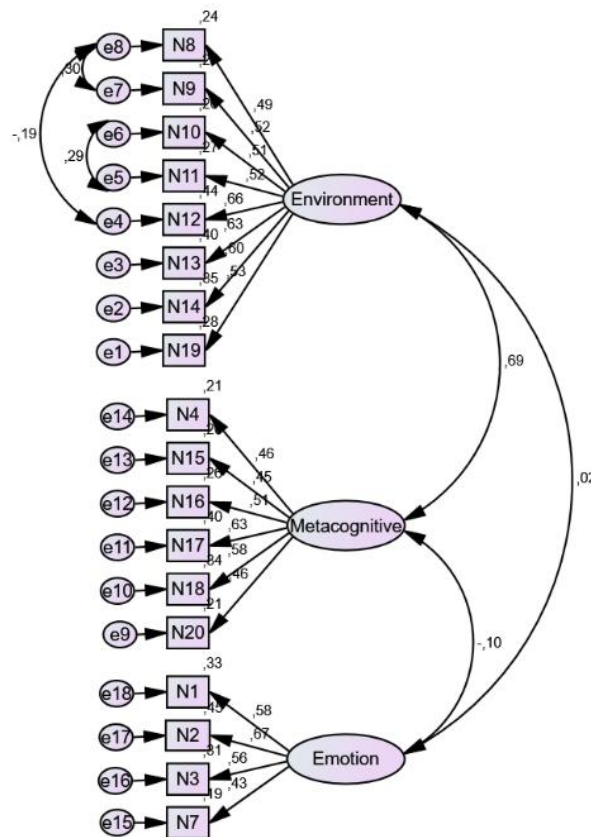


Figure 2. Confirmatory Factor Analysis First Order Model

The second order model of the CFA was named as difficulty in Physic with three factors. Figure 3 display the second order model. The result indicated acceptable model fit indices; CMIN = 1.922, GFI= .936, AGFI= .913, TLI =.895, CFI =.913, RMSEA =.049 and SRMR =.079. Other than that, the factor loading ranged from.389 to.668. the comparison of the first order and the second order model with the threshold shown in the table 5.

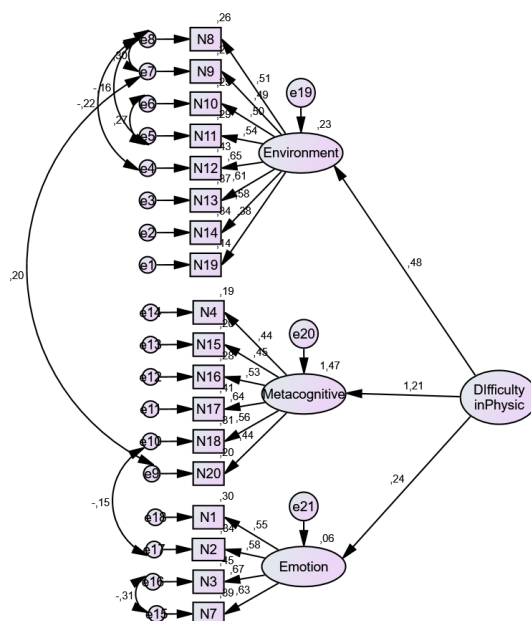


Figure 3. Confirmatory Factor Analysis Second Order Model

Table 5 Confirmatory Factor Analysis

| Goodness of fit | Criterion | Model | |
|-----------------|-------------|-------------|--------------|
| | | First order | Second order |
| CMIN | <5 | 1.792 | 1.922 |
| GFI | ≥.90 | .937 | .936 |
| AGFI | ≥.90 | .916 | .913 |
| TLI | ≥.90 | .910 | .895 |
| CFI | ≥.90 | .924 | .913 |
| RMSEA | <.06 to .08 | .045 | .049 |
| SRMR | <.05 | .057 | .079 |

Table 5 compares the first-order model and the second-order model with the threshold given. The values of CMIN, GFI, AGFI, TLI, and CFI were acceptable. The value of TLI in the second order was below .90 which is .895 however, it is still acceptable. Other than that, the RMSEA did not achieve the standard given, but it can be replaced or filled by the acceptable value in SRMR. Therefore, based on the CFA, the current model of the scale is acceptable and valid. CFA first and second order model emphasise the structure of the instrument through several model fit indices. For example, the model fit indices in the CFA first order model were GFI with the value of .937, AGFI .916, TLI .910, CFI .924, RMSEA .045, and SRMR .057. The value for the second order model were GFI with the value of .936, AGFI .913, TLI .895, CFI .913, RMSEA .049 and SRMR .079. It can be seen that the CFA of the first order model is more significant compare to CFA second order model. It is because several model fit indices namely TLI and SRMR in CFA second order model did not achieve the threshold given. CFA first order model examine whether each observed variable is considered to depend on a single latent component that represents a specific dimension of the construct being measured (Baharum et al., 2023). In contrast, a second-order CFA model introduces an additional layer of abstraction by positing that the first-order factors themselves are indicators of a higher-order latent variable (Kruse et al., 2024). In the current analysis, the CFA first order model strengthening the three factors of the scale as suggested by parallel analysis.

The first factor was the environmental factor. This factor is related to how the environment supports and restricts the students learning process in physics. In the current research, the factors associated with the teachers (N10 and N11), facilities (N8, N9, N12, N13, and N19), and peers (N14). Sidorova & Chernyavskaya (2021) stated that physical supports affect students ability to learn physics. For example, teachers have a pivotal role in supporting the students in neglecting barriers faced during the learning process by giving motivation and support (Johnson, 2017). The role of teachers is more necessary in physic education since the material obligate students to integrate multiple representations,

such as mathematical formulas, graphical data, and experimental results, to fully grasp the material, the role of good teachers is pivotal (Candido et al., 2023). It can be the case when the teachers encounter challenges in their teaching practices, such as addressing student misconceptions and adapting their instructional methods to meet diverse learning needs (Navos et al., 2024). Other than that, the role of facilities were also significant. Facilities provided could enhance the students achievement, as founded by Ramli et al. (2018) that the availability of facilities could boost students achievement to 51.5%;. One of the primary issues arising from inadequate facilities is the limited opportunity for practical work, which is essential in physics education. Practical experiments enable students to apply theoretical concepts, which improves their grasp and memory of the information (Niyitanga et al., 2021). Furthermore, peer support has a significant role in supporting students learning and neglecting learning difficulties in terms of building protective factors for positive mental health outcomes, which is very important in maintaining students motivation in learning, with good mental health any barriers and difficulties could be solved (McBeath et al., 2018).

The second factor on the scale was the metacognitive factor. Learning physics can be influenced by metacognitive elements, such as awareness and comprehension of one's thought processes. Planning, tracking, and assessing one's learning are examples of metacognitive strategies that have been shown to improve learning outcomes (Bogdanović et al., 2015; Lodge et al., 2018). The ability of individuals to self-monitor and self-regulate their learning is referred to as a metacognitive factor (Veenman, 2016). The examples of metacognitive factors found in the current research were students interest (N4) and their effective learning strategies (N15, N16, N17, N18, and N20). According to research, when students are genuinely engaged in the subject matter, they are more likely to participate actively in the learning process, resulting in a better grasp and retention of concepts. For example, Pratihina et al (2024) emphasises that modeling-based physics online learning, which enables exploration and self-construction of knowledge, increases student engagement compared to traditional lecture forms. This is consistent with the findings of Etkina (2015), who explains the Interactive Science Learning Environment (ISLE) framework, which facilitates collaborative interaction among students, thus enhancing their interest and involvement in physics practices. Through metacognitive factor, the students were able to form their own learning strategy, such as taking notes, reading the text, understanding the concept, and doing the practice as a way to respond and reduce the difficulties faced (Stanton et al., 2021). In this case, a lack of self-awareness about the learning process and learning difficulties when faced with setbacks are all possible signs of academic struggles. Therefore, the current research instrument could mitigate how the students respond to their learning difficulties.

The third factor is related to students emotions, which significantly impact the learning process. Positive emotions like curiosity and excitement can help enhance learning, while negative emotions like fear and anxiety became barriers in learning process (Lodge et al., 2018). Emotional aspects significantly influence a person's learning progress in physics. A lack of interest or motivation (N1), the existence of negative attitudes toward the subject, and feelings like anxiety, fear, frustration (N7), or discouragement when faced with challenging physics problems are some of these indicators. Research by Siouli et al. (2020) proved that students' emotions positively influence their learning performance and could reduce their learning difficulties. Wangchuk et al. (2022) emphasise the importance of motivation in learning physics. Their research reveals that motivated students are more likely to connect with the content, seek help when needed, and persevere through problems, eventually leading to improved academic success. On the necessary of the motivation, Liu and Lipowski (2021) suggest the integration of technology in cultivating the students' motivation in learning physics. Furthermore, Mirawati and Sikarni (2023) emphasises that students' attitudes appear as sentiments of delight or unhappiness in learning physics, which play an important impact in their learning results. When students have bad views about the subject, they are less likely to put forth effort in their studies, resulting in lower academic success. Overall, mitigating students emotions is important to understand students difficulties; moreover, among secondary school students. Sainio et al. (2020) stated that students with learning difficulties might experience the school transition even more stressful due to additional struggle in the learning. On this occasion, the scale validated in the current research incorporated the students emotions through their learning difficulties in order to facilitate researchers in understanding students difficulties widely.

Compared to other instruments measuring students' learning difficulty, the current instrument, which consists of the environmental factor, metacognitive factor, and emotion factor, seems more accurate to be used to measure the students' learning difficulty and analyze what factors might influence students' learning difficulty. It is different from previous instruments, which only examine in what aspect

the students face the difficulty. For example, Al-Qadri et al. (2021) proposed that the student learning difficulty instrument consist of reading difficulty, writing difficulty, expression difficulty, calculation difficulty, and general study difficulty in math education. This instrument is only able to be used to identify in what aspect the students have difficulty in math education. Similar to that, Willcutt et al. (2011) also proposed the student learning difficulty instrument consist of reading difficulty, social cognition, social anxiety, spatial ability, and math, which are only able to be used to analyze the aspects that the students face difficulty in. Therefore, the novelty of the current research is that it is not only able to explore the students' difficulty but also analyze the possible factors affecting the students' difficulty in physical education.

In this case, the implication of the current research is that it provides a valid and reliable instrument to measure students' learning difficulty. Through this instrument, teachers and researchers can have more accurate identification of students' learning difficulties and identify the factors that might influence the students' learning difficulties in physical education. Other than that, teachers and educational stakeholders can utilize the instrument to design targeted interventions to reduce the students' barriers, improve the students' support system, and foster a more conducive learning environment for students. Through this implication, researchers recommend that the current validated instrument be adopted in schools in order to routinely assess students' learning difficulties, specifically in physical education. Other than that, the structure of the current validated instrument, namely environment, metacognition, and emotion, can be integrated within the curriculum when designing a supportive learning environment for students. Furthermore, researchers can adopt the current research to do further research analyzing the students' learning difficulty and analyzing the possible factors that might influence the students' learning difficulty in physical education.

CONCLUSION

This study aimed to test the validity of physic learning difficulty scale for secondary school students in indonesia. Specifically, this research aims to test the underlying factor of physic learning difficulty scale among secondary school students in Indonesia, test the structure of the instrument of emotional intelligence hypothesised in exploratory factor analysis, and confirmed the structure of the scale through confirmatory factor analysis. To attain the aim of this research, two analysis methods were conducted, namely exploratory factor analysis and confirmatory. The study comprised 388 secondary students in West Nusa Tenggara Indonesia. EFA and CFA tested the psychometric properties of the scale by exploring the initial structure of the instrument and confirming the structure. Through exploratory factor analysis, three factors were retained, namely environment factor, metacognitive factor and emotional factor. The structure of the scale then confirmed with confirmatory factor analysis which indicated the suitable model fit indices. Therefore, the current research was valid and reliable to be used to test the students physic learning difficulty.

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AUTHOR CONTRIBUTIONS

Conceptualization, Mazlina Mat Darus and Zahida Aliatu Zain; Methodology, Muh Khairul Wajedi Imami; Software, Muh Khairul Wajedi Imami; Validation, Muh Khairul Wajedi Imami; Formal Analysis, Muh Khairul Wajedi Imami; Investigation, Mutahharah Hasyim; Resources, Mazlina Mat Darus and Zahida Aliatu Zain; Data Curation, Zahida Aliatu Zain; Writing – Original Draft Preparation, Mazlina Mat Darus and Zahida Aliatu Zain; Writing – Review & Editing, Muh Khairul Wajedi Imami; Visualization, Muh Khairul Wajedi Imami; Supervision, Mazlina mat Darus; Project Administration, Mutahharah Hasyim; Funding Acquisition, Mutahharah Hasyim and Mazlina Mat Darus.

CONFLICTS OF INTEREST

The author(s) declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the generation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and

manuscript preparation, were carried out entirely by the authors without the assistance of AI-based technologies.

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