

Adaptation of Academic Self-Efficacy Measuring Tools using the Confirmatory Factor Analysis (CFA)

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ABSTRACT

Students with higher self-efficacy, are more self-confident, can set higher learning goals, and are better at problem solving, which may lead to better academic performance. This research aims to adapt and validate The Scale of Sources of Self-efficacy in Mathematics (SSSEM) in the context of Indonesian culture and language and test its reliability in high school students. The research sample consisted of 200 students from six high schools in the city of Palangkaraya. All items were analyzed using Confirmatory Factor Analysis (CFA). The research results show the construct validity of the instrument with the index criterion value $\chi^2 = 170.749$ $p = 0.97$ or (p -value > 0.05) meaning there is a match between the data and the model, then the RMSEA value = .028 (≤ 0.09), CMIN/DF = 1.154 (≤ 2.00), GFI = 0.920, CFI = 0.994, TLI = 0.993 and AGFI = 0.897 (≥ 0.90). The results of the reliability analysis show that the scale has an adequate level of reliability. Then the construct reliability has good reliability with coefficient values for each dimension of 0.89, 0.88, 0.89 and 0.87. Cronbach's Alpha value is above 0.70. This adapted scale had a good fit with empirical data after several modifications. Therefore, the Indonesian version of the SSSEM can be used as a valid and reliable measuring tool to measure self-efficacy in high school students in Indonesia.

Keywords: Academic self-efficacy, The Scale of Sources of Self-efficacy in Mathematics, Confirmatory factor analysis, Construct Validity, Reliability

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INTRODUCTION

Beliefs about one's own abilities are not identical to beliefs about the possibilities that one's actions will produce. Bandura, (1997) has drawn a distinction between the role of self-efficacy beliefs versus outcome expectations in influencing and predicting motivation and behavior. Efficacy beliefs and outcome expectations are often positively related. Expected results depend largely on their assessment of what they can achieve. For example, students who are confident in their academic abilities usually expect high scores on exams. However, the relationship between self-efficacy and outcome expectations is not always consistent. A student who is fairly confident in his math abilities, for example, might choose not to take an advanced statistics course because the teacher's grading curve convinces him that he is unlikely to get the highest grades.

Bandura (1997) hypothesized that self-efficacy beliefs develop when individuals interpret from four sources of information, the most powerful of which is the interpretation of one's previous accomplishments or mastery experiences. In school, for example, after students complete academic assignments, they interpret and obtain the results obtained, and competency

assessments are created or revised according to those interpretations. Mastery experiences have been shown to be particularly powerful when individuals overcome obstacles or succeed at challenging tasks, especially those that are difficult for others (Bandura, 1997). Most individuals do not immediately dismiss their experiences of mastery (or failure). It is true, successful performance in a domain can have long-term effects on a person's self-efficacy

In addition to interpreting the results of their own actions, students also strengthen confidence in their abilities through the experience of acting out themselves in observing others. In many academic contexts, there are no absolute standards for expertise. As a result, students can assess their abilities by comparing them with the performance of others. They judge themselves by measuring their abilities against specific individuals such as classmates, peers, and even adults. This assessment often changes with success or failure in following the model they observe, until they reach a level where they feel capable of being like that model in the area concerned. For example, seeing similar classmates succeed in solving difficult math problems can reassure students that they too are capable of meeting the challenge. Additionally, individuals can compare their current performance with the past, both cognitively and

by recording and evaluating their performance. In this context, self-comparison information is a form of experience playing another self that can influence a person's self-confidence.

Social persuasion that students receive from other individuals acts as a third source in influencing self-efficacy beliefs. Support provided by parents, teachers and peers who are trusted by students can increase students' self-confidence in their academic abilities. Positive messages can encourage effort and increase student self-confidence, especially if accompanied by conditions and instructions that support the achievement of success (Bandura, 1997). However, the effectiveness of social persuasion may have limits in maintaining increased self-efficacy in the long term. In fact, reducing one's self-efficacy through social persuasion may be easier than increasing it, especially in the formative years when children are most attentive to the messages they receive from their immediate environment (Bandura, 1997).

Bandura (1997) also put forward the hypothesis that self-efficacy beliefs are influenced by emotional and physiological conditions such as stress, fatigue, and mood. Students learn to interpret their physiological reactions as indicators of personal competence by evaluating their performance under various conditions. Strong emotional reactions to school assignments can provide clues about anticipated success or failure. High levels of anxiety can weaken self-efficacy. Students who feel anxious when facing a particular task tend to interpret their feelings of anxiety as evidence of a lack of skill in that area. Overall, improving students' physical and emotional well-being and reducing negative emotional states will strengthen self-efficacy.

Researchers have not yet reached a consensus on how best to measure the sources of self-efficacy in academic settings. Most have used an adapted version of the Resource Mathematics Self-Efficacy Scale (SMES) developed by Lent et al., (1991). Originally designed to assess the sources of students' mathematics self-efficacy, the items have been adapted for use in both academic and social settings (Anderson & Betz, 2001) as well as designing a scale to measure the sources of students' mathematics self-efficacy, which has been adapted for use with more students. Hampton, (1998) developed the Sources of Academic Self-Efficacy scale, which was validated and subsequently used with high school and college students with learning disabilities.

Mastery experience assessment has been carried out in various ways. Researchers adopting the model proposed by Lent and his colleagues have evaluated Mastery experience by asking students to rate their past and present performance in academic subjects of interest to them, and the items have demonstrated strong internal consistency (Lent et al., 1991). Vicarious experience is typically measured by questions asking students to rate how often they encounter peer or adult models who demonstrate competence in a subject of interest. These questions typically cover students' views on academic skills from various models such as career, close friends in class,

parents, teachers, or older students. Lent and his colleagues typically use questions that tap peer and adult modeling experiences to assess vicarious experiences (Lent et al., 1999). To evaluate social persuasion, researchers generally ask students to rate whether they receive supportive messages about their academic abilities from close individuals such as peers, parents, teachers, and other adults (e.g., Lent et al., 1991). In assessing social persuasion with this approach, most researchers have reported reliability ranging from moderate to strong for these social persuasion items. However, some researchers have used measurements that do not align with Bandura's (1997) theory of these sources. For example, some people evaluate social persuasion with items that refer to the expectations of others, such as "My teacher expects me to go to college" or the directions students receive from others, such as "My teacher told me to read questions carefully before writing down answers when take the exam" (Hampton, 1998). This approach does not fully reflect social persuasion as defined and theorized by Bandura (1997), nor does it evaluate the extent to which students receive evaluative feedback and criticism.

Bandura (1997) stated that several factors can influence a person's physiological and affective state, including mood, physical strength, and level of distress. However, physiological arousal is usually assessed as students' anxiety about certain academic subjects. Researchers using anxiety as a measure of physiological arousal have reported strong reliability. Although anxiety may be the most salient form of psychological arousal in the classroom, especially in mathematics, measures that include other forms such as physical arousal and mood would be more in line with Bandura's (1997) description of this resource.

Research Purposes there are two important reasons why a valid and reliable source measure of self-efficacy is needed. First, self-efficacy beliefs play an important role in students' academic and career choices. So of course it is important for teachers and counselors to be aware of the factors that help create and foster students' self-efficacy beliefs. This information is invaluable in helping teachers adapt their teaching strategies and counseling practices in ways that best support students' self-efficacy and, subsequently, their achievement. Teachers and counselors may also use such assessments as they evaluate the ways academic programs and intervention strategies may influence self-efficacy beliefs.

Another important reason why a psychometric assessment of the sources of self-efficacy is necessary is that the principles of Bandura's (1986) social cognitive theory regarding how self-efficacy works cannot be tested effectively without such an assessment. Researchers who wish to understand the formation of academic self-efficacy must gain such understanding by using valid and reliable measures that appropriately reflect its hypothesized sources and role within the broader structure of social cognitive theory. This is especially important in the field of academic motivation where

sources of self-efficacy are often operationalized and measured in ways that bear no resemblance to Bandura's (1986, 1997) hypothesis.

METHOD

Researchers tested the SSEM (Scale of Sources of Self-efficacy in Mathematics) measuring tool on 200 students from 6 high schools in the city of Palangkaraya. Purposive sampling with sample criteria based on interviews with Counseling Guidance teachers of class XII SMAN 1 Senior High School 2, Senior High School 4, Senior High School 5, SMKN 1 dan Vocational School 2 in the city of Palangka Raya in the 2022/2023 academic year.

Researchers adapted a self-efficacy instrument, namely The Scale of Sources of Self-efficacy in Mathematics. Where there are 24 statements consisting of 4 aspects, namely mastery experience, vicarious experience, social persuasions and physiological state. Students respond to items on a five-point scale, namely 5 = strongly agree, to 1 = strongly disagree). So a higher score means higher self-efficacy and vice versa. In theory, the construct of self-efficacy consists of four main dimensions, mastery experience, vicarious experience, social persuasions and physiological statistics. Therefore, the proposed measurement model is also a multidimensional model consisting of four intercorrelated dimensions. This model is known as "multidimensional test with correlated dimensions" (Furr & Bacharach, 2013)

There are six items in the Mastery Experience dimension, namely items number 1, 2, 3, 4, 5 and 6. The Vicarious Experience dimension consists of six items, namely item numbers 7, 8, 9, 10, 11 and 12. Meanwhile, the Social Persuasions includes six items, namely item numbers 13, 14, 15, 16, 17 and 18. Finally, the Physiological State dimension consists of six items, namely item numbers 19, 20, 21, 22, 23 and 24. Therefore, The construct of self-efficacy is hypothesized to be a multidimensional construct formed from four main aspects: Mastery Experience, Vicarious Experience, Social Persuasions and Physiological State.

The measuring instrument used in this research is the result of an adaptation from English to Indonesian. The adaptation process is not only limited to translation, but also includes adjustments so that the test is appropriate to the social and cultural context of students in Indonesia. Adaptation of this instrument includes steps such as ensuring that the measuring instrument can measure the same construct in different languages and cultures, selecting an appropriate translator, determining necessary adjustments, and checking its equivalence in the adapted form (Hambleton et al., 2004).

Adaptation of measuring instruments was carried out based on technical procedures for cross-cultural adaptation of measuring instruments by (Beaton et al., 2000). The adaptation process consists of 5 stages, namely: (1) translation, (2)

synthesis, (3), back translation, (4) expert assessment, and (5) data collection (Beaton et al., 2000)

Stage 1 Translation; This stage is the earliest stage which aims to produce a translation of the Scale. This research involved two translators who separately translated the SSEM Scale from English to Indonesian. The first translator has a non-psychological science background and has an IELTS score of 6.5. The second translator is a professional English teacher who has an educational background in English. This stage then produces translation data for Translator 1 (P1) and Translator 2 (P2). **Stage 2 Synthesis;** At this stage, researchers carry out a synthesis of data P1 and P2. Synthesis is carried out by comparing the translation results of P1 and P2, looking at the similarities and differences in the grammar used, then evaluating its conformity with the theoretical concept of authenticity, and evaluating the grammar in accordance with the Indonesian EYD. This synthesis stage then produces a draft synthesis of the Indonesian version of the Scale. **Stage 3 Back Translation;** At this stage, the initial draft of the Indonesian version of the SSEM scale data was back-translated into English by two translators separately. These results were then compared with the original statement, even though the structure was different, the meaning content was equivalent (Farida et al., 2018). **Stage 4 Expert Assessment;** At this stage, the researcher sent the Indonesian version of the scale draft to experts which included five experts who had expertise in the fields of psychology, measurement, language and had a good understanding of the concept of the scale to be adapted. These five experts were asked to provide an assessment to ensure whether the adapted instrument prepared was equivalent to measuring the construct and appropriate to the cultural context in Indonesia. The results of the assessments from these four experts were then quantified using the Aiken's V formula (Aiken, 1985). In stage 5, a trial was carried out by giving instruments to a number of respondents on a small scale to determine the extent to which the instructions and items on the scale could be understood by the respondents. After the researchers refined the items based on input from experts, a pilot test was carried out on 40 students. The results of this pilot trial showed that the instructions could be understood well, and all 20 items were also clear according to respondents. So, the next step is to carry out trials on a large scale.

AMOS (Version 26) is used as an analytical tool, used for Structural Equation Modeling-Confirmatory Factor Analysis (SEM CFA) analysis. SEM is a leading analysis in various research because SEM can analyze the correlation of many variables at once; can find out the correlation between indicators and aspects in a variable; as well as the relationship between dependent, independent, moderating and mediating variables, both direct and indirect relationships in a measurement and structural model. Confirmatory Factor Analysis (CFA) is one part of the SEM (Structural Equation Modeling) method which functions to test and analyze existing hypothetical relationships between indicators and their latent

variables (Hair et al., 2011b). The indicator that shows whether the measuring instrument is fit or not is shown by the Goodness-of-fit (GOF) value.

RESULTS AND DISCUSSION

Results of Study I: Results of Confirmatory Factor Analysis (CFA) SSEM Scale

Assessment of the validity of the items in the instrument is necessary to determine the extent to which the items in the instrument are appropriate and relevant to the purpose of measuring the variable being investigated. According to (Heale & Twycross, 2015), validity is related to the extent to which a concept can be measured precisely in quantitative studies.

According to the Educational and Psychological Testing standards published by the American Education Research Association (AERA) in 2014, it is explained that there is only one type of validity, namely construct validity. Construct validity can be tested using five types of evidence: (1) test

content; (2) cognitive/response test; (3) internal structure; (4) relationships to other variables, and (5) consequences of testing (AERA, 2018). In this research, construct validity is established based on evidence of internal structure. To assess construct validity based on internal structure, confirmatory factor analysis (CFA) was conducted. The CFA test is used to evaluate the feasibility of the model and measure the factor loading of each item as evidence of construct validity based on internal structure.

A model is considered adequate if at least one of the model feasibility test parameters has been met. However, the level of model feasibility will be better if it can fulfill more than one model feasibility test parameter. According to (Hair et al., 2011a) the use of 4 to 5 goodness of fit criteria is considered adequate to assess the suitability of a model.

Below are presented the results obtained from confirmatory factor analysis using AMOS software.

Table 1. Goodness of fit of adaptation of SSEM

Goodness of Fit Indices	Cut off value	Berofe modification	Status	After modification	Status
P value of Chi-square	≥ 0.05	0,000	No Fit	0,097	Fit
CMIN/DF	≤ 2.00	1,420	Fit	1,154	Fit
RMSEA	≤ 0.08	0,046	Fit	0,028	Fit
GFI	≥ 0.90	0,876	No Fit	0,920	Fit
AGFI	≥ 0.90	0,851	No Fit	0,897	Fit
TLI	≥ 0.90	0,976	Fit	0,993	Fit
CFI	≥ 0.90	0,978	Fit	0,994	Fit
NFI	≥ 0.90	0,931	Fit	0,956	Fit

Information: P-value=signifikansi; RMSEA=Root Mean Square Error of Approximation; NFI=Normed Fit Index; NNFI/TLI=Tucker Lewis Index; CFI=Comparative Fit Index; IFI=Incremental Fit Index; RFI=Relative Fit Index; RMR=Root Mean Square Residual; GFI=Goodness of Fit Indeks; AGFI=Adjusted Goodness Fit of Index

The CFA results in the table above show that the self-efficacy measurement model that the researchers constructed based on the initial model constructed by Usher & Pajares, (2009) resulted in a model that was not yet fit as seen from the p value = 0.000. To assess model fit, it is expected that the Chi-Square value is not significant (p-value > 0.05).

Dropping items was carried out in an effort to increase the accuracy of the measurement model (Hair et al., 2014).

Therefore, there are five items, namely item no. 2 which measures the mastery experience dimension, item no. 9 which measures vicarious experience, and item no 18 which measures social persuasions, items no 20 and 23 which measure physiological state were dropped. This is based on looking at the modification indices that have the highest M.I Par.

After making modifications, the chi-square value = 170.749 p = 0.97 or (p-value > 0.05) means there is a match between the data and the model, then the RMSEA value = .028 (≤ 0.09), CMIN/DF = 1.154 (≤ 2.00), GFI = 0.920, CFI = 0.994, TLI = 0.993 (≥ 0.90) and AGFI = 0.897 also show that the model meets the criteria. Therefore, it can be concluded that the construct model is acceptable/FIT construct model.

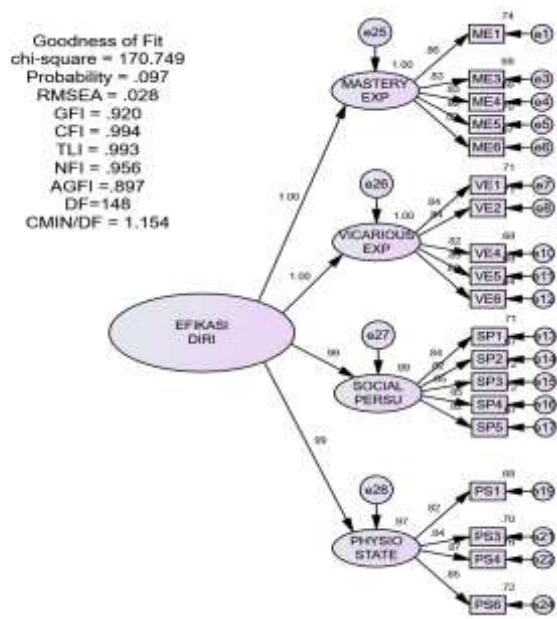


Figure 1. Self-Efficacy CFA Results After Modification

Furthermore, the factor loading value for the mastery experience aspect of self-efficacy is 1.00, vicarious experience of self-efficacy is 1.00, the social persuasion aspect is 0.99 and the physiological state aspect is 0.99. Apart from that, items in the mastery experience aspect have factor loading values ranging from 0.82 to 0.86, items in the vicarious experience aspect have values from 0.80 to 0.84, items in the social experience aspect have values from 0.82 to 0.85 and items on the physiological state aspect have values from 0.82 to 0.87. This means that all 19 items on the self-efficacy scale were proven to be valid, because they had a factor loading value criterion (≥ 0.40).

Based on the results of this CFA analysis, it can be concluded that the self-efficacy scale is a measuring tool that measures the construct of self-efficacy as a multidimensional construct formed from the dimensions of mastery experience, vicarious experience, social persuasions and physiological state. Thus, the self-efficacy scale has received data support. It can be concluded that the self-efficacy scale is a multidimensional scale with four dimensions that correlate according to the theoretical concept of self-efficacy.

Results of Study 2: Instrument Reliability

Reliability testing is the next stage after testing the model and loading factors. The construct reliability coefficient emphasizes

how far the measuring indicators reflect the latent factors that have been compiled. The greater the indicator reflects the latent factors, the greater the measurement reliability value. The reliability value is obtained from construct reliability or composite reliability (CR) and the average variance extracted (AVE). In construct reliability, the minimum value set to indicate that the construct is acceptable is $CR \geq 0.7$ and the minimum recommended AVE value is $AVE \geq 0.5$ (Hair et al., 2011a)

Statistical methods used to assess internal consistency reliability may include Cronbach's Alpha coefficient testing. Cronbach's alpha is the technique most often used by researchers and the only reliability index that can be calculated with one test (Cohen, 2012). Cronbach's alpha reliability coefficient ranges from 0 to 1, with values between 0.60 and 0.70 considered the minimum acceptable limit (Hair et al., 2011b). In other words, an instrument is considered reliable if it has a value of $(CR) > 0.70$ and $(AVE) \geq 0.50$ and a Cronbach's alpha coefficient ≥ 0.70 .

The results of the reliability estimation for all items from the five instruments/scales used in this research can be seen in table 3 below

Table 2. Reliability of Research Instruments

Variable	Dimensions	CR	AVE	Cronbach's Alpha	Ket
Self-efficacy	Mastery Experience	0.89	0.61	0.92	Reliable
	Vicarious Experience	0.88	0.59	0.92	Reliable
	Social Persuasions	0.89	0.62	0.91	Reliable
	Physiological State	0.87	0.63	0.91	Reliable

Source: Data processed by AMOS and SPSS

Based on the results of the analysis, the CR of each self-efficacy construct is 0.61 (Mastery Experience), 0.59 (Vicarious Experience), 0.62 (Social Persuasions) and 0.63 (Physiological State). The Cronbach's Alpha values of each construct are 0.92, 0.92, 0.91 and 0.91 while the Cronbach's Alpha of each self-efficacy construct is 0.92 (Mastery Experience), 0.92 (Vicarious Experience), 0.91 (Social Persuasions) and 0.91 (Physiological State).

Thus, both academic efficacy constructs have CR values above 0.70, AVE values above 0.50 and Cronbach's Alpha values above 0.70. It can be concluded that the two scales used in this research already have good reliability requirements for measuring instruments.

This study has limitations that need to be considered to further understand and interpret the results. First, the sample involved was not too large (N=200) and was limited by a number of respondent criteria and the research location was carried out in just one city. Therefore, this research still needs to be tested in a large sample with more varied socio-demographic variables. Second, regarding the results of the reliability and validity tests, the two items on the self-efficacy scale that have been discussed still show the need to be revised more accurately according to the Indonesian context so that the reliability and validity values of the SSEM items and scales can increase so that future studies are expected to be able to carry out revisions on the items. Third, the limitations of this study are also related to the diversity of the participant sample which does not involve more varied final levels of education so that future studies can involve more samples that are more representative of the Indonesian region.

CONCLUSION

Results Overall it can be concluded that of the 24 items that researchers adapted to measure self-efficacy, 19 items correctly measured self-efficacy while 5 items did not. This scale is a valid and reliable measuring tool that can be used to measure students' self-efficacy. Fourth. The results of this research reflect the latent variables that were measured and also each statement on each indicator shows good validity figures. All model suitability parameters also show that the SSSEM model is suitable for measuring self-efficacy among respondents in Indonesia.

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