Construction Validity Testing on Blended Learning Implementation Evaluation Instruments

Muhammad Yusuf[1*], *Andi* Andariana[2], *Perawati* Bte Abustang[3], *Abdul* Mannan[1], *Muhammad* Ansarullah S. Tabbu[1], *Dinil* Qaiyimah[1], and *Haris*[1]

[1]Department of Geography Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Makassar
[2]Department of Biology Education, Faculty of Teacher Training and Education, Universitas Patompo
[3]Department of Primary Teacher Education, Faculty of Teacher Training and Education, Universitas Megarezky

Abstract. This study aims to determine the construct validity of the instrument used in the application *of Blended Learning*. Respondents were randomly selected 60 students from the Department of Geography, Faculty of Mathematics and Natural Sciences, Makassar State University, 60 students from the Department of Biology Education, Faculty of Teacher Training and Education, Patompo University, and 60 students from the Department of Primary Teacher Education, Faculty of Teacher Training and Education, Megarezky University. Construct validity was tested by Confirmatory Factor Analysis (CFA) in Structural Equation Modeling (SEM) through the AMOS 22.0 application. The analysis findings reveal that the indicators employed in developing the Instrument for Blended Learning Model Application encompass the constructs of Orientation, Organization, Investigation, Presentation, Analysis, and Evaluation. These constructs meet the criteria of Construct Reliability, Variance Extracted, and Discriminant Validity. Consequently, the instrument proves suitable for implementation in research examining the application of the Blended Learning Model.

1 Introduction

Validity refers to the extent to which an instrument or measurement accurately assesses what it intends to measure [1]–[3]. Validity is closely related to the reliability of the instrument in collecting data, as it ensures that the instrument effectively captures the intended measurement. Validity primarily focuses on the accuracy of measurement or observation tools. In studies involving variables or concepts that cannot be directly measured, establishing validity becomes a complex task that involves translating theoretical concepts into empirical indicators. However, it is important to note that having a valid research instrument alone does not guarantee trustworthy results [4]–[8].

Construct validity is the level of reliability, validity, accuracy, and capability of a measuring instrument in measuring the meaning of a concept it measures [4], [9]–[12]. To put it differently, construct validity examines the consistency and accuracy of a construct derived from the conceptual framework that underpins it. It assesses the extent to which an instrument can effectively measure the concepts encompassed within a theory or construct. Construct validity goes beyond measuring the correlation of individual items among the overall set of items and instead evaluates how well the instrument captures the theoretical concepts it is designed to assess. Thus, construct validity provides insights into the level of validity associated with the concepts that form the foundation of a theory [13]–[16].

Construct validity can be assessed through various methods, one of which is by employing Confirmatory Factor Analysis (CFA), a statistical technique utilized to explore the variation among variables that can potentially be categorized into distinct factors. CFA serves as a valuable statistical tool in uncovering the underlying construct of a set of observable variables or examining the assumptions underlying a variable. Therefore, confirmatory analysis is particularly suitable for evaluating the theoretical variable based on the observable manifestations or indicators that constitute it, assuming that the variable is exclusively measured through these indicators [9], [17]–[21].

Factor analysis can also be understood as a technique employed to identify the underlying variables or factors that account for the pattern of relationships among a set of observed variables. It is commonly used in data reduction to identify a smaller number of factors that explain the shared characteristics of several related factors [17], [19], [22]–[25]. The objective of data reduction is to

*Corresponding author: m.yusuf@unm.ac.id

eliminate intercorrelated independent variables, resulting in a reduced set of uncorrelated variables. Variables that are correlated with each other have similarities/similar characters with other variables so that they can be used as a factor[19], [26]–[30]. The outcomes of the validity test utilizing CFA determine the extent to which the scores obtained from an instrument reflect the underlying theoretical construct upon which the instrument was developed, particularly for non-test instruments [31]–[37].

In the field of educational studies, apart from using test instruments, non-test instruments such as questionnaires, observations, and others are often used. Non-test instruments in the field of educational studies are often used to capture information about students' perceptions or responses to learning methods, media, teaching materials, and others. As in the application of the Blended Learning Model, a questionnaire was used to find out the extent to which students' responses to the application of the model were used.

2 Library Survey

2.1 Blended Learning Model

Etymologically, the term "blended learning" comprises two words, namely "blended" and "learning." "Blended" refers to a mixture or combination aimed at enhancing the quality or improving effectiveness, indicating a formula for aligning or integrating different elements [38]–[41]. On the other hand, "learning" has a general meaning of acquiring knowledge or skills, suggesting a learning pattern that incorporates elements of integration or combination. This implies that the blend involves merging two primary components, namely classroom instruction and online learning [40], [42]–[44].
The Blended Learning Model represents a combination of information and communication technology with conventional or face-to-face learning approaches. It combines online learning utilizing technology with in-person classroom instruction [45]. Consequently, this model addresses the limitations of both online learning and conventional face-to-face learning [41], [44], [46]–[57]. The characteristics of the Blended Learning Model include: (1) Integration of various teaching methods, learning styles, and technology-based media, (2) Combination of direct instruction, independent learning, and online learning, (3) Effective combination of delivery methods, teaching strategies, and learning styles, and (4) Equally important roles for teachers and parents, with teachers acting as facilitators and parents providing support.

2.2 Construct Validity

Validity is a metric that indicates the degree of accuracy or soundness of an instrument [4], [10], [24]. The concept of validity refers to the extent to which a measurement or observation accurately captures the intended data and aligns with the principle of instrument reliability during data collection. The goal of the research is to find the truth. In this effort, the issue of validity is a very important aspect. The truth can only be obtained with valid instruments. Then it is said validity because it is the essence of truth from research results. Validity is seen as the most important concept in research. In each research, the validity of the tools used is always questioned. Therefore, to make a valid instrument, it needs the attention of every researcher. A measuring tool is said to be valid if the tool measures what should be measured by the tool. For example, to measure the weight of an object using scales [9]–[13], [15], [17].

Some traits cannot be directly manifested in human behavior, for example, a person's personality. Personality consists of various components, with personality tests we want to know which aspects we are measuring. With a statistical technique called factor analysis, various components of personality can be investigated, so that the test can be prepared based on these components, such a test can be said to have construct validity. Construct validity is used when we see whether the symptoms being tested contain only one dimension. If it turns out that the symptom contains more than one dimension then the validity of the test is doubtful. The advantage of this construct validity is knowing the components of attitudes or traits that are measured by the test [1]–[3], [5].

Construct validity refers to the extent to which the test items accurately measure the intended concept or conceptual definition that has been established. It specifically addresses the measurement of abstract phenomena and objects, although the symptoms or indicators can be observed and quantified [6], [10], [17], [19], [22]–[25], [58]. Construct validity applies to various domains, including measuring attitudes, self-concept, interests, locus of control, leadership style, achievement motivation, and other constructs that pertain to maximum performance, such as talent assessments, intellectual intelligence, emotional intelligence, and more.

3 Method

The construct validity of the instrument for implementing the Blended Learning Model was assessed among students from three different universities: the Department of Geography at

Makassar State University, the Department of Biology Education at the University of Patompo, and the Department of Primary Teacher Education at Megarezky University. A total of 180 students participated in the study, with 60 students randomly selected from each university. Data collection was conducted online using the Google Forms application, which was deemed effective and efficient for data gathering. To evaluate construct validity, Confirmatory Factor Analysis (CFA) was employed through the Amos 24.0 application. CFA, as part of the Structural Equation Modeling (SEM) statistical analysis, was utilized following previous research [9], [15], [25], [28]–[32], [34], [37], [59], [60]. This approach yielded accurate results in conducting the validity assessments.

4 Results and Discussion

The validity of the instrument for implementing the Blended Learning Model in this study was tested using the SEM validity technique through the AMOS 24.0 application. Before conducting the test, a list of indicators for each construct being tested is first made. The implementation of the Blended Learning Model encompasses five constructs: Orientation, Organization, Investigation, Presentation, and Analysis and Evaluation. The indicators that comprise each construct are presented in the table below.

Table 1. Constructs and Indicators Instrument Implementation of Blended Learning Model

Constructs	Indicators	Labels
Orientation	The Proportion of learning time	X11
	Prepare learning material	X12
	Prepare learning aids	X13
	Student learning readiness	X14
	Online applications used in learning	X15
Organization	Communicating learning methods	X21
	Explain the relationship between the problem and with learning material	X22
	Organize other reference searches related to problem-solving	X23
	Communicating the problem-solving flow	X24
	Communicate the use of IT devices in learning	X25
Investigation	Make observations to find solutions to problems in everyday life	X31
	Gather information/facts related to problem-solving	X32
	Conducting independent investigations in solving problems	X33
	Communicate the results of problem-solving	X34
	Examine the suitability of theory with problem-solving	X35
Presentation	Discuss the advantages and disadvantages of solving the problem	X41
	Developing problem-solving based on the theory	X42
	Communicate various alternatives in solving problems	X43
	Demonstrates activity in discussion	X44
	Demonstrates the activity of consulting directly or indirectly	X45
Analysis & Evaluation	Communicate the evaluation techniques used	X51
	Reflecting on problem-solving	X52
	Analyzing the relationship with other problems	X53
	Assessment of IT tools or online media used	X54
	The response to learning is fun, according to the times	X55

Next, modeling is made based on the constructs and indicators above. Modeling is done using AMOS 24.0. The modeling drawing is shown as follows

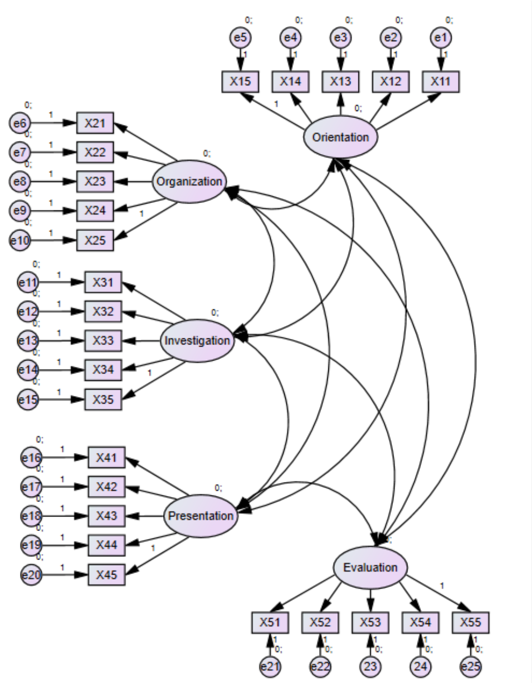

Fig. 1. Construction Model and Instrument Indicators for Implementing Blended Learning Models

Based on the model above, validity and reliability tests were carried out using the SEM technique. The results of model testing are shown in the following figure.

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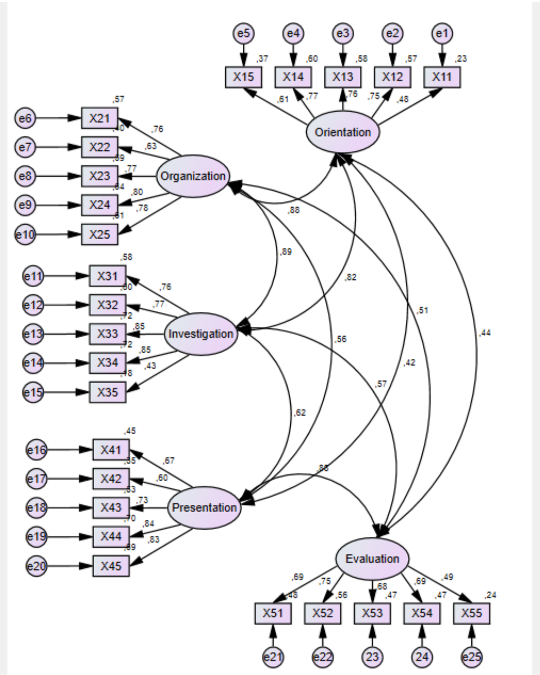

Fig. 2. The outcomes of the validity and reliability assessments conducted through the (SEM) technique.

The assessment of validity and reliability includes several aspects, such as Convergent Validity, Construct Reliability, Variance Extracted, and Discriminant Validity. Convergent Validity evaluates whether each indicator effectively measures the dimensions of the concept under consideration. An indicator demonstrates significant convergent validity if its coefficient exceeds twice the standard error (C.R > 2. SE). When each indicator exhibits a critical ratio (C.R) surpassing twice the standard error, it indicates that the indicator effectively measures the intended construct within the model. The results of the Convergent Validity test are summarized in the following Regression Weights table.

Table 2. Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
X15	<---	Orientation	1,000				
X14	<---	Orientation	1,481	,185	7,985	***	par_1
X13	<---	Orientation	1,412	,179	7,897	***	par_2
X12	<---	Orientation	1,215	,155	7,859	***	par_3
X11	<---	Orientation	,830	,150	5,519	***	par_4
X25	<---	Organization	1,000				
X24	<---	Organization	,876	,076	11,488	***	par_5
X23	<---	Organization	,926	,085	10,911	***	par_6
X22	<---	Organization	,684	,079	8,692	***	par_7
X21	<---	Organization	,817	,076	10,693	***	par_8
X35	<---	Investigation	1,000				
X34	<---	Investigation	2,047	,351	5,832	***	par_9
X33	<---	Investigation	2,015	,346	5,832	***	par_10
X32	<---	Investigation	1,868	,329	5,675	***	par_11
X31	<---	Investigation	1,899	,336	5,652	***	par_12
X45	<---	Presentation	1,000				
X44	<---	Presentation	1,020	,079	12,927	***	par_13
X43	<---	Presentation	,906	,085	10,658	***	par_14
X42	<---	Presentation	,773	,093	8,305	***	par_15
X41	<---	Presentation	,875	,091	9,566	***	par_16
X55	<---	Evaluation	1,000				
X54	<---	Evaluation	1,285	,217	5,928	***	par_17
X53	<---	Evaluation	1,269	,214	5,916	***	par_18
X52	<---	Evaluation	1,212	,197	6,151	***	par_19
X51	<---	Evaluation	1,075	,181	5,945	***	par_20

Table 2 above as a whole shows the value of C.R > 2.SE, so each indicator that is estimated validly measures the dimensions of the construct being tested. In addition, the probability value for each indicator tested is less than 0.05. These results support the value of C.R > 2.SE so that each indicator meets the Convergent Validity criteria.

Next, the Construct Reliability test is carried out, using the Standardized Loading value. Construct reliability is a measure of the internal consistency of the indicators of a formed variable that shows the degree of the formed variable. Variance extracted is a measure of how much total variance of the indicators extracted by the variables formed.

$$\text{Construct reliability} = \frac{\text{Square of Total Standardize Loading}}{\text{Square of Total Standardize Loading} + \text{measurement error}} \quad (1)$$

Measurement error = 1 – (Standardized Loading)^2

The accepted cutoff value for the Construct Reliability test is > 0.70. However, in explanatory research, a value below 0.7 may still be considered acceptable.

In addition to Construct Reliability, the Variance Extracted value is also important to indicate the variance of the indicators extracted by the latent construct compared to the error variance. The Variance Extracted value is calculated by summing the squared standard loading values and dividing it by the sum of the squared standard loading values plus the total error value. The accepted cutoff value for the Variance Extracted test is > 0.70. The complete formula is provided below.

$$\text{Variance Extracted} = \frac{\mathit{Sum}\text{ of Standardize Loadning Square}}{\text{Sum of Standardized Loading Square} + \text{measurement error}} \quad (2)$$

Furthermore, the Discriminant Validity value is obtained from: Discriminant Validity = $\sqrt{\text{Variance Extracted}}$ (3)

Discriminant validity was carried out to test the two constructs whether are indeed different and each is an independent (free) construct. The summary table presents the results of the Construct Reliability, Variance Extracted, and Discriminant Validity tests.

Table 3. Testing Construct Reliability, Variance Extracted, and Discriminant Validity

Contruct	Indicators	Standardized	Square of Standardized	Measurement	Construct	Varaince	Disoriminant
		Loading	Loading	Error	Reliability	Extracted	Validity
Orientation	X15	0,606	0,367	0,633	0,870	0,576	0,759
	X14	0,773	0,598	0,402			

	X13	0,760	0,578	0,422			
	X12	0,754	0,569	0,431			
	X11	0,876	0,767	0,233			
	Sum	3,769	2,878	2,122			
	Square	14,205					
Organisation	X25	0,780	0,608	0,392	0,865	0,563	0,750
	X24	0,801	0,642	0,358			
	X23	0,768	0,590	0,410			
	X22	0,634	0,402	0,598			
	X21	0,756	0,572	0,428			
	Sum	3,739	2,813	2,187			
	Square	13,98					
Investigation	X35	0,430	0,185	0,815	0,859	0,560	0,749
	X34	0,874	0,717	0,283			
	X33	0,874	0,717	0,283			
	X32	0,774	0,599	0,401			
	X31	0,764	0,584	0,416			
	Sum	3,662	2,802	2,198			
	Square	13,410					
Presentation	X45	0,829	0,687	0,313	0,854	0,543	0,737
	X44	0,837	0,702	0,299			
	X43	0,726	0,527	0,473			
	X42	0,595	0,354	0,646			
	X41	0,667	0,445	0,555			
	Sum	3,654	2,714	2,286			
	Square	13,352					
Analysis & Evaluation	X55	0,889	0,790	0,210	0,859	0,553	0,744
	X54	0,687	0,472	0,528			
	X53	0,684	0,468	0,532			
	X52	0,746	0,557	0,443			
	X51	0,691	0,477	0,523			
	Sum	3,697	2,764	2,236			
	Square	13,668					

Based on the test results above, it can be seen that all the indicators tested met the Construct Reliability, Variance Extracted, and Discriminant Validity criteria. Therefore, it can be said that the indicators compiled theoretically in the Blended Learning Model Application Instrument meet the Construct Reliability, Variance Extracted, and Discriminant Validity criteria. In other words, these indicators come from concepts compiled from theory.

5 Conclusion

Based on the results of the Construct Validity test using the SEM technique, it can be concluded that the indicators used in the preparation of the Blended Learning Model Application Instrument consist of constructs; Orientation, Organization, Investigation, Presentation, Analysis, and Evaluation, meet the criteria of Construct Reliability, Variance Extracted, and Discriminant Validity. Therefore, the instrument is suitable for use in research that examines the application of the Blended Learning Model.

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