Measuring early reading skills using valid and reliable instrument

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Abstract: Reading is an important language skill and plays a role in students' learning success. Reading success is driven by adequate early reading skills. To measure early reading skills, valid and reliable measurement tools were needed. The purpose of this study was to assess the construct validity and construct reliability of a newly designed early reading instrument. Using quantitative methods, 320 respondents from 17 randomly selected elementary schools were involved in the study. Using the Lisrel 8.80 program, the obtained data was analyzed using second-order confirmatory factor analysis. The findings revealed that the early reading skills instrument was valid in terms of loading factor, convergent validity, and discriminant validity, as well as meeting the construct reliability requirements, so that the developed early reading skills instrument was feasible to use.

Keywords: Confirmatory Factor Analysis, Early Reading Skill, Construct Validity, and Construct Reliability.

INTRODUCTION

Reading is a language skill that is important for anyone to obtain information and knowledge. Reading skills for students in elementary school play a very important role in student learning success. Reading is included in complex activities that include physical and mental aspects (Melati Beauty et al., 2023). In simple terms, reading is a thinking process to gain an understanding of the content of the text read (Paz & Coutinho, 2022). Successful reading is driven by early reading skills (Alibakhshi Kenari, 2018; Loo & Md Nor, 2019). As the basis for subsequent abilities, early reading skills require serious attention from teachers so that students have adequate early reading skills (Tarman & Erkan, 2021). Appropriate stimulation needs to be done to develop early reading skills and must be repeated as often as possible so that students' early reading skills can be well developed (Biščević et al., 2021; Sonnenschein et al., 2022).

Teaching early reading to students must pay attention to the stage of development and its characteristics (Niklas et al., 2016). Reading in young children is divided into four stages, namely: the stage of awareness of writing; the stage of reading pictures; the stage of reading recognition; and the stage of reading fluently (Cárdenas et al., 2020; Purandina & AR, 2022; Sajedi et al., 2018). Early grade students learn by seeing various concrete objects and representing the world through words, stories, and pictures (Aisyah et al., 2020; Hasanudin & Asror, 2017; Wulandari, 2018). In early reading skills, it focuses more on literacy, where students convert written symbols and can pronounce them into sounds that have meaning (Anggraeni & Alpian, 2019). Reading is not just recognizing and pronouncing sound symbols; it is also necessary to understand the content of what is read (Kharisma & Arvianto, 2019). Based on these conditions, suitable methods and means are needed to develop students' early reading skills. To see the development of early reading skills, an appropriate evaluation needs to be given. So far, the evaluation model used is still limited to measuring reasoning without allowing students to explore their abilities (Kartini et al., 2022).

To conduct an evaluation, a valid and reliable instrument is needed. Varied instruments will motivate students to do the assignments (Giati Anisah & Midya Yuli Amreta, 2023). This includes the instrument for the development of early reading skills, the majority of which have not been tested for validity (Pratiwi et al., 2021). Therefore, it is important to carry out research on the development of early reading ability assessment instruments in early childhood.

The novelty of this research lies in the development of an early reading skills instrument that is valid and reliable. The construct validity and reliability of the early reading skills instrument were investigated. Construct validity measures how successfully the researcher transfers theory into the instrument utilized. Factor analysis can be used to demonstrate construct validity. Confirmatory Factor Analysis (CFA) is one of the factor analysis methodologies used in testing how well the variables measured can represent the factors or constructs previously compiled. This test is useful for measuring the model (model measurement) in order to describe the aspects and indicators as a reflection of the latent variable, namely the early reading skill, by examining the loading factor of each part that makes up a construct. CFA may also be used to assess the construct validity and construct reliability of items that make up latent constructs (Elfida et al., 2021).

The CFA applied in this study is second-order confirmatory factor analysis, which is a framework with two levels of assessment. The first level of analysis proceeds from the latent aspect construct to each of its indicators, and the second level proceeds from the latent construct to the aspect construct. (Abdulloh, 2022; Petsangsri & Pislae-Ngam, 2020). The objective of this study was to put to the test an early reading skills instrument that passed construct validity and reliability standards. Construct validity encompasses both convergent and discriminant validity. The instrument test used confirmatory factor analysis assisted by Lisrel 8.80 software.

METHODS

The variable investigated in this study is early reading ability. The early reading skills variable is focused on first-grade primary school kids. This study used quantitative research methods. This study aimed to assess the construct validity and construct reliability of a newly designed beginning reading instrument.

Participant

The study's sample was acquired from seventeen elementary schools in Klaten Regency, which were randomly selected. The appropriateness of the sample employed influences model fit in factor analysis (Habibi et al., 2017). Therefore, consideration is needed when using sample adequacy. In order to acquire valid data from factor analysis, more than 100 participants, or five times the number of items studied, can be used. (Koran, 2016; Kyriazos, 2018). Based on this view, to meet the good category, the sample involved in the study amounted to 320 participants. The sample size has been determined to be enough for obtaining accurate data and model fit.

Instrument

The variable in this study was assessed using four indicators and 16 measurement items in this study. The four indications are as follows: recognizing letters, pronouncing words or sentences, reading with tempo and intonation, and reading fluency. Each indicator is measured by four items. The distribution of indicators and measurement items is explained in **Table 1**.

Procedure

Data collection was conducted by observation using early reading skill instruments and by conducting performance tests with participants. Data were obtained from 320 students who were observed. The observation sheet applied matches up with the study variable's construct, which contains 16 measurement items form four categories of indicators. A measuring scale was applied to categorize the observation results. The questionnaire's scales are 5, 4, 3, 2, and 1. The research data were then summarized and tabulated for future analysis.

TABLE 1. *Measurement Indicators and Items*

Indicator	Measurement Item	Kode
Recognize	Shows the shapes of letter symbols with their sounds	A1
Letters	Sounds the letters according to the letter symbols	A2
	Shows and sounds vowel letter shapes	A3
	Shows and sounds consonant letter shapes	A4
Pronounce	List words with vowels (a, i, u, e, o)	B5
words or	List words with consonants (b, c, d, f, ...)	B6
sentences	Pronounce words according to syllable divisions	B7
	Pronounce simple sentences	B8
Reading with	Pronounce words with a rising tone	C9
tempo and	Pronounce words with a descending tone	C10
intonation	Read with a tempo (fast and slow reading) that is appropriate to the content of the reading text	C11
	Responds appropriately to punctuation marks	C12
Reading fluency	Reading without spelling	D13
	Reading with the use of pauses	D14
	Pronouncing words per word or syllable	D15
	Reading with clear pronunciation without stammering	D16

Data Analyze

Confirmatory factor analysis (CFA) was utilized to analyze the data in this study. The Lisrel 8.80 program is utilized for this analysis. There are two types of variables in confirmatory factor analysis: latent variables and indicator variables. Latent variables are variables that cannot be generated or constructed directly, but indicator variables may be seen and assessed directly. (Lei & Shiverdecker, 2020; Selomo et al., 2019). Indicators are said to measure latent variables if they have a loading factor coefficient of not less than 0.4 (Rinaldi et al., 2021). The type of analysis used in this study comes to reliability analysis by finding the construct reliability coefficient, it is vital to confirm that the data fulfills convergent and discriminant validity before computing the construct reliability coefficient. (Herwin & Riana Nurhayati, 2021).

RESULTS

The study's findings are summarized using the previously developed variable building blocks of early reading skills., including four indicators: recognizing letters, pronouncing words or sentences, reading with tempo and intonation, and reading fluency. Tests were conducted on the four indicators of early reading skill builders, which consist of sixteen measurement items.

Confirmatory Factor Analysis

Figure 1 shows the findings of the second-order confirmatory factor analysis.
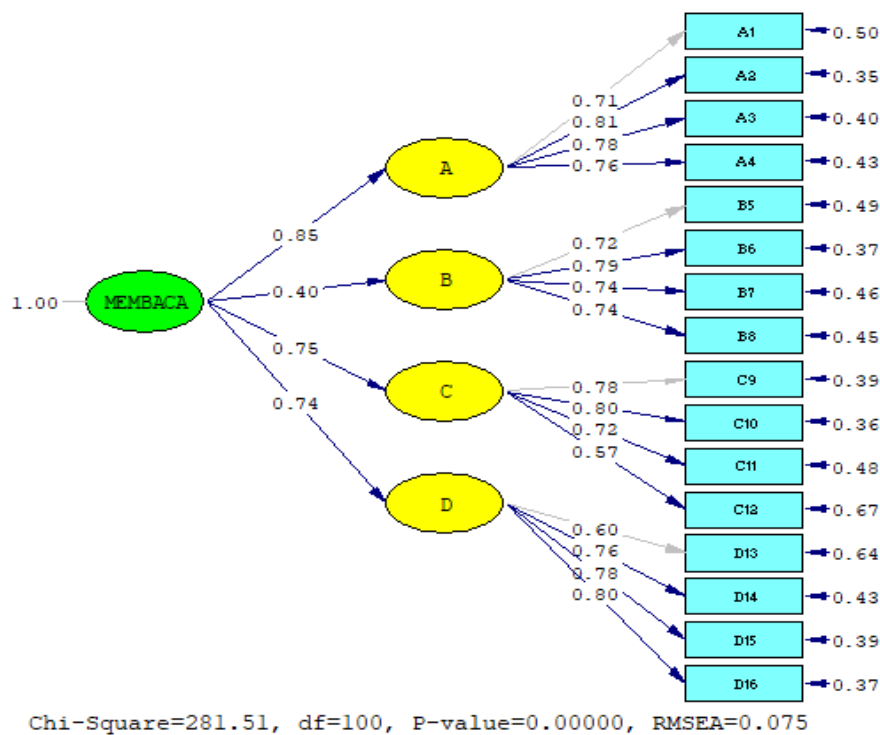
FIGURE 1. *Result of second-order confirmatory factor analysis*

TABLE 2. *Convergent validity (AVE)*

Indicator	Item	λ	λ²	1-λ²	AVE
	A1	0,71	0,5041	0,4959	0,58655
	A2	0,81	0,6561	0,3439	
A	A3	0,78	0,6084	0,3916	
	A4	0,76	0,5776	0,4224	
	∑	3,06	2,3462	1,6538	
Indicator	Item	λ	λ²	1-λ²	AVE
	B5	0,72	0,5184	0,4816	0,559425
	B6	0,79	0,6241	0,3759	
B	B7	0,74	0,5476	0,4524	
	B8	0,74	0,5476	0,4524	
	∑	2,99	2,2377	1,7623	
Indicator	Item	λ	λ²	1-λ²	AVE
	C9	0,78	0,6084	0,3916	0,522925
	C10	0,80	0,64	0,36	
C	C11	0,72	0,5184	0,4816	
	C12	0,57	0,3249	0,6751	
	∑	2,87	2,0917	1,9083	
Indicator	Item	λ	λ²	1-λ²	AVE
	D13	0,60	0,36	0,64	0,5465
	D14	0,76	0,5776	0,4224	
D	D15	0,78	0,6084	0,3916	
	D16	0,80	0,64	0,36	
	∑	2,94	2,186	1,814	

TABLE 3. *Discriminant validity*

	A	B	C	D
A	0,765866			
B	0,234542	0,747947		
C	0,57671	0,220361	0,723136	
D	0,57326	0,333007	0,468018	0,739256

Convergent Validity Test

Furthermore, a convergent validity test was conducted. The results of the convergent validity analysis of the early reading skills instrument were based on the data gathered in the study can be described in **Table 2**.

Discriminant Validity Test

The next validity test to be carried out is the discriminant validity test. The results of the correlation analysis between constructs using SPSS Statistics 24.0 for Windows are presented in Table 3 below.

Construct Reliability Test

Construct reliability is a measure of each variable's internal consistency in expressing the latent construct to be tested (Malcolm et al., 2019). After construct validity is established using confirmatory factor analysis based on loading factor analysis, construct reliability may be assessed. This component is then used to determine construct reliability, and a construct reliability coefficient greater than 0.70 is considered acceptable (Naqsyahbandi & Prodjosantoso, 2023). **Table 4** presents the findings of the construct reliability analysis.

TABLE 4. *Construct reliability analysis*

Item	λ	λ²	1-λ²	ω
A1	0,71	0,50	0,50	**0,95**
A2	0,81	0,66	0,34	
A3	0,78	0,61	0,39	
A4	0,76	0,58	0,42	
B5	0,72	0,52	0,48	
B6	0,79	0,62	0,38	
B7	0,74	0,55	0,45	
B8	0,74	0,55	0,45	
C9	0,78	0,61	0,39	
C10	0,80	0,64	0,36	
C11	0,72	0,52	0,48	
C12	0,57	0,32	0,68	
D13	0,60	0,36	0,64	
D14	0,76	0,58	0,42	
D15	0,78	0,61	0,39	
D16	0,80	0,64	0,36	
∑	11,86		7,14	

DISCUSSION

According to the findings of the second-order confirmatory factor analysis, the four indicators are significant for the early reading skills variable. This is demonstrated by the loading factor coefficients, which are all at or above 0.4. The indicator that makes the smallest contribution to the variable of early reading skills with a loading factor coefficient of 0.40 is the indicator that makes the largest contribution with a loading factor coefficient of 0.85 on the indicator of recognizing letters and the indicator of pronouncing words or sentences.

Based on **Table 2**, the AVE values for the four indicators in the early reading skills instrument are 0.58655; 0.559425; 0.522925; and 0.5465. Exceeding the AVE value of 0.50 in each indicator forming the instrument of early reading skills gives the conclusion that the indicators are declared convergently valid.

The discriminant validity test has the aim of proving that one construct is quite distinct from the others (Voorhees et al., 2016). Discriminant validity reveals the extent to which a construct is distinguished from other constructs in a model. One latent construct should not have a high correlation with other constructs (Jauk & Ehrenthal, 2021). Discriminant validity is met if the latent variable shows more variance in the associated indicator variable than it shares with other constructs in the same model (Roemer et al., 2021). Based on the findings in Table 3, it can be determined that the four latent constructs each have an AVE square root of 0.765866, 0.747947, 0.723136, and 0,739256. The AVE square root value of the four latent components is bigger than the correlation between each of the constructs, so it can be convincingly decided that the four latent constructs have met the criteria for discriminant validity.

To determine the persistence of the early reading skills instrument, a construct reliability test was conducted (Riswanda Himawan & Burhan Nurgiyantoro, 2022). Construct reliability is a measure of how effectively the variables underlying the construct are covered in the structural equation model (Cheung et al., 2023). The high coefficient shows solid internal consistency, which is only achievable if each variable measures the same latent construct consistently (Sujati et al., 2020). Based on the total loading factor-

based construct reliability analysis, the omega (ω) result is 0.95. Referring to the criteria used, namely the construct reliability coefficient value of more than 0.70, it is reasonable to conclude that the initial reading skills instrument is reliable and fit for use.

CONCLUSION

Based on the results and discussion, it has been determined that the four indications are: recognizing letters, pronouncing words or sentences, reading with tempo and intonation, and reading fluency. Designed theoretically to develop an instrument of early reading skills, it has been proven to be valid, both in terms of loading factor, convergent validity, and discriminant validity. The instrument developed is also declared feasible for use in collecting data to measure early reading skills. It is expected that teachers can measure students' early reading skills using this instrument. Moreover, if used regularly, teachers can monitor the development of students early reading skills.

ACKNOWLEDGMENTS

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