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Validity and Reliability Analysis Using the Rasch Model in Developing Creativity Tests Instruments for Elementary School Students

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ABSTRAK

Penelitian ini dilatarbelakangi oleh kebutuhan untuk mengembangkan instrumen tes kreativitas yang efektif dalam menilai dan mengembangkan kreativitas peserta didik di Sekolah Dasar. Tujuan penelitian untuk mengembangkan instrumen tes kreativitas peserta didik Sekolah Dasar yang valid dan realiabel berdasarkan teori Torrance, yang mencakup fluency, flexibility, originality, and elaboration. Metode yang digunakan yaitu survei dengan crosssectional study design. Jumlah partisipan pada penelitian ini adalah 772 orang peserta didik Sekolah Dasar kelas atas dari salah satu kabupaten di Indonesia. Analisis data menggunakan Rasch Model melalui aplikasi Winsteps Versi 3.73. Hasil unidimensionality pada nilai unexplained variance in 1st to 5st contrast kurang dari 15% menunjukkan instrumen tes kreativitas mengukur satu konstruk kreativitas tunggal, tidak dipengaruhi oleh faktor eksternal. Hasil analisitis item measure mengungkapkan tingkat kesulitan yang bervariasi diantara item-item menyebar mulai dari item sangat sulit, sulit, mudah dan sangat mudah. Semua item fit dengan analisis Rasch Model, menunjukkan kesesuaian instrumen untuk menilai kreativitas siswa sekolah dasar. Analisis summary statistic menunjukkan reliabilitas tinggi, dengan Alpha Cronbach pada 0,9, person reliability pada 0,91, dan item reliability pada 1,00, mengkonfirmasi konsistensi dalam tanggapan siswa dan kualitas item instrumen. Hal ini menunjukkan konsistensi jawaban peserta didik pada kategori bagus sekali dan kualitas item pada instrumen kategorinya istimewa Instrumen kreativitas yang valid dan andal ini berfungsi sebagai alat penilaian berharga untuk program kurikulum merdeka dalam pengembangan program pembelajaran untuk meningkatkan hasil pendidikan dan kreativitas peserta didik di Sekolah Dasar.

ABSTRACT

This research was motivated by the need to develop a creativity test instrument that is effective in assessing and developing the creativity of students in elementary schools. The aim of the research is to develop a valid and reliable creativity test instrument for elementary school students based on Torrance's theory, which includes fluency, flexibility, originality, and elaboration. The method used is a survey with a cross-sectional study design. The number of participants in this research was 772 upper elementary school students from one of the districts in Indonesia. Data analysis used the Rasch Model via the Winsteps application Version 3.73. The unidimensionality results on the unexplained variance in 1st to 5th contrast value are less than 15%, indicating that the creativity test instrument measures a single creativity construct, not influenced by external factors. The results of the item measure analysis revealed varying levels of difficulty among the items, ranging from very difficult, difficult, easy and very easy items. All items fit with Rasch Model analysis, indicating the suitability of the instrument for assessing elementary school students' creativity. Summary statistical analysis indicated high reliability, with Cronbach's Alpha at 0.9, person reliability at 0.91, and item reliability at 1.00, confirming consistency in student responses and the quality of the instrument items. This shows the consistency of students' answers in the excellent category and the quality of the items in the instrument category is special. This valid and reliable creativity instrument functions as a valuable assessment tool for the independent curriculum program in developing learning programs to improve educational outcomes and creativity of students in elementary schools.

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1. INTRODUCTION

Creativity is a thinking skill highlighted in the 21st century framework as important and essential for learning, work and everyday life. Fostering creativity has become one of the goals in schools in various countries. Creativity is the key to the learning process that needs to be developed in an educational environment (Huang et al., 2021; Liyanage et al., 2021). Education is not enough just to provide access to information to students, but is required to develop creativity to face the fast and complex development of the world of work. Educators are currently focusing on a series of recommendations called 21st century skills, including creativity skills. Schools as educational institutions need to make a major contribution to the development of student creativity (Guo & Woulfin, 2016; Zainudin et al., 2019). The importance of mastering creativity as a skill in the 21st century can be used as a means of success in life both in the social environment of society and in the educational and learning environment. Students at school have different levels of creativity. The characteristics of creative students are independent, enthusiastic, diligent, persistent, adventurous, always curious, imaginative, open to new experiences and tolerant, this is relatively consistent over time (Huang et al., 2021; MacKinnon, 2014). Every individual has a creative talent that must be developed, if it is not developed then this talent will be latent and cannot be realized. In elementary school age children, there is a decline in creativity at the fourth grade level, known as the fourth grade slump in creativity. This decline in almost all aspects of creativity, namely fluency, flexibility, originality and elaboration, has all decreased. This shows the urgency of measuring creativity as a basis for developing creativity in elementary schools. To determine the level of student creativity, teachers need a valid and reliable measuring tool or instrument that is used to determine how big and to what extent the level of student creativity (Nurhayati & Rahardi, 2021; Rahmawati et al., 2021).

A valid creativity instrument is able to accurately measure the extent to which individuals have creative abilities and potential. Meanwhile, reliable creativity instruments are able to provide consistent and reliable results when used repeatedly or in different situations (Huang et al., 2021; Pichotac et al., 2020). Research on the validity and reliability of the Torrance Test of Creative Thinking (TTCT) uses classical theory in validity analysis using concurrent validity and content validity as well as reliability testing using test retets showing that the correlation coefficient of the test subscale is correlated with other subscales and the reliability coefficient is low. Evaluation of the psychometric properties of Thinking Creatively in Action and Movement (TCAM) in a classic analysis of 115 preschool children showed adequate internal consistency for measuring children's motor creativity dimensions (Mitarlis et al., 2020; Siang et al., 2020). Previous research on the relationship between the two versions (verbal and figural) on 994 participants ranging from preschool children to adults and tested cross-gender reliability (Hahm et al., 2019). The results of research on this classic analysis show that the scores on the two versions are significantly related, but the figural test is a more comprehensive, reliable and valid measure of creativity than the verbal test.

A neglected area in research on developing children's creativity instruments is data analysis techniques. Most research uses data analysis using classical theory in measuring the validity and reliability of instruments, while data analysis using modern theory using Rasch model analysis is still rarely used. As many as 95% of measurements in psychological studies are still developed based on the classical test theory approach, although there is a lot of criticism directed at this approach. The Rasch model is an instrument analysis method that complements the shortcomings of previous models which can measure the quality of instruments at the person and item level (Nurhudaya et al., 2019; van der Lans et al., 2018). The Rasch model can be used to measure the level of difficulty of questions, analyze the quality of questions in the instrument, find out students' ability levels, find out whether there are biased questions, and even find out if there are students who cheat when filling out creativity assessment instruments (Alhadabi & Aldhafri, 2021; Sumintono & Widhiarso, 2015). The novelty of this study provide validity and reliability of instruments using the Rasch model can help guidance and counseling teachers to develop valid and reliable creativity instruments so that they can accurately measure and develop the creativity of students in elementary schools. The aim of the research is to develop a valid and reliable creativity test instrument for elementary school students based on Torrance's theory, which includes fluency, flexibility, originality, and elaboration.

2. METHOD

This type of quantitative research uses a survey method with a cross-sectional study design. The cross-sectional design was chosen because it can describe the attitudes, opinions, behavior and characteristics of the population regarding a condition or characteristic in the population at a certain time which is analyzed using statistical procedures (Creswell, 2012; Maier et al., 2023). Survey methods can help in making generalizations about broader populations. Participants in this research are upper

elementary school students in one of the districts in Indonesia who will be selected using convenience sampling. The number of participants in this study was 772 students in grades four, five and six of elementary school.

The instrument used in the research is Ellis Paul Torrance's theoretical creativity instrument consisting of 4 aspects, namely fluency, flexibility, originality, and elaboration. Fluency is the ability to produce lots of ideas, flexibility is the ability to produce a variety of ideas, originality is the ability to produce unique and unusual ideas, and elaboration is the ability to develop and detail a product in detail (Kim, 2011).

Data were analyzed for validity and reliability using the Rasch model with the Partial Credit Mode (PCM) in the Winstep application version 3.7. The analysis stages in the Rasch model consist of unidimensionality to determine construct validity, item measurement to determine the extent to which items can reach respondents at each level of ability, item fit as content validity and reliability as viewed from the person and item levels (Ling Lee et al., 2020).

3. Result and Discussion

Result

The results of this research describe empirical data regarding the validity and reliability of elementary school student creativity test instruments which will be used as material for consideration of the use of test instruments as a tool for measuring student creativity in elementary schools. Validity and reliability analysis uses the Rasch model which will detail the stages and findings is show in Table 1.

Table 1. Unidimensionality Test Results of Creativity Instruments

Undımensıonalıtas Table of Standarized Residual Variance (in Eigenvalue unit)		**Empirical**		**Model**
Total raw variance in observation	20.06	100.0 %		100.0 %
Raw variance explained by measure	13.06	66.0%		65.7%
Raw variance explained by persons	7.04	36.1%		35.9%
Raw variance explained by items	6.02	29.9%		29.8%
Raw unexplained variance (total)	7.00	34.0%	100.0%	34.3%
Unexplained cariance in 1st contrast	1.04	7.0%	20.6	
Unexplained cariance in 2nd contrast	1.03	6.4%	18.8	
Unexplained cariance in 3rd contrast	1.02	5.6%	16.6	
Unexplained cariance in 4th contrast	1.01	5.3%	15.6	
Unexplained cariance in 5th contrast	1.00	4.9%	14.5%	

Base on Table 1, the unidimensionality test of students' creativity in elementary schools shows that the raw variance explained by measures value is 66% in the special category. Then the unexplained variance in 1st to 5th contrast values are sequentially starting from unexplained variance in 1st at 7.0%, unexplained variance in 2nd at 6.4%, unexplained variance in 3rd at 5.6%, unexplained variance in 4th at 5.3%, and unexplained variance in 5th amounting to 4.9% which shows that the unexplained variance in 1st to 5th contrast value is less than 15%, this explains that the instrument construct used meets the requirements and only measures one variable in its entirety, namely creativity without being influenced by other variables. Item measure is show in Table 2.

Tabel 2. Item Measure

Entrance Number	**Total Score**	**Measure**	**Infit**		**Outfit**		**Point Measure Correlation**	
			MN SQ	**ZS TD**	**MN SQ**	**ZS TD**	**Corr**	**Ex. Value**
2	2835	1.18	0.97	-0.6	0.97	-0.6	0.78	0.78
6	3990	0.62	0.95	-0.1	0.94	-1.2	0.80	0.79
3	3283	0.11	1.08	1.7	1.08	1.5	0.78	0.79
7	3814	-0.22	0.99	-0.2	1.00	0.0	0.77	0.76
5	3528	-0.23	0.94	-1.2	0.95	-1.0	0.79	0.79
4	3881	-0.72	0.95	-1.0	0.96	-0.8	0.79	0.79

Entrance Number	Total Score	Measure	Infit		Outfit		Point Measure Correlation	
			MN SQ	ZS TD	MN SQ	ZS TD	Corr	Ex. Value
1	3903	-0.75	1.05	0.9	1.04	0.8	0.79	0.79
Mean	287.1	0.0	0.99	-0.2	0.99	-0.2		
Standard Deviation		0.65	0.05	1.0	0.05	0.9		

Base on Table 2 the level of difficulty of a question item can be identified by looking at the Standard Deviation (SD) value. It was found that a standard deviation of 0.65 was the threshold for item difficulty levels ranging from very difficult, difficult, easy and very easy. The threshold value for the "very difficult" category is above 0.65, for the "difficult" category it ranges from 0.00 to 0.65, for the "easy" category it ranges from -0.65 to less than 0.00, and for the “very easy” category less than -0.65. By looking at the logit value of each question item in the question difficulty level table, it can be seen that the difficulty level of the creativity test instrument is divided into four levels, starting from questions which are classified as very difficult, difficult, easy and very easy. There is one question item in the very difficult category, namely item number 2; the difficult category consists of two questions, namely numbers 3 and 6; The easy category consists of numbers 7 and 5, while the very easy category consists of numbers 1 and 4. Item fit is show in Table 3.

Table 3. Item Fit

Entrance Number	Total Score	Measure	Infit		Outfit		Point Measure Correlation	
			MN SQ	ZS TD	MN SQ	ZS TD	Corr	Ex. Value
3	3283	0.11	1.08	1.7	1.08	1.5	0.78	0.78
1	3903	-0.75	1.05	0.9	1.04	0.8	0.80	0.79
7	3814	-0.22	0.99	-0.2	1.00	1.5	0.78	0.79
2	2835	1.18	0.97	-0.6	0.97	0.0	0.77	0.76
4	3881	-0.72	0.95	-1.0	0.96	-1.0	0.79	0.79
5	3528	-0.23	0.94	-1.2	0.95	-0.8	0.79	0.79
6	3990	-0.62	0.95	-1.0	0.94	0.8	0.79	0.79
Mean	3604.9	0.0	0.99	-0.2	0.99	-0.2		
Standard Deviation	389.0	0.65	0.05	1.0	0.05	0.9		

Base on Table 3, the level of suitability of an item shows that the item describes whether an item operates normally in the measurement process, so that students can understand the meaning of the item. The suitability of the items is assessed based on three criteria, the first criterion is that the MNRSQ outfit value shows that all items are fit because they are in the range 0.5 < MNSQ < 1.5, meaning that this creativity instrument is suitable for measuring the creativity of students in elementary schools. Second, the ZSTD outfit value shows that all items are fit because they are in the range -2.0 < ZTSD < 2.0, which means that overall the items on the creativity instrument have the possibility of a rational value. Third, the point measure values for all items are fit because they are in the correlation range 0.4 < Pt Mean Corr < 0.85, which means that the statement items can be understood and can be responded to well by students. Based on the three criteria for the level of suitability of the items, it can be concluded that all items on the creativity instruments for elementary school students are proven to be fit because they meet the three criteria required by the Rasch Model. The eight items in the creativity test instrument are in accordance with the Rasch Model, the content can be understood by students and can be used as a valid instrument to measure students' creativity. Summary statistics pearson is show in Table 4 and summary statistic item is show in Table 5.

Table 4. Summary Statistics Pearson

Summary Pearson								
	Total			Model Error	Infit		Outfit	
	Total Score	Count	Measure		MN SQ	ZS TD	MN SQ	ZS TD
Mean	32.7	7.0	0.16	0.40	0.98	-0.1	1.08	-0.1
Standard Deviation	8.6	0.0	1.34	0.05	0.62	1.2	1.04	1.1
Max.	55.0	7.0	5.33	0.92	4.06	3.5	1.00	3.6
Min.	12.0	7.0	-4.63	0.37	0.07	-3.1	0.97	-3.1
REAL RMSE	0.45	SD	1.27	Separation	2.82	Person Reability		0.89
Standard Error of Pearson mean = 0.05								
Pearson raw score-to-measure correlation = 0.99								
Cronch's alpha = 20 person raw score ("test") reliability = 0.90								

Tabel 5. Summary Statistic Item

Summary Item								
	Total			Model Error	Infit		Outfit	
	Total Score	Count	Measure		MN SQ	ZS TD	MN SQ	ZS TD
Mean	3604.9	772.0	0.00	0.04	0.99	-0.2	0.99	-0.2
Standard Deviation	389.0	0.0	0.65	0.00	0.05	1.0	0.05	0.9
Max.	3990.0	772.0	1.18	0.04	1.08	1.7	1.08	1.5
Min.	2835.0	772.0	-0.05	0.04	0.94	-1.2	0.94	-1.2
REAL RMSE	0.04	SD	0.65	Separation	17.1	Person Reability		1.00
Standard Error of Pearson mean = 0.07								

The statistical summary on Table 4 and Table 5 show the reliability of the instrument both at the item level and at the person level. Cronbach's alpha value measures reliability, namely the interaction between the person and the question item as a whole. The Cronbach's alpha value obtained was 0.90, which is in the very good category. Person reliability and item reliability values measure the consistency of students' answers and the quality of the question items. The values obtained for person reliability and item reliability are 0.89 and 1.00 respectively. It can be concluded that the consistency of students' answers in the category is very good and the quality of the items on the reliability aspect of the instrument is special.

Discussion

Unidimensionality analysis is carried out based on the number of dimensions measured by the instrument according to the data collected. If there are indications of additional dimensions to the instrument construct, Rasch identifies items that may contribute to those dimensions. This encourages researchers to delve deeper into the items in the instrument, then choose whether to eliminate, retain, or further examine these items (Hagell, 2014; Ishak et al., 2018).

The diversity of item difficulty levels illustrates the variation in the difficulty level of each question or element in the instrument. Varying item difficulty levels have a number of advantages in a research context, varying levels of difficulty in test items provides advantages in terms of measurement accuracy, more effective learning, and better instrument development (Hamdu et al., 2020; Prasetya & Pratama, 2023). The benefit of instruments with varying levels of item difficulty lies in their ability to assess various abilities or characteristics of respondents, assisting in determining the depth of understanding of the concepts being measured and mitigating the impact of random selection. Varying item difficulty levels provide richer data for analysis (Aryadoust et al., 2019; Prasetya & Pratama, 2023). This opens up the opportunity for more in-depth analysis of how respondents of varying ability levels respond to each item.

The research findings in the summary statistical test provide several conclusions about the reliability of the instrument. The reliability information provided is at the item and person level. Participants took the test seriously as evidenced by the person reliability score at a very good level, then the item reliability at an excellent level. Instruments with high reliability usually produce a reliability coefficient close to 1.0. One common method for measuring reliability is using the Cronbach alpha coefficient. The analysis shows a Cronbach alpha coefficient of 0.9, meaning that the reliability of the creativity instrument is in the very good category (Rifbjerg-Madsen et al., 2017; Tavakol & Dennick, 2011). High reliability indicates that the creativity instrument measures concepts or variables consistently and is not influenced by random factors. The reliability and Cronbach alpha values provide confidence that the measurement results are not just the result of chance, but are relevant results produced by the creativity of the instrument (Amirrudin et al., 2020; Carson et al., 2005). It can be explained by perfect item reliability, then if this instrument is tested again on the same group of participants in different situations it will produce answers that tend to be the same, then what can be explained from person reliability is that this instrument is consistent with participants, and predicted participants fill out the instrument seriously.

The Rasch model assesses the fit of the model to the data during analysis, any significant deviations from the Rasch model require consideration, and individuals or items that do not fit may need to be removed. In the Rasch model, two types of fit are considered namely item fit and person fit, which underlines the measurement validity of the Rasch model (Alhadabi & Aldhafri, 2021; Bond & Fox, 2015). Item congruence evaluates the degree to which a sample's response pattern to an item matches other individuals responses to other items. The suitability of items has an important meaning in the testing process, especially regarding the assessment and selection of items, as well as decisions regarding test scores obtained from individual responses. Therefore, by utilizing item fit, errors that atrise at the calibration stage in instrument development can be clearly identified. If a question exhibits suboptimal discriminative power parameters, item fit statistics will indicate this problem (Hayat et al., 2020; Karabatsos, 2003).

Recommendations for further research are to test creativity instruments with a wider research area coverage, a larger number of participants, equipped with cultural differences to analyze creativity. accompanied by cultural differences. The sampling method uses random sampling so that the test results can better describe the population's creativity. Adding concurrent validity testing to produce a calibration comparison of the results of the creativity test instrument developed with the standard creativity test instrument.

4. CONCLUSION

This research succeeded in developing a creativity instrument for elementary school students whose validity and reliability have been tested. The creativity test instrument has seven items with four aspects consisting of fluency, flexibility, originality, and elaboration. This instrument consists of two parts, namely a verbal test with three question items and a figural test with four question items. Validity and reliability testing uses the Rasch model with the Partial Credit Mode (PCM) technique to accommodate different weights for each question item. Analysis of the validity of the creativity instrument was tested at the construct, content and item difficulty levels. The validity test results prove that the creativity test instrument is valid. The reliability of the creativity instrument was analyzed as a whole at the item and person level, resulting in the conclusion that the creativity instrument was proven to be reliable.

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