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A Validation Study of Cultural Awareness Related Mathematics for Primary School Using Rasch Model

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ABSTRACT

This study aims to develop and test the feasibility of students' cultural awareness items. The method used in this study is quantitative. A total of 24 items were developed to measure cultural awareness, and the research subjects consisted of 23 students. Data analysis was carried out using the Rasch model. The results showed that of the 24 items developed, 20 items were declared feasible to use, with each person and item reliability showing relatively high values. However, some items still need to be improved to improve their ability to measure more diverse students' cultural awareness.

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INTRODUCTION

Education is a means or bridge for humans to develop their potential through learning. Education has the responsibility to improve, expand, and develop human knowledge and interests so that it can help them to be able to respond to significant new challenges and ideas in the future (Putra et al., 2021). This is in line with the Ministry of Kemendiknas (2014), which explains that education is an effort to empower students to develop into full Indonesian humans, namely those who uphold and hold firmly to norms and values. Education is the right of every individual to get it (Fitri, 2021). Education aims to form high-quality human resources, namely humans who can face the times (Sujana, 2019). Therefore, the role of education is crucial because it is the main capital in creating human resources with character and quality (Ikhsandi et al., 2023). One of the important subjects to learn at all levels of education is mathematics because mathematics can help students learn other sciences.

Mathematics is an essential discipline in everyday life and can support the progress of science and technology (Siagian, 2016; Badjeber & Purwaningrum, 2018). Therefore, mathematics is a globalized field of science; it lives in nature without limits (Kamarullah, 2017). Mathematics learning itself has several objectives. The purpose of learning mathematics, according to Depdiknas (in Munjiat & Syaefunisa, 2020) is for students to be able to connect mathematical concepts, apply

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algorithms appropriately in problem-solving, use reasoning patterns to make generalizations, and communicate mathematical ideas through various forms of output. They are also invited to solve problems, appreciate the usefulness of mathematics in everyday life, and show a positive attitude towards learning mathematics. If they have these abilities, students have successfully developed their thinking patterns to face and solve various problems they will face in class or everyday life.

The basic concepts of mathematics are fundamental because for students mastering basic concepts, students will not have difficulty solving math problems even though the teacher changes the problem's form or the problem's difficulty level (Alim et al., 2021). Therefore, mathematics is a science that must be given from the basic level and mastered by everyone because it has an essential role in human life, especially in students. There are so many sciences; their discovery and development depend on mathematics (Afsari et al., 2021).

Based on the preliminary study results, information was obtained that there are several problems for students related to cultural awareness. First, many children experience limitations in their knowledge of Indonesian culture, especially the local culture in their area. This is due to the dominance of interest in popular culture, such as boy bands or K-pop, which often obscures traditional cultural values that should be an essential part of their identity as Indonesian citizens. Second, students lack awareness of their culture; this can be seen from a simple example when students call their friends by imitating their language accent. This behavior reflects a lack of appreciation for the diversity of local and national cultures, which should be an integral part of character education in schools. Problems related to cultural awareness are reinforced by research conducted by Suriata (2022), which shows that the nation's identity has begun to blur and is eroded by the times. The teaching and learning process in the classroom should attract students' attention to the material being studied and be associated with student culture (Kartika, 2019). In the midst of the development of educational technology, the education curriculum also demands the involvement of culture in learning at school to preserve culture as the foundation of national character (Kemendikbud, 2017).

Cultural values must be instilled in every individual from an early age so that each individual can understand better, interpret, appreciate, and realize the importance of cultural values in learning, especially culture. We need to have cultural awareness in order to understand culture and essential factors that can develop cultural values so that national character can be formed. The material in mathematics subjects is an abstract concept. Awareness of culture in mathematics education can help build a closer relationship between learning materials and students' daily lives. Then, it is essential to conduct an in-depth evaluation of the evaluation instruments that teachers will use to measure student awareness.

An instrument is considered valid if it can precisely measure what should be measured, namely, each variable that has been set. In this context, the study used the Rasch model to convey the effectiveness of the student cultural awareness evaluation instrument. The goal is to create a consistent interval measurement scale to provide accurate information about student awareness and the quality of the item statements used. The Rasch model provides in-depth insight into how the instrument can accurately measure students' cultural awareness. Therefore, this study aims to answer the following questions specifically:

1. How acceptable is the cultural awareness instrument of students assessed by mathematics education experts?
2. How are the validity and reliability of the cultural awareness instrument assessed by elementary school students?

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THEORETICAL FRAMEWORK

Cultural Awareness

Cultural awareness is when a person is aware, observant, and conscious of the similarities and differences between and among cultural groups; cultural awareness also refers to self-awareness of their own culture and how it shapes their perception of the world (Cartwright & Shingles, 2021). When education is free from cultural awareness, students may no longer be sensitive to their cultural background and respect other cultures.

Different cultural awareness in education is caused by a lack of cultural competence education. Learning the components of ethnic-based culture that contribute to our environment is cultural awareness (Kaymak, 2018). Cultural awareness concerns the individual's rational act of cultural experience. Although the development of cultural self-awareness partly requires individuals to have some knowledge of culture, this knowledge needs to be clear and coherent. This distinguishes cultural self-awareness from constructs such as cultural competence (Lu & Wan, 2018). The concept of culture encompasses a variety of human activities and practices necessary to understand individual thoughts and actions. This suggests that students' cultural context must be a concern in learning. Students' cultural values relevant to education must be integrated into learning and used as a basis for developing learning. Cultural context not only plays an essential role in humanities subjects but also plays an essential role in mathematics and science subjects. There is mathematical thinking behind actions and discourses (Simamora, 2018). Thus, increasing cultural awareness in educational contexts enriches students' learning experiences, strengthens their cultural identity, and helps them develop a broader understanding of this multicultural world.

Malay Cultur

The word "culture" comes from Sanskrit, namely "budhayah," which is the plural form of the word "buddhi," which means mind or reason. In English, the word "culture" is translated as "culture,"which comes from the Latin word "colera.". Colera means cultivating, working, fertilizing, or developing land (farming) (Karmadi, 2007). According to Ki Hajar Dewantara, humans cultivate themselves to achieve safety and happiness in their struggle for life (Maryamah, 2016).

Malay culture is known to be identical to Islam and values that highly value shame. Malays tend to uphold shame, emphasizing the importance of not embarrassing or insulting others rudely. This reflects the high degree of shame in Malay culture. In Malay culture, lineage is often seen from the female side or based on the maternal lineage. Therefore, women living in Malay culture are expected to comply with the rules that govern daily life, including maintaining the family's dignity by maintaining shame (Ruek, 2022).

In their cultural system, Malays are very protective of the feeling of "shame." Shame that befalls an individual means shame for the family. The measure of shame is at the level of "faith," because shame comes from Islamic values. Following the message of the Prophet Muhammad SAW, "Shame and faith are one; if one (faith) is lost, the other (shame) is lost, and vice versa." Therefore, the parents were cautious not to do anything that would embarrass themselves and their families, including protecting their children and grandchildren (Deli, 2000). Malays, as a cultural entity, have a rich cultural conception with various discourses that shape their unique identity. In this context, Malay culture or Malayness needs to be understood dynamically, considering the variety of definitions related to Malay identity that can provide a holistic perspective. However, in this paper, the discussion will not be too broad and will focus more on specific aspects of the

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definition of Malay and its culture. This is because there are still various views on Malay identity, especially from outsiders' perspective to the Malays (Arkeo-anthropologist, 2016).

Mathematics

Mathematics is an integral part of the curriculum in formal educational institutions and has a crucial role in improving the overall quality of education (Novitasari, 2016). Mathematics has become an important foundation in learning other disciplines because almost all fields of knowledge use mathematical concepts to understand their objects of study (Khaesarani & Khairani Hasibuan, 2021). Mathematics is a language that has various symbols, syntax, grammar, and representations. It also relies on intensively using various types of letters to represent variables, number signs, diagrams, formulas, and algorithms (D'Entremont, 2015). Mathematics emphasizes activities in the world of ratios (reasoning) rather than emphasizing the results of experiments or observations. Mathematics is formed because of human thoughts related to ideas, processes, and reasoning (Rahmah, 2013). Understanding mathematics requires perseverance, tenacity, attention, and high motivation so that students can master mathematics subject matter well (Sugiyamti, 2018). Then Soedjadi (2000) stated several terms in mathematics, including (1) mathematics is a branch of exact science and systematically organized; (2) mathematics is knowledge about numbers and calculations; (3) mathematics is knowledge about logical reasoning and is related to numbers; (4) mathematics is knowledge about quantitative facts and problems about space and shape. (5) Mathematics is knowledge about logical structures, and (6) mathematics is knowledge about strict rules. Thus, mathematics is not only a tool for understanding phenomena in the real world but also as a foundation in forming rational thinking, developing reasoning skills, and strengthening thought structures in various disciplines and everyday life.

Rasch Model

The Rasch model, developed by Danish mathematician Georg Rasch in the 1960s, is a unique approach to statistical modeling. This model uses raw data from respondents to produce an equivalent interval measurement scale (Ngadi, 2023). The Rasch model is a table of probability responses to items, where the probability of success depends on the individual's ability and the item's difficulty (Bond & Fox, 2015). Some important assumptions in the Rasch model include unidimensionality, the fit between the item and the measured construct, and the relationship between individual ability and item difficulty (Bond & Fox, 2015). Analysis using the Rasch model can produce more accurate measurements and provide in-depth information about the test instrument and student abilities (Sumintono & Widhiarso, 2015). This is similar to Salsabila et al., (2017) that the Rasch model has the advantage of providing more accurate estimates and finding model inaccuracies. The Rasch model assumes that all items can be discriminated in the same way so that the correct answer cannot be obtained arbitrarily or randomly (Nurcahyo, 2017). Measurement using the Rasch model can describe the interaction between respondents and test items (Putra et al., 2021). Rasch model analysis is used to investigate the validity of the instrument. Instrument quality measures in Rasch model analysis consist of unidimensionality, Wright map analysis, item analysis, participant ability analysis, and instrument analysis (Muslihin et al., 2022).

METHOD

Research Approach

This study uses a quantitative approach (Sugiyono, 2022), which explains that quantitative research methods generally include collecting, analyzing, interpreting data, and writing research results.

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This study aims to collect information and data that can be used to empirically describe the quality of test instruments, focusing on the validity and reliability aspects analyzed using the Rasch model.

Participants

The participants in this study consisted of one mathematics education expert and 23 third-grade students who acted as volunteers for the trial. Participants were given a simple explanation of cultural awareness. All data collected will remain anonymous and confidential, as participants were instructed not to include their names or other identifying information when filling out the questionnaire.

Data Collection

Data collection was carried out using two types of instruments. The first instrument is a questionnaire comprising 24 statement items related to cultural awareness. The second instrument is a validation sheet given to the mathematics education expert. The validity of the cultural awareness instrument was evaluated by one mathematics education expert, while to ensure construct validity, Rasch analysis was conducted using Ministep software version 4.8.2 (Linacre, 2017). In addition, the instrument's reliability was estimated using the Cronbach Alpha method.

Data Analysis

The data analysis techniques used in this study include descriptive analysis and the Rasch model. Rasch model analysis can provide comprehensive information about the quality of the instrument used in the measurement, the overall response of students, and the interaction between students and the test items (Sumintono & Widhiarso, 2015). Descriptive analysis was first used for data in the form of suggestions or input obtained from mathematics education experts through direct or written interviews. This data was used as a basis for revising the cultural awareness instrument. Furthermore, quantitative descriptive analysis was used to evaluate the quality of the cultural awareness instrument based on the validation sheet given to the experts and the trial conducted on students. This data was then analyzed using the Rasch model with the help of Ministep software version 4.8.2 (Linacre, 2017) to ensure the instrument's construct validity. In addition, the reliability of the designed instrument was evaluated using the Cronbach Alpha method. This aims to ensure that the instrument is consistent in measuring students' cultural awareness

RESULTS

The results of this study are presented in 3 sub-chapters. Sub-chapter 1 explains the summary statistics, then sub-chapter 2 explains the characteristics of the test items, and sub-chapter 3 explains the analysis of the person-test item map.

Summary Statistics

The summary statistics of the measurement results of 23 students are presented in Table 1. The average value of students' cultural awareness measurement results is 75.5 with a Pearson mean s.e. of 0.16. The person's reliability is relatively high, namely 0.80. Meanwhile, the summary statistics of the measurement results of 25 test items. The average value of the measurement results of the test items is 72.4 with a Pearson mean s.e. of 0.15. The reliability of the test items is quite high, at 0.76.

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Table 1. Summary of 23 Measured Person

SUMMARY OF 23 MEASURED PERSON

	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	75.5	24.0	1.31	.32	1.02	.11	.98	-.02
SEM	1.6	.0	.16	.01	.05	.18	.05	.16
P.SD	7.5	.0	.75	.04	.25	.82	.22	.76
S.SD	7.7	.0	.77	.04	.25	.84	.23	.77
MAX.	89.0	24.0	2.89	.43	1.71	2.16	1.64	1.96
MIN.	64.0	24.0	.26	.28	.65	-1.40	.66	-1.34

REAL RMSE	.34	TRUE SD	.67	SEPARATION 1.99	PERSON RELIABILITY .80
MODEL RMSE	.32	TRUE SD	.68	SEPARATION 2.12	PERSON RELIABILITY .82

S.E. OF PERSON MEAN = .16

Table 2. Summary of 24 Measured Item

SUMMARY OF 24 MEASURED ITEM

	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	72.4	23.0	.00	.32	.99	-.06	.98	-.07
SEM	1.5	.0	.15	.01	.07	.26	.08	.25
P.SD	7.3	.0	.71	.03	.36	1.25	.36	1.21
S.SD	7.5	.0	.72	.03	.37	1.27	.37	1.24
MAX.	82.0	23.0	1.70	.38	1.89	2.70	1.97	2.88
MIN.	53.0	23.0	-1.05	.28	.44	-2.34	.51	-1.92

REAL RMSE	.34	TRUE SD	.62	SEPARATION 1.80	ITEM RELIABILITY .76
MODEL RMSE	.32	TRUE SD	.63	SEPARATION 1.95	ITEM RELIABILITY .79

S.E. OF ITEM MEAN = .15

Individual Item Characteristics

Table 3 presents the items' difficulty level from the most difficult to the easiest. Based on the table, statement number 8 is the statement that is most difficult for students to understand. This statement is positive and refers to the indicator of cultural knowledge. The statement reads: "The younger generation needs to know local culture to improve mathematics learning in a cultural context." This statement requires students to understand the relationship between local culture and mathematics learning.

On the other hand, the statement that is easiest for students to understand is statement number 19. This statement is negative and also refers to the indicator of cultural knowledge. The statement reads: "The marble game is a cultural heritage that does not need to be studied in mathematics learning because it has no meaning in the present."In addition, two statements do not meet the output mean square (MNSQ) value criteria, namely the range of 0.5 to MNSQ < 1.5. These statements are numbers 4 and 24. Statement number 4 is negative and relates to the indicator of respecting and understanding culture. The statement reads: "I don't care about the advice of teachers and friends in mathematics learning."

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Meanwhile, statement number 24 is positive and also related to the indicator of respect and understanding of culture, with the statement: "The younger generation needs to instill an attitude of mutual respect and tolerance in learning mathematics." These two statements indicate that students have difficulty understanding the statement.

Based on the point measure correlation value criteria, which stipulates that an item is said to be fit if it is in the range of 0.4 to 0.85, four statements were found that were not fit, namely numbers 22, 4, 24, and 13. Thus, statements 4 and 24 are not fit, while the other two statements (numbers 22 and 13) need to be considered further in their use to measure students' cultural awareness.

Table 3. Item Measure and Fit Statistics

ITEM STATISTICS: MEASURE ORDER

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	JMLE MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PTMEASUR-AL CORR.	PTMEASUR-AL EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	ITEM
8	53	23	1.70	.28	1.36	1.31	1.32	1.20	.43	.49	47.8	47.8	P8
20	60	23	1.14	.28	1.19	.77	1.22	.84	.49	.48	34.8	49.7	P20
22	62	23	.98	.29	1.45	1.56	1.46	1.57	.28	.48	43.5	49.1	P22
4	63	23	.89	.29	1.89	2.70	1.97	2.88	-.05	.47	39.1	48.6	P4
5	67	23	.56	.30	.97	.00	.95	-.10	.45	.46	52.2	50.5	P5
7	68	23	.47	.30	.79	-.73	.80	-.70	.45	.46	65.2	51.8	P7
23	68	23	.47	.30	.86	-.45	.86	-.43	.53	.46	56.5	51.8	P23
17	70	23	.29	.30	.60	-1.55	.60	-1.59	.55	.45	73.9	52.8	P17
10	72	23	.10	.31	1.07	.33	1.24	.89	.46	.44	43.5	53.4	P10
24	72	23	.10	.31	1.61	1.90	1.69	2.12	.01	.44	34.8	53.4	P24
1	73	23	.00	.31	.86	-.41	.86	-.41	.47	.43	52.2	53.4	P1
3	74	23	-.10	.32	.65	-1.31	.66	-1.25	.44	.42	65.2	53.2	P3
15	74	23	-.10	.32	1.38	1.27	1.31	1.08	.52	.42	43.5	53.2	P15
21	74	23	-.10	.32	1.11	.46	1.01	.12	.48	.42	60.9	53.2	P21
16	75	23	-.20	.32	.72	-.95	.72	-.99	.60	.42	65.2	53.6	P16
2	76	23	-.31	.33	.55	-1.77	.57	-1.62	.69	.41	73.9	55.5	P2
12	76	23	-.31	.33	.78	-.71	.73	-.93	.47	.41	65.2	55.5	P12
14	76	23	-.31	.33	.44	-2.34	.51	-1.92	.62	.41	73.9	55.5	P14
9	77	23	-.42	.34	.66	-1.23	.64	-1.27	.46	.40	65.2	56.4	P9
11	80	23	-.78	.36	1.12	.47	.97	.00	.54	.37	65.2	61.4	P11
6	81	23	-.91	.37	1.25	.85	1.08	.34	.47	.36	60.9	62.3	P6
13	82	23	-1.05	.38	.98	.04	.91	-.16	.35	.35	56.5	62.9	P13
18	82	23	-1.05	.38	.91	-.20	.80	-.50	.45	.35	65.2	62.9	P18
19	82	23	-1.05	.38	.57	-1.52	.68	-.90	.52	.35	82.6	62.9	P19
MEAN	72.4	23.0	.00	.32	.99	-.06	.98	-.07			57.8	54.6	
P.SD	7.3	.0	.71	.03	.36	1.25	.36	1.21			12.9	4.6	

Person-Item Map Analysis

Figure 1 presents a person-item map depicting 23 students and 24 items. In this map, items at the top represent items that are difficult for students to understand, while items at the bottom represent items that are easier to understand. This map helps visualize the difficulty level of the items and students' understanding of the items.

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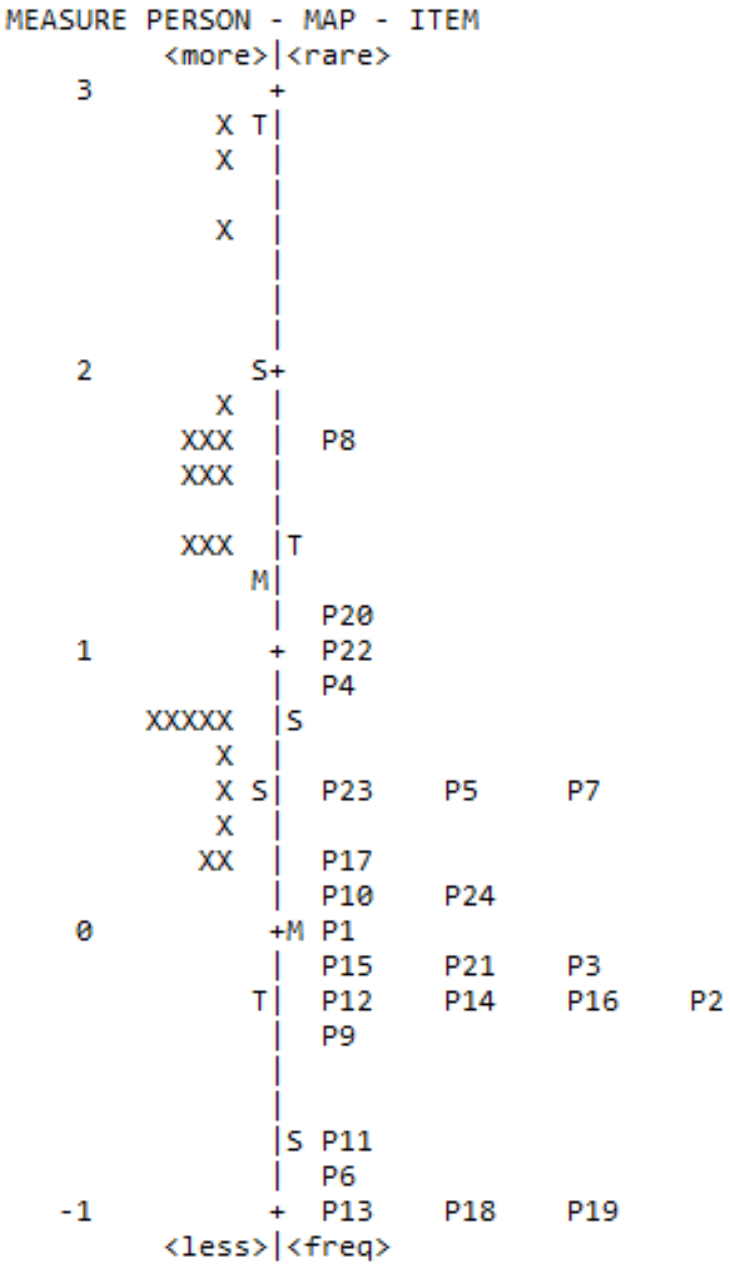

Figure 1. Person-Item Map Analysis

DISCUSSION AND CONCLUSION

This study uses the Rasch model to evaluate the quality of the students' cultural awareness questionnaire items. The analysis results show that out of a total of 24 items developed, 20 items were declared suitable for use without the need for improvement. However, 2 items can still be used with some additional considerations, while the other 2 cannot. Therefore, improvements are needed to the problematic items so that the questionnaire can more effectively measure students' cultural awareness and produce better questionnaire items.

The Rasch model provides insight into how such items fit to measure students' cultural awareness related mathematics. This study also supports the previous study conducted by Putra et

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al. (2022), who developed computational thinking tasks using the Rasch model and showed how such a helpful model gives valid justification regarding the quality of tasks being developed. Therefore, further study needs to test the questionnaires on cultural awareness related to mathematics for students in primary school.

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