PROSIDING DISKUSI PANEL NASIONAL PENDIDIKAN MATEMATIKA

Original Research

Validating with a Rasch Models for Mathematics Creative Thinking and Learning Motivation Students'

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INFO ARTICLES

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Rasch Model, Mathematical Creative Thinking, Learning Motivation, Instrument Validity, Mathematics Education

Abstract: *This study aimed to validate a mathematical creative thinking instrument and a learning motivation questionnaire using the Rasch Measurement Model. A quantitative survey was conducted involving 286 junior high school students' in East Jakarta, Indonesia. Data were analyzed using Rasch analysis to examine reliability, person responses, and differential item functioning (DIF). The results showed excellent item reliability (0.99) for both instruments, indicating stable item calibration. Wright Maps analysis revealed that most students' demonstrated moderate levels of mathematical creative thinking and learning motivation. However, the mathematical creative thinking instrument exhibited a substantial targeting gap, resulting in relatively low person reliability. Furthermore, DIF analysis identified several items with potential demographic bias. Overall, the findings provide psychometric evidence supporting the refinement of the mathematical creative thinking instrument and the learning motivation questionnaire to improve measurement precision, fairness, and their applicability in mathematics education.*

Abstrak: Penelitian ini bertujuan untuk memvalidasi instrumen berpikir kreatif matematika dan kuesioner motivasi belajar menggunakan Model Pengukuran Rasch. Survei kuantitatif dilakukan terhadap 286 siswa sekolah menengah pertama di Jakarta Timur, Indonesia. Data dianalisis menggunakan analisis Rasch untuk menguji reliabilitas, respons individu, dan fungsi item diferensial (DIF). Hasil menunjukkan reliabilitas item yang sangat baik (0,99) untuk kedua instrumen, menunjukkan kalibrasi item yang stabil. Analisis Wright Maps mengungkapkan bahwa sebagian besar siswa menunjukkan tingkat berpikir kreatif matematika dan motivasi belajar yang moderat. Namun, instrumen berpikir kreatif matematika menunjukkan kesenjangan target yang substansial, sehingga menghasilkan reliabilitas individu yang relatif rendah. Lebih lanjut, analisis DIF mengidentifikasi beberapa item dengan potensi bias demografis. Secara keseluruhan, temuan ini memberikan bukti psikometrik yang mendukung penyempurnaan instrumen berpikir kreatif matematika dan kuesioner motivasi belajar untuk meningkatkan presisi pengukuran, keadilan, dan penerapannya dalam pendidikan matematika.

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INTRODUCTION

Mathematical creative thinking is one of the essential competencies required in the twenty-first century because it enables students' to generate diverse, original, and effective solutions to mathematical problems (Salamah et al., 2025). In addition, this competence is generally defined as the ability to produce novel and useful mathematical ideas, identify various solution strategies, and apply mathematical concepts flexibly in solving problems (Sipahi & Bahar, 2025). Furthermore, mathematical creative thinking involves constructing meaningful mathematical relationships and generating innovative approaches when encountering unfamiliar situations (Salamah et al., 2025). In mathematics learning, creative thinking has evolved from a complementary skill into a core competency that supports higher-order thinking and innovation. Consequently, fostering students' creative thinking has become an important goal of mathematics instruction and assessment Faradillah & Maulida, (2022); Septiyanto et al., (2024) These studies indicate that mathematical creative thinking is an important competency that helps students' construct innovative ideas and develop multiple solution strategies when facing mathematical problems.

Despite numerous studies indicating that students' mathematical creative thinking abilities remain relatively low. Students' frequently experience difficulties in generating multiple solution strategies, expressing original ideas, and applying mathematical concepts in unfamiliar situations (Fineldi & Hidayati, 2023). These challenges suggest that creative thinking skills are not adequately developed through conventional mathematics instruction. Beyond these cognitive and instructional aspects, students' psychological and affective domains also play a critical role in shaping their creative potential. Several studies have also identified learning motivation as an important factor influencing students' mathematical creative thinking.

Learning motivation is generally the internal and external driving force that directs and maintains students' behavior in learning activities, including willingness to engage, persistence and achievement of academic goals (Nurkarim et al., 2023; Solehah & Mutaqin, 2026). It indicates the degree to which students are motivated to exert effort, remain focused on tasks, and control their learning processes to accomplish expected learning outcomes. In the process of mathematics learning, learning motivation plays an important part in determining students' engagement, persistence in solving problems as well as willingness to explore different solution strategies.

However, not all students show high learning motivation in classroom practice. Students' learning motivation is low; they tend to have little participation in learning activities, do not persist in the face of difficulties, and avoid challenging mathematical tasks (Sabirin et al., 2022). Such conditions may hinder students' learning development and limit their opportunity to engage in higher-order thinking processes. Meanwhile, learners with high motivation to learn, are more likely to be active in learning, are more persistent to solve difficult problems, and are more willing to explore and develop new ideas in solving mathematical problems (Shobichah, 2025). In addition, research has shown that students with a higher motivation to learn tend to achieve better learning outcomes and have higher levels of cognitive performance, including the capacity for creative thinking (Wang, 2022). Therefore, learning motivation is an important psychological factor that can support students' engagement and contribute to the development of mathematical creative thinking skills.

In addition to knowledge of these affective factors, correct assessment is also important to assess students' actual creative performance. In addition, the lack of well-validated instruments may impede the accurate measurement of students' creative thinking abilities (Febryana et al., 2024; Yusfiah et al., 2024). The results of these studies imply that the measurement of creative thinking is still a problem, as the existing tools might not be able to capture students' actual creative potential in learning mathematics. Therefore, a careful validation process is necessary to ensure that the instrument is highly accurate, reliable and able to measure creative thinking. To meet this rigorous validation standard, Rasch Model analysis can be employed owing to its robustness in validating construct validity and objectively assessing the appropriateness of items.

There are many instruments to measure mathematical creative thinking and learning motivation. However, most of these instruments measure these constructs separately and do not measure the interaction between students' cognitive and affective characteristics. In addition, many of the existing instruments have not been comprehensively evaluated for item functioning, validity, and reliability, which can impact the precision of measurement (Qirom & Nurlaelah, 2023). Therefore, it is important to have strict validation procedures in place to ensure that educational instruments yield accurate and reliable data. These rigorous validation requirements have been widely addressed by the Rasch Model (especially by the Winsteps analysis) in a contemporary psychometric setting. The Rasch Model provides more robust and integrated evidence than Classical Test Theory, including in-depth information about person ability, item difficulty, person responses, and Differential Item Functioning (DIF) (Romdlon et al., 2022). This approach thus allows a more accurate assessment of both instrument quality and respondent characteristics in mathematics learning.

In the last few years, contemporary psychometric paradigms have become more and more prominent in the field of mathematics education, aiming to guarantee that educational instruments yield accurate and trustworthy data . In the literature, the application of the Rasch Model, especially with Winsteps analysis, has been extensively advocated as a strong alternative to Classical Test Theory (CTT) because of its capability to produce invariant linear measures and detect item bias. With this methodological shift, several attempts to assess single-construct measures within this contemporary framework are documented in the literature of reputable journals. For example, Yusfiah et al., (2024) documented their effort to validate a mathematical creative thinking instrument and provided adequate evidence of validity and item reliability. Other researchers, such as Febryana et al., (2024), focused their analysis on analyzing the psychometric properties of a learning motivation instrument, so that it met the required measurement criteria. Qirom & Nurlaelah, (2023) conducted another psychometric evaluation using the Rasch Model to evaluate item functioning, validity, reliability, and the overall quality of the measurement instrument.

Previous studies have demonstrated the usefulness of the Rasch Model in validating educational instruments Yusfiah et al., (2024)validated a mathematical creative thinking instrument using the Rasch Model and reported satisfactory validity and reliability evidence. Similarly, (Febryana et al., 2024) examined the study evaluated the psychometric properties of a learning motivation instrument using the Rasch Model and SPSS and found that the instrument met the required measurement criteria. In addition, Qirom & Nurlaelah, (2023) evaluated a learning motivation scale using the Rasch Model, confirming satisfactory item reliability and effective alignment between item difficulty and student ability. These findings indicate that the Rasch Model is an effective approach for evaluating the psychometric quality of educational instruments.

However, the studies mentioned above generally focused on a single construct and validated mathematical creative thinking and learning motivation instruments separately. Despite the widespread recognition of both constructs in mathematics education, there is little evidence regarding the integration of cognitive and affective dimensions into a single psychometric evaluation. Indeed, the literature is largely void of integrated instruments as previous studies have assessed mathematical creative thinking and learning motivation as isolated variables only Febryana et al., (2024); Yusfiah et al., (2024) This piecemeal perspective fails to incorporate the interaction between students' psychological drive and the objective difficulty of creative tasks. The novelty of the current study is the validation of a fully integrated instrument that measures both constructs simultaneously within a single Rasch Model framework to bridge this gap. This approach is more than routine, separate validations, it puts cognitive ability and affective motivation on one linear scale. Thus, the objective of this study is to validate the instrument by investigating reliability, Differential Item Functioning (DIF) and Wright Maps.

METHOD

This study employs a quantitative method using a survey approach. The survey approach was used to gather information regarding the characteristics, beliefs, behaviors, and responses of students' to the variables under investigation. Survey research is a type of research that includes questions for respondents regarding opinions, beliefs, characteristics, or actions that are currently occurring or have occurred (Dwi & Faradillah, 2025). Additionally, the survey approach allows researchers to collect data from a relatively large population more efficiently through structured and standardized instruments (Dwi & Faradillah, 2025; Goodfellow, 2023). The research was carried out in three Junior High Schools in East Jakarta, Indonesia. The research subjects were selected using non-probability sampling to collect data from 286 students' who voluntarily completed the instruments. In the first screening process the data sets were checked for completeness and suitability for the psychometric analysis that followed to evaluate the complete data sets further.

The researchers developed two main instruments to collect data from the participants: the mathematics creative thinking instrument (open-ended essay test) and the Learning Motivation questionnaire. The mathematics creative thinking instrument was consisted of 35 open-ended mathematical items. The learning motivation questionnaire meanwhile consisted of 8 items using a rating scale format. Both instruments were subjected to a rigorous evaluation by mathematics education experts before being put into operation in order to guarantee a high degree of content validity. The instruments were then tested for their internal consistency, utilising the information from the data of the present study. The reliability of each instrument is given in Table 1.

Table 1. Reliability of the Questionnaire and Essay Test

		Creative Thinking	
Indicators	**Total Item**	**Score**	**Cronbach's Alpha**
Fluency (FL)	2	Score (1) to (4)	0.46
Flexibility (FX)	2	Score (1) to (4)	0.76
Originality (OR)	2	Score (1) to (4)	0.81
Elaboration (EL)	2	Score (1) to (4)	0.85
		Learning Motivation	
Aspects	**Total Item**	**Likert**	**Cronbach's Alpha**
Role Models (RM)	4	Strongly Disagree (1) to Strongly Agree (4)	0.69
Scaffolding (SC)	7	Strongly Disagree (1) to Strongly Agree (4)	0.84
Engagement Facilitators (EF)	5	Strongly Disagree (1) to Strongly Agree (4)	0.78
Effective Communicatiors (EC)	2	Strongly Disagree (1) to Strongly Agree (4)	0.61
Student Motivation (SM)	5	Strongly Disagree (1) to Strongly Agree (4)	0.77
Teacher Motivation (TM)	5	Strongly Disagree (1) to Strongly Agree (4)	0.73
Extramural Math (EM)	3	Strongly Disagree (1) to Strongly Agree (4)	0.00
Task Formats (TF)	4	Strongly Disagree (1) to Strongly Agree (4)	0.05

The reliability analysis of the creative thinking instrument and learning motivation questionnaire is shown in Table 1, which presents different levels of internal consistency of each dimension and indicator. The reliability of the creative thinking questionnaire was low for FL with a Cronbach's alpha coefficient of 0.46. FX, OR and EL, on the other hand, had acceptable to good reliability with alpha values of 0.76, 0.81 and 0.85, respectively. These findings suggest that the OR and EL dimensions were the most internally consistent, whereas the FL dimension needs to be further refined to improve the stability of the measurements.

Similarly, the learning motivation questionnaire showed varying reliability levels across its eight indicators. SC demonstrated the highest reliability ($\alpha = 0.84$), followed by EF ($\alpha = 0.78$), SM ($\alpha = 0.77$), and TM ($\alpha = 0.73$), indicating acceptable to good internal consistency. RM and EC yielded moderate reliability coefficients of 0.69 and 0.61, respectively. However, EM and TF showed extremely low reliability coefficients of 0.00 and 0.05, respectively, suggesting poor internal consistency and the need for further examination and revision of the associated items.

Following the reliability analysis, Rasch statistical analysis with Winsteps software version 3.73 was performed separately on the creative thinking and learning motivation datasets. The Rasch measurement model, a modern psychometric approach used to transform raw ordinal data into interval-level measures (logits), was applied to examine the latent traits underlying students' responses (Ekstrand et al., 2022; Tennant & Küçükdeveci, 2023). Several Rasch measurement indicators were examined, including item and person reliability, separation indices, item polarity, item fit statistics, rating scale functioning, and unidimensionality (Loh et al., 2022; Wicaksono, 2021). Rasch analysis was chosen because it was appropriate for analyzing ordinal questionnaire data and its ability to estimate respondents' abilities and item difficulties on a common logit scale. Furthermore, Differential Item Functioning (DIF) analysis was conducted to identify potential item bias across demographic groups. To facilitate the interpretation of students' creative thinking performance, respondents were classified into Low, Moderate, and High categories based on the standard deviation criteria of their logit measures.

FINDINGS

Validating with a Rasch Model for Mathematics Creative Thinking and Learning Motivation of Students'

The first research question examined the levels of mathematical creative thinking and learning motivation across the items. To address this, an Item-Rasch Wright map was generated, and the responses were analyzed, as illustrated in Figure 1.

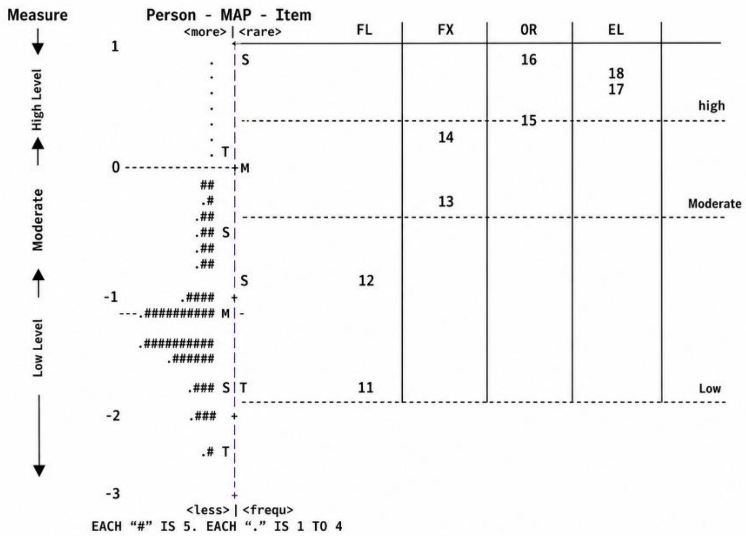

Figure 1. Wright Maps Mathematical Creative Thinking Analysis on the Person Responses

The Wright Maps are separated into two sections, as seen in Figure 1: an object distribution map on the right and a human distribution map on the left. The person measure's mean and standard deviation were found to be -1.10 and 0.45 logits, respectively. A small minority of junior high school students have a low level of ability (N=26, or 9.1%), the vast majority have a moderate level (N=246, or 86.0%), and a small number have a high level (N=14, or 4.9%), according to the Figure 1. According to the item distributions shown in the Wright Maps' right-hand side (see Figure 1), pupils were very capable of finishing I1, which is at the lowest difficulty level. However, students showed a lack of proficiency with moderate items, especially I3 and I4. Additionally, they have limited proficiency in answering the most challenging high-level items, like I5, I6, I7, and I8 (Mulyono, 2023).

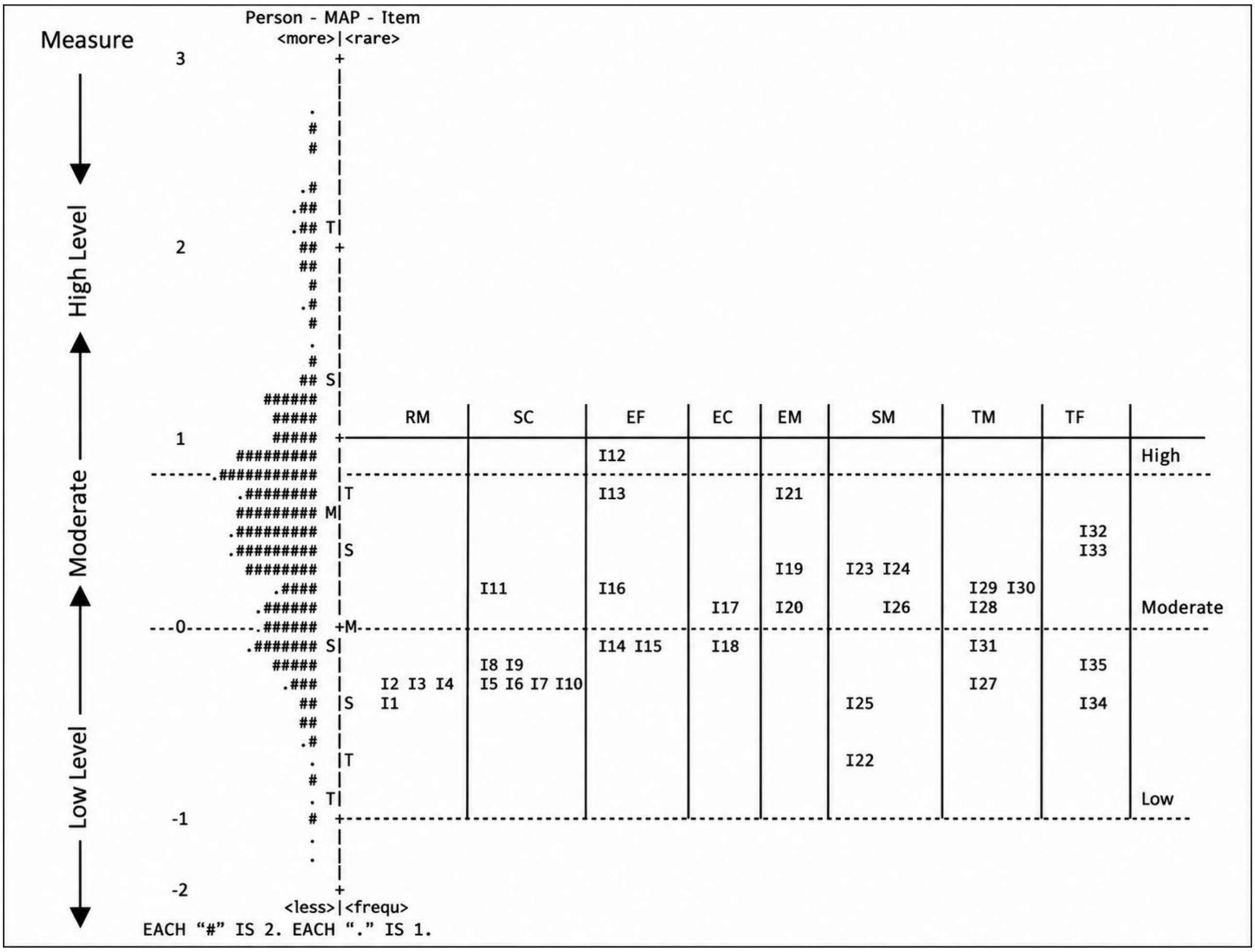

Figure 2. Wright Maps Analysis on the Person Responses

The Wright Maps are separated into two sections, as seen in Figure 2: an object distribution map on the right and a human distribution map on the left. The person measure's mean and standard deviation were found to be 2.44 and 1.98 logits, respectively. The majority of students had a moderate level of learning motivation (N = 200, or 69.93%), followed by a low level (N = 51, or 17.83%), and a high level (N = 35, or 12.24%), according to Figure 2. The item distributions shown on the Wright Maps' right-hand side (see Figure 2) indicate that student learning motivation varies noticeably among the several indicators offered. The data shows several areas that might need more pedagogical intervention to improve student involvement in the learning process, even though the majority of students retain a consistent level of motivation (Sabirin et al., 2022).

Analysis of Students' Mathematical Creative Thinking Ability Using the Rasch Model

The second research question asked whether students' enthusiasm to learn and their creative thinking in mathematics varied depending on their demographic. Many scholars have proposed that

DIF might be investigated when the DIF contrast value was statistically significant (Rasch-Welch $p < 0.05$) and exceeded the conventional value of 0.5 logits (Chan & Subramaniam, 2020; Humphry & Montuoro, 2021; Ningsih et al., 2021). Table 3 shows the occurrence of DIF for certain demographic characteristics based on the study of the Wright Maps, whereas Table 2 outlines the levels of mathematics creative thinking and learning motivation across participant demographics.

Table 2. Mathematical Creative Thinking and Learning Motivation Level Based on Demography

Creative Thinking					
Demography	**Description**	**N (%)**	**Low (%)**	**Moderate (%)**	**High (%)**
Gender	Male (L)	146 (51.0%)	17 (11.6%)	123 (84.2%)	6 (4.1%)
	Female (P)	140 (49.0%)	9 (6.4%)	123 (87.9%)	8 (5.7%)
Domicile	Jakarta (Q)	241 (84.3%)	21 (8.7%)	207 (85.9%)	13 (5.4%)
	Bekasi (R)	45 (15.7%)	5 (11.1%)	39 (86.7%)	1 (2.2%)
Age	13-14 yo (X)	178 (62.2%)	16 (9.0%)	150 (84.3%)	12 (6.7%)
	15 yo (Z)	108 (37.8%)	10 (9.3%)	96 (88.9%)	2 (1.9%)
Total	Junior High School (D)	286 (100%)	26 (9.1%)	246 (86.0%)	14 (4.9%)
Learning Motivation					
Demography	**Description**	**N (%)**	**Low (%)**	**Moderate (%)**	**High (%)**
Gender	Male (L)	146 (51.05%)	23 (15.75%)	105 (71.92%)	18 (12.33%)
	Female (P)	140 (48.95%)	28 (20.00%)	95 (67.86%)	17 (12.14%)
Domicile	Jakarta (Q)	241 (84.27%)	45 (18.67%)	166 (68.88%)	30 (12.45%)
	Bekasi (R)	45 (15.73%)	6 (13.33%)	34 (75.56%)	5 (11.11%)
Age	13-14 yo (X)	178 (62.24%)	35 (19.66%)	124 (69.66%)	19 (10.67%)
	15 yo (Z)	108 (37.76%)	16 (14.81%)	76 (70.37%)	16 (14.81%)

Table 3. Differences in School Mathematical Creative Thinking and Learning Motivation

Creative Thinking					
Item	**Code***	**DIF Measure**	**DIF Contrast**	**t**	**Probability**
I1	G	-2.08	-0.60	-3.76	0.0002
	A	-2.68	0.60	3.76	0.0002
	U	-2.68	2.11	13.74	0.0000
I2	A	-0.09	-0.99	-7.72	0.0000
	U	-1.33	1.25	9.74	0.0000
I3	G	-0.42	0.89	5.16	0.0000
	A	0.48	-0.89	-5.16	0.0000
I4	G	0.66	0.75	2.64	0.0089
	A	1.42	-0.75	-2.64	0.0089
	U	1.42	-1.61	-6.39	0.0000
I5	G	0.83	0.98	2.96	0.0034
	A	1.81	-0.98	-2.96	0.0034
	U	1.81	-1.79	-6.13	0.0000
I6	G	0.55	1.31	3.65	0.0004
	A	0.55	0.54	2.18	0.0305
	U	1.86	-1.31	-3.65	0.0004
I7	G	0.30	1.47	4.53	0.0000
	A	0.30	0.89	3.66	0.0003
	U	1.76	-1.47	-4.53	0.0000
I8	G	0.42	1.42	4.05	0.0001
	A	0.42	1.11	3.98	0.0001
	U	1.84	-1.42	-4.05	0.0001
Learning Motivation					

Item	Code*	DIF Measure	DIF Contrast	t	Probability
I9	G	-0.56	0.53	2.76	0.0063
	U	-0.03	-0.53	-2.76	0.0063
I10	G	-0.74	0.54	2.73	0.0069
	A	-0.74	0.62	3.21	0.0016
	U	-0.20	-0.54	-2.73	0.0069

*Gender: (G), School: (A), Age: (U)

As shown in Table 2 presents the distribution of students' mathematical creative thinking and learning motivation levels based on demographic characteristics, including gender, domicile, and age. For mathematical creative thinking, the majority of students were classified in the moderate category (246 students; 86.0%), followed by the low category (26 students; 9.1%) and the high category (14 students; 4.9%). Across all demographic groups, the moderate category consistently represented the largest proportion. Female students showed a slightly higher percentage of high mathematical creative thinking than male students, while students from Jakarta and those aged 13–14 years constituted the largest proportion of respondents and were predominantly classified in the moderate category. For learning motivation, most students were also categorized at the moderate level across all demographic groups. Male students had a slightly higher proportion of moderate learning motivation than female students, whereas students from Jakarta and those aged 15 years showed slightly higher percentages of high learning motivation. Overall, these findings indicate that students generally exhibited moderate levels of both mathematical creative thinking and learning motivation regardless of demographic characteristics (Mila et al., 2021; Sari et al., 2022)

As shown in Table 3, According to the DIF research students' responses varied according to their demographic backgrounds. Differences were observed in the mathematical creative thinking dimension. It was found that students' from different age groups responded differently to items measuring FL. In particular, age-related differences were evident in I1, indicating that certain age groups were more capable of generating mathematical ideas and solutions than others. Similar differences were also observed in I2, suggesting that students' ability to produce multiple responses when solving mathematical problems varied according to their age background (Mumpuni et al., 2023).

Additionally, significant differences were observed in FX. The response pattern of students in I3 and I4 was different for different gender and school-level groups. The results showed that there were groups of students that were more capable of applying different approaches and strategies to solve mathematical problems than other groups (Mulbar et al., 2026). The differences found suggest that FX may be related to students' demographic characteristics and educational experiences.

Differences were also identified in OR. As reflected in I5 and I6, students' from different demographic groups demonstrated varying abilities to generate unique and uncommon mathematical ideas. In particular, age and gender differences were evident, indicating that some student groups tended to provide more original solutions than others. Similarly, significant differences were observed in EL represented by I7 and I8. These results suggest that students' differed in their ability to expand, develop, and explain mathematical ideas in detail according to their demographic backgrounds (Mumpuni et al., 2023).

Moreover, differences in students' responses were also evident in the learning motivation dimension. Significant DIF was found in SC. As shown in I6, I7, I9, and I10, students' from different age, gender, and school-level groups responded differently to statements related to instructional support and guidance. These findings indicate that some groups of students' perceived learning assistance and academic support more positively than others. Furthermore, significant differences were identified in EF, particularly in I16. It was found that students' from different demographic backgrounds demonstrated different perceptions regarding learning activities and classroom environments that facilitate engagement in mathematics learning. These differences suggest that factors promoting students' participation and involvement in learning may not be experienced equally across demographic groups (Alyani & Hadi, 2026).

Overall, the DIF analysis indicated that age was the demographic factor most frequently associated with differential item functioning, although gender and school level also contributed to significant differences in several items. These findings suggest that students' mathematical creative thinking and learning motivation may be influenced by demographic characteristics, highlighting the importance of considering these factors when interpreting assessment results.

DISCUSSION

While there is a growing emphasis on incorporating 21st-century skills into the teaching of mathematics Salamah et al., (2025); Septiyanto et al., (2024), the operationalization and accurate measurement of students' higher-order thinking skills are still a work in progress in the field of education. This demand has triggered various psychometric efforts to validate the measurement instruments for either cognitive abilities or psychological attributes (Febryana et al., 2024; Yusfiah et al., 2024). However, little has been discussed on an integrated framework mapping the interaction of students' affective traits such as learning motivation, with the objective difficulty of mathematical creative tasks simultaneously. The literature on mathematical education has largely failed to provide unified evidence on both dimensions on a single linear metric because prior research has only evaluated mathematical creative thinking and learning motivation as isolated, fragmented variables (Febryana et al., 2024; Yusfiah et al., 2024). The current survey study aimed to examine the integrated psychometric properties of a mathematical creative thinking and learning motivation instrument in junior high school students' across three schools in East Jakarta using Rasch statistical analysis to overcome this problem.

The empirical evidence in figure 1 shows a large mismatch between the students' abilities and the difficulty of the tasks in mathematical creative thinking. The baseline data shows that the vast majority of junior high school students only have a moderate level of creative ability and a noticeable minority struggling at the lowest spectrum. The average ability of students, when adjusted for the difficulty of the items, is substantially lower than the average difficulty of the test items. This trend is strong evidence in favor of previous findings that students' mathematical creative thinking abilities are still low (Alifa et al., 2021; Fineldi & Hidayati, 2023; Ningsih et al., 2021). Specifically, students are quite proficient in solving basic, lower-level tasks, but their ability decreases significantly when they are given moderately difficult items and vanishes altogether when they are asked to solve the most advanced creative tasks, consistent with previous studies that found students have more difficulties when they are required to use higher-order and creative thinking strategies (Hilmi et al., 2022).

Figure 2 Wright maps for the affective domain show a very promising baseline on the other hand. The majority of the student cohort is characterized by a high and stable level of learning motivation, the average student motivation is significantly higher than the baseline indicators of the scale. This contrast in the landscape is in line with the claims of Shobichah, (2025); Wang, (2022), who noted that high learning motivation is an internal driver for engagement, but it does not automatically guarantee mastery over highly abstract, unfamiliar creative tasks. The difference in students' motivation level and creative performance indicates the need for specific pedagogical support to facilitate psychological preparedness for the application of sophisticated problem-solving strategies such as flexibility and originality (Nurkarim et al., 2023; Solehah & Mutaqin, 2026).

Addition, the early low reliability found in certain indicators during early consistency checks emphasizes the importance of a modern psychometric framework (Febryana et al., 2024; Yusfiah et al., 2024). Using Differential Item Functioning (DIF) analysis, this study was able to identify systematic differences in how various demographic subgroups respond to advanced creative tasks. The characteristic patterns of higher or lower endorsement probabilities within specific background groups for the most difficult items show that cognitive and affective responses are strongly influenced by demographic attributes. This study goes beyond traditional isolated validation methods Arias & Aguayo, (2021); Qirom & Nurlaelah, (2023) by identifying these underlying measurement biases and evaluating item suitability across a range of student profiles. It does so successfully delivering a more precise, robust and integrated instrument blueprint that captures how cognitive performance and affective motivation work in tandem within modern mathematical education.

CONCLUSION

In summary, the mathematical creative thinking instrument and the questionnaire of learning motivation were validated in this study using the Rasch Measurement Model. Findings revealed that the two instruments have excellent item reliability, indicating the items are stably calibrated, and support the psychometric quality of the instruments. According to the Wright Maps analysis, the majority of the junior high school students were at the moderate level of mathematical creative thinking and learning motivation. The Mathematical Creative Thinking instrument had a significant target gap, as many items were above the ability level of most students, causing relatively low person reliability. Moreover, the Differential Item Functioning (DIF) analysis revealed several items that functioned differently across demographic groups, suggesting potential item bias and the need for further investigation. The findings contribute to mathematics education by providing psychometric evidence for the development of more objective, reliable and equitable assessment instruments for measuring mathematical creative thinking and learning motivation. However, several items need further refinement to improve measurement precision and to reduce potential bias. It is suggested that future studies should re-evaluate the revised instrument and questionnaire with larger and more diverse samples to further strengthen their psychometric quality and generalizability.

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