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Rasch Model Analysis of Learning Interest Instrument for Mathematics Education Students in Statistical Course

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A B S T RAK

Penelitian ini bertujuan untuk mengkaji secara komprehensif kualitas instrumen minat belajar statistika dilihat dari validitas, reliabilitas, undimensionality, sebaran abilitas, dan kesesuaian respon mahasiswa, sehingga penelitian ini menggunakan metode deskriptif kuantitatif berbasis survei. Pengumpulan data dilakukan dengan menyebarkan angket minat belajar sebanyak 25 pernyataan kepada mahasiswa pendidikan matematika semester 4 di salah satu universitas di Semarang. Hasil penelitian menunjukkan bahwa instrumen minat belajar yang digunakan valid dan reliabel sehingga instrumen tersebut dapat digunakan untuk mengukur minat belajar mahasiswa. Sebaran abilitas item juga menunjukkan bahwa sebagian besar mahasiswa mengakui memiliki minat belajar yang tinggi terhadap mata kuliah statistika. Analisis kesesuaian respon mahasiswa menunjukkan bahwa 21 pernyataan menggambarkan kesesuaian antara minat belajar dan respon yang diberikan oleh mahasiswa sedangkan, 4 pernyataan lainnya menunjukkan ketidaksesuaian.

A R T I C L E I N F O

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A B S T R A C T

This study aims to comprehensively examine the quality of statistics learning interest instruments in terms of validity, reliability, undimensionality, distribution of abilities, and suitability of student responses. So, this research uses a survey-based quantitative descriptive method. Data collection was done by distributing a learning interest questionnaire consisting of 25 statements to mathematics education students who were in the 4th semester at one of the universities in Semarang. The results showed that the learning interest instrument used was valid and reliable so that the instrument could be used to measure student learning interest. The distribution of the items also shows that most students admit to having a high interest in learning statistics courses. Analysis of the suitability of student responses shows that 21 statements describe the suitability between learning interests and responses given by students. Meanwhile, 4 other statements showed discrepancies.

Keywords:
rasch model
learning interest
validity
reliability

1. INTRODUCTION

Technological developments in education should be seen as a way to encourage the improvement of the quality of education (Fredlina et al., 2021). These technological developments encourage digital transformation so it can open broad access to information, provide opportunities for students to learn independently through various sources, and increase understanding of various topics. Technological development has also become a critical force in preparing students to be a more productive part of an increasingly digitally connected global society. The abundance of information that accompanies these technological developments encourages students to grow into an information society (Sayaf, et al., 2021).

Information that spreads so fast and widely requires students to have the ability to process and understand information well. This ability can be developed through Statistics courses taught at the college level. This is because statistics courses encourage students to understand data collection, data processing, and interpretation of statistical results (Khairunnisa et al., 2023). Through this understanding, students are encouraged to be able to carry out productive activities in accordance with the fields studied. Students can also apply this knowledge to various fields, ranging from presenting assessment results in a school and analyzing them, to conducting research to make a policy.

The mastery of understanding of statistics is influenced by internal factors and external factors. These factors can be an influence on the achievement of learning outcomes (Darwin & Ismail, 2021). Internal factors are factors that arise from within students. Meanwhile, external factors are factors that arise from outside students (Jayanti et al., 2020). Internal factors can be fatigue factors (physical fatigue and spiritual fatigue), physical factors (health, disability), and psychological factors (intelligence, attention, interest, talent, motive, skill maturity, and learning readiness). Meanwhile, external factors can be in the form of family, school, and community environments (Oktaviani et al., 2020).

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Internal factors are important when students are in a state of learning. If the conditions faced are less supportive, then students will tend to be less interested in learning or less concentrated in participating in learning (Sirait, 2016). Students who have no interest in learning will not take learning seriously (Islamiah, 2017). This indicates that students' interest in learning needs to be optimized so that students have deeper attention to learn learning topics well (Ratnasari, 2017). Furthermore, a supportive learning environment is also very effective for students who previously had low interest (Firdausih & Aslan, 2024).

Interest reflects a situation or condition related to individual wants and needs (Azmidar et al., 2017). Interest refers to an individual's readiness to acquire new knowledge and skills related to matters of interest and the desire to apply that knowledge and skills (Sproesser et al., 2016). Interest in learning is a person's desire or encouragement to learn something with full attention and seriousness. Interest in learning is very important to increase motivation, concentration, achievement, and satisfaction in learning. It can also influence career choices, personal development, and quality of life.

Dispositional, course-related, and person-related learning events have an influence on students' attitudes towards Statistics (Slootmaeckers et al., 2014). However, conditions show that teachers have difficulty in optimizing students' learning interest in Statistics courses (Ngwu, 2015). In addition, Statistics is considered by many students as a course that has more difficulty than other courses (Hannigan et al., 2014). Therefore, it is important for educators to foster students' interest in learning.

To determine students' interest in learning, an instrument is needed that is feasible and can accurately measure learning interest. The instrument can use a questionnaire. The main purpose of questionnaires in research is to obtain relevant information in a reliable and valid way (Taherdoost, 2018). The validity and reliability of an instrument is done with a series of statistical tests that can use several customizable methods, one of which uses the Rasch model. Therefore, this study will

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comprehensively examine the quality of student learning interest instruments as seen from validity, reliability, undimensionality, ability distribution, and student response suitability using the Rasch model.

2. METHOD

This study aims to comprehensively examine the quality of mathematics learning interest instruments in terms of validity, reliability, undimensionality, distribution of abilities, and suitability of student responses. So, this research uses a survey-based quantitative descriptive method. In survey research, data are collected through observation, which can be carried out by interviewing or distributing questionnaires (Nasution, et al., 2024). Therefore, data collection in this study was carried out by distributing questionnaires of learning interest to mathematics education students in semester 4 at one of the universities in Semarang.

The instrument used in this study is a questionnaire of interest in learning mathematics consisting of 25 statements. This questionnaire was developed from (Saputro & Marsudi, 2017). The scoring guide for the learning interest questionnaire uses a Likert scale consisting of 4 answer options, namely: strongly agree, agree, disagree, and st rongly disagree. The use of four scales aims to encourage respondents to avoid middle judgments, so that respondents can clearly state their perspective on statement items. The learning interest questionnaire lattice is presented in Table 1.

Table 1. Learning Interest Indicators

Indicator	Description
Feeling of pleasure	Students' opinions about learning mathematics Students' impression of math teachers Students' feelings during math learning
Attention	Attention when participating in math learning Students' attention when discussing math lessons
Interest	Curiosity of students when participating in math learning Students' acceptance when given assignments / homework by the teacher
Student engagement	Awareness about studying at home Students' activities after and before school

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The data obtained from the learning interest questionnaire score will be analyzed using the Rasch model to determine the results of validity and reliability tests, dimensionality tests, ability distribution tests, and student response suitability tests.

3. RESULT AND DISCUSSION

a. Validity and Reliability Instrument

Validity testing aims to assess the extent to which the instrument can measure exactly the aspects that should be measured (Amrein-Beardsley & Geiger, 2020). Meanwhile, reliability testing aims to show the extent to which an instrument can be relied upon in measuring the consistency of student interest in learning (Amirrudin, Nasution, & Supahar, 2021). Using the Ministep application, information regarding the results of testing the validity and reliability of the instrument is presented in Table 2.

Table 2. Validity and Reliability Test Results

	Validity		
	Outfit ZSTD	Infit MNSQ	**Reliability**
Person	-0.25	0.98	0.89
Item	-0.10	1.00	0.85
Cronbach Alpha	-	-	0.89

Based on Table 2, the validity value of the instrument can be seen from the Outfit Z Standardized (Outfit ZSTD) value, which shows -0.25 for the person dimension and -0.10 for the item dimension. The value is in the range of -2.0 to 2.0 which indicates that all items have a reasonable possible value. Therefore, it can be concluded that each statement or item as a whole fits the Rasch model and can be considered as a valid instrument to measure student learning interest.

The reliability test results show a Cronbach Alpha (KR-20) value of 0.89, this value places it in the high reliability category. Meanwhile, the respondent reliability value and item model RMSE are 0.89 and 0.85 respectively, which are classified in the good reliability category. Therefore, the overall reliability value of the instrument is at a high level. This is also reinforced

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by good item reliability, thus providing confidence that each item is individually reliable in measuring student learning interest.

b. Undimensionality

Undimensionality aims to measure the instrument's ability to estimate the aspects that the researcher wants to explore, undimensionality is measured through its success in achieving a single dimension (VanderWeele, & Johnson, 2025). In this research, the focus of the research is the exploration of student learning interest. Research conducted by (Purnami et al., 2021) showed that the minimum raw variance explained by the instrument was greater than 24%. The Rasch model was used to demonstrate unidimensionality through Principal Component Analysis (PCA) and local independence analysis. Although this study only reports the PCA results, the results show that the variance explained by the learning interest instrument exceeds the minimum score limit of 40%, amounting to 55.6% of the total observed scores. This indicates that the instrument can be considered valid in measuring students' interest in learning. The results of the unidimensionality test of the learning interest instrument are presented in Table 3.

Table 3. Undimensionality Test Results

	Explained Variance		
	Item	Person	Total
Observed	23.6%	20,8%	55,6%
Eigenvalue	6.78	5.96	16.00

Based on Table 3, the Eigenvalue reaches 6.78, exceeding the threshold value of 3. This indicates the possibility of problems with some statement items. Therefore, further analysis is needed using item fit order analysis to determine whether an item can remain in use or needs to be replaced (Mokshein et al., 2019). This item fit order analysis aims to evaluate the fit of the measurement response to the expected model of the Rasch model.

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c. Respondents' Ability Distribution Results

The distribution of students' interest in learning can be observed through the distribution of respondents' abilities presented in the Ministep application. Figure 1 shows the results of the distribution test of students' interest in learning.

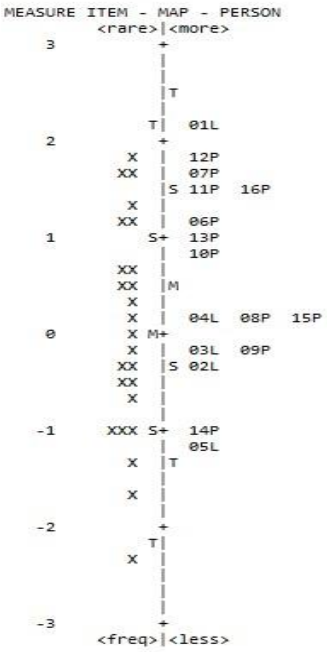

Figure 1. Respondent Wright Map

Based on Figure 1, the distribution of students' learning interest level can be seen through the responses to each statement item. Analysis of the distribution of learning interest levels is carried out based on the logit measure value. The logit mean value is set at 0.0 as the standard of student ability. Students with code 01L showed the highest level of interest in learning with a logit value of more than +2.0, this value exceeds the value obtained by other students. This indicates that students with code 01L have a high level of interest in learning. Meanwhile, students coded 14P and 05L showed a very low level of interest in learning with a logit value of -1.0, indicating that both had a minimal level of interest in learning.

d. Item Distribution Results

Figure 2 illustrates the distribution of item trust difficulty as reflected in the logit values. Items P1, P2, P3, P15, P17 and P23 have logit values greater than +1.00, indicating that items 1,

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2, 3, 15, 17 and 23 are considered the most difficult items for students to agree with. These items represent each of the learning interest indicators, namely feelings of pleasure, attention, interest, and student involvement. Thus, students find it difficult to agree on the representation of each item which shows the lack of student interest in learning statistics. Lack of student interest in learning is caused by external and internal factors in students (Safitri & Nurmayanti, 2018). External factors include the interaction between lecturers and students in providing learning motivation, teaching methods, and teaching materials that tend to be difficult. Meanwhile, internal factors include lack of student motivation, attitude, talent, and ability.

Item P18 has a logit value of -2.00, which indicates that item P18 is considered the easiest statement for students to agree with. Item P18 expresses interest in the statement of enjoying trying to solve math problems. This shows that most students have a fighting spirit to try to understand and provide solutions to problems faced in the learning context. Students' interest in learning will affect their actions and behavior in the learning process. Therefore, students tend to keep trying to complete tasks and do not give up easily if they face difficulties even though they show indifference in learning (Putri et al., 2022).

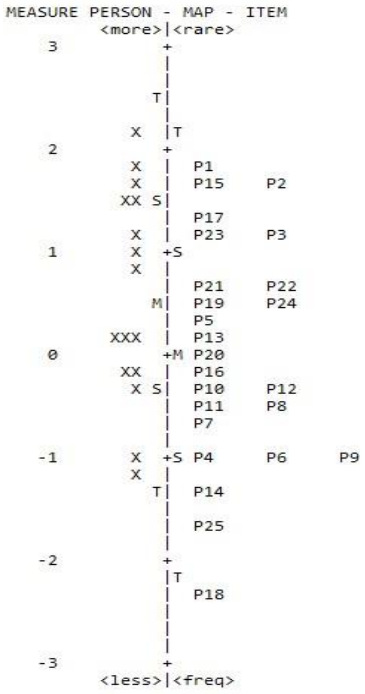

Figure 2. Item Wright Map

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e. Conformity Analysis of Student Statements

The ICC Expected Score graph on the Ministep Application is used to evaluate the suitability of student statements. If the ICC expected score value cuts the gray standard line, it can be concluded that the item is outside the confidence space boundary. Conversely, if the ICC expected score value does not cut the gray standard line, it can be concluded that the item is still within the confidence boundary (Risdianto et al., 2021). The result of the evaluation of the suitability of student answers based on the ICC Expected Score graph is presented in Figure 3.

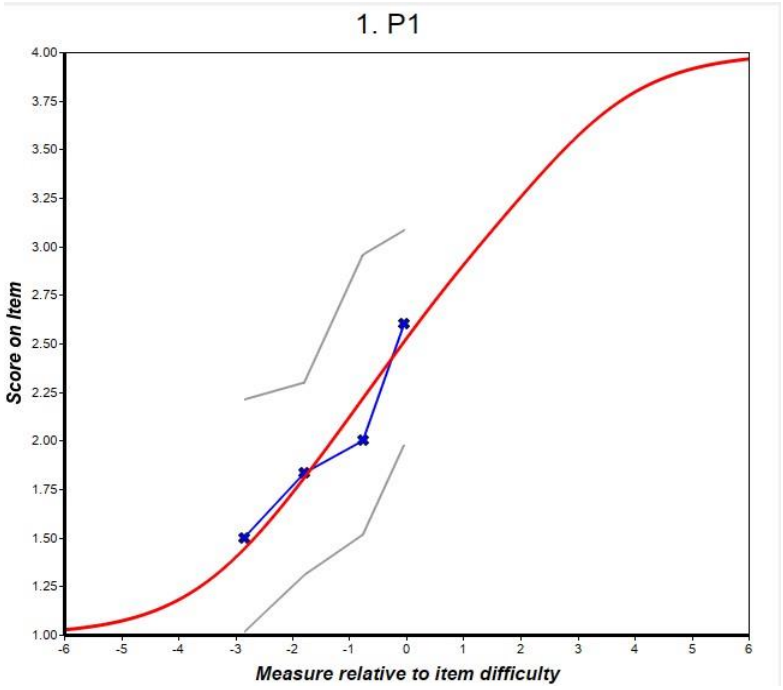

Figure 3. Appropriateness of Student Response

Based on Figure 3, it can be concluded that students' answers to item 1 (P1) are in accordance with expectations. This can be seen from the absence of blue line intersections on the items concerned with the standard line. A total of 21 statement items spread across four indicators, namely feelings of pleasure, interest, attention, and student involvement, show conformity. This indicates that the items reflect the suitability between the level of interest in learning and the responses given by students. Therefore, the instrument that has been developed by researchers can describe the level of student interest in learning in statistics courses.

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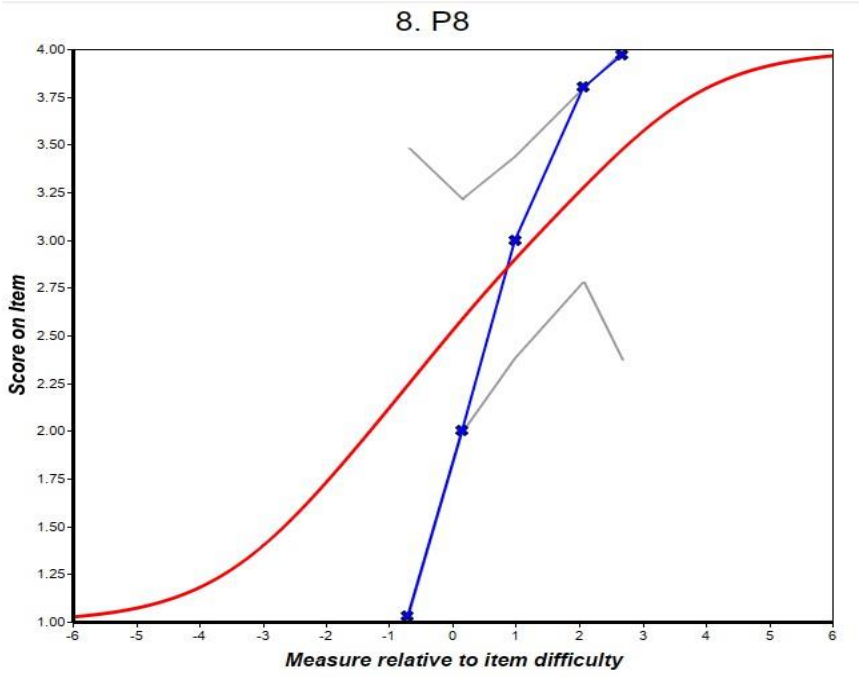

Figure 4. Discrepancy of Student Response

Based on Figure 4, item 8 shows a mismatch with the expected response from students, this item shows a statement of student attention when the lecturer explains the learning material. This discrepancy can be seen from the intersection of the blue item line with the standard line. Likewise, item 11 and item 14 show the same thing. Item 25 with the student engagement indicator also shows an incompatible graph pattern. This means that the four items do not reflect a consistent relationship between the level of learning interest and student responses. Therefore, items 8, 11, 14, and 25 cannot be relied upon as a basis for determining students' level of interest in learning and require revision in the instrument.

4. CONCLUSION

Based on the Rasch Model analysis of the student learning interest instrument using the Ministep application, it can be concluded that the learning interest instrument is declared valid and can be used to measure student learning interest. While the overall reliability of the questionnaire is in the good category. The results of the distribution of item abilities show that most students admit to having a high interest in learning statistics courses. From the analysis of the suitability of student responses, there are 21 statements that show the suitability between learning interests and

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the answers given by students. Meanwhile, 4 other statements show discrepancies. Memuat kesimpulan penelitian yang singkat dan jelas disertai saran-saran

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