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ANALYSIS OF MATHEMATICS QUESTIONS ON THE TOPIC OF EXPERSED NUMBERS IN GRADE XI AT SMKN 1 MOJOANYAR

Abstrak

Tujuan penelitian ini adalah untuk mendeskripsikan karakteristik soal matematika pada topik eksponen. Metode penelitian yang digunakan dalam penelitian ini adalah penelitian deskriptif kuantitatif. Teknik pengumpulan data yang digunakan adalah tes pilihan ganda. Sumber data dalam penelitian ini adalah 30 lembar jawaban siswa kelas XI SMKN 1 Mojoanyar. Berdasarkan hasil analisis soal matematika topik eksponen dapat disimpulkan bahwa kualitas soal cukup baik. Hal ini ditunjukkan dengan hasil analisis soal dari 25 soal yang diujikan pada 30 siswa Kelas XI SMKN 1 Mojoanyar. Diketahui kelas XI, (1) Validitas isi 2 validator dengan 5 kategori untuk 25 soal semuanya mendapat skor 1 (valid); (2) Tingkat kesukaran butir soal dari 25 soal, kategori mudah terdapat 7 butir soal (28%), kategori sedang sebanyak 18 soal (72%), (3) Untuk tingkat daya diskriminatif terdapat 1 2 item kategori daya diskriminatif sangat baik (48%), 11 item kategori daya diskriminatif baik (44%), 2 item kategori daya diskriminatif cukup (8%), (4) Reliabilitas diperoleh koefisien korelasi sebesar 0,963 termasuk kategori Reliable, dan (5) Sedangkan untuk validitas konstruk menggunakan analisis faktor, seluruh item mempunyai koefisien > 0,5 (valid).

Kata Kunci: Soal Tes, Matematika, Validitas, Reliabilitas, Tingkat Kesukaran, Daya Pembeda.

Abstract

The purpose of this study was to describe the characteristics of mathematical questions on the topic of exponents. The research method used in this study is descriptive quantitative research. The data collection technique used was a multiple-choice test. The data source in the study was 30 answer sheets of class XI students at SMKN 1 Mojoanyar. Based on the results of the analysis of mathematical questions on the topic of exponents, it can be concluded that the quality of the questions is quite good. This is indicated by the results of the analysis of the questions from 25 questions tested on 30 students of Class XI at SMKN 1 Mojoanyar. Class XI is known that, (1) The validity of the content of 2 validators with 5 categories for 25 questions all got a score of 1 (valid); (2) The level of difficulty of the items for 25 questions, there are 7 items in the easy category (28 %), 18 items in the medium category (72 %), (3) For the level of discriminatory power, there are 1 2 items in the very good discriminatory power category (48 %), 11 items in the good discriminatory power category (44 %), 2 items in the sufficient discriminatory power category (8 %), (4) Reliability obtained a correlation coefficient of 0.963, including the Reliable category, and (5) Meanwhile, for construct validity using factor analysis, all items have a coefficient > 0.5 (valid).

Keywords: Test Items, Mathematics, Validity, Reliability, Level Of Difficulty, Discriminating Power.

INTRODUCTION

Mathematics of exponents is important because it has many applications in everyday life, technology, and science. Here are some reasons why it is important to study exponents: (1) Understanding Exponential Growth: Exponents help in understanding the concept of exponential growth, such as population growth, compound interest in finance, and the spread of viruses. This is important in fields such as biology, economics, and epidemiology, (2) Technology Applications: Exponents are used in computing and data storage technology, such as in the representation of file sizes (megabytes, gigabytes, terabytes) and in algorithms

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involving large calculations, (3) Physics and Natural Sciences: Many concepts in physics and chemistry, such as the law of gravity, kinetic energy, and radiation, use exponents. Exponents help simplify complex calculations in science, (4) Calculation Efficiency: Exponents allow us to simplify complex calculations, especially when dealing with large or small numbers. For example, large numbers such as 10^8 are easier to write and manipulate than whole numbers, and (5) Advanced Mathematics Foundation: Exponential numbers are the foundation for more complex concepts such as logarithms, exponential equations, and trigonometry. Understanding exponents is essential for moving on to more advanced mathematical concepts. By understanding exponents, we can use this concept for a variety of real-world and academic purposes, making it an important foundation in mathematics. (Bano et al., 2022; Masulili et al., 2022; Nur Cahyo et al., 2022) .

Learning evaluation is a process or activity that is systematic, continuous, and comprehensive in controlling, guaranteeing, and determining the quality of learning for various learning components based on certain considerations and criteria. Teachers must evaluate learning outcomes and determine the competency standards that students must achieve. By evaluating learning outcomes, teachers can find out whether the instruments used are too easy or difficult, or whether they are in accordance with the learning indicators or not, as well as the learning (models, approaches, strategies, and methods) used in teaching. If the instruments used are too difficult, improvements need to be made by analyzing each question item used (Krisma & 'Adna, 2023; Kuba et al., 2023; Zalfa Zuhri et al., 2024) .

Item analysis is the process of reviewing the quality of questions on each item. Analyzing each item is very important, so that each item does not contain things that are not in accordance with learning objectives, when viewed from the level of difficulty, distracting patterns, distinguishing power, and others. Many teachers or prospective teachers who already have adequate skills on how to formulate learning objectives, determine learning materials in detail, choose and determine teaching methodologies, prepare media and learning facilities, but still do not have the expected skills in the field of evaluating learning outcomes, especially in analyzing items (Validity, Reliability, level of difficulty, distinguishing power). Therefore, the ability and skills to conduct evaluations are professional skills that must be mastered by every teacher or prospective teacher (Hidayatunnisa'i et al., 2023; Ismiyati et al., 2023; Siskawati et al., 2022) .

Mastering this ability is not easy, but requires adequate practice and field experience. The ability in the field of evaluation, especially evaluation of learning outcomes, is not only useful in the teaching and learning process, but also useful in the context of scientific research, namely on how to create valid and reliable measuring instruments. In compiling a measuring instrument, several steps are required, namely: how to compile/write a measuring instrument and analyze the measuring instrument so that it becomes a valid and reliable measuring instrument. Item analysis is a process that must be taken and carried out by a teacher to find out the extent of the quality of the questions given and with this analysis activity, it can help teachers regarding good questions and those that are worthy of being maintained and questions that should be discarded (Fajriyati Nahdiyah et al., 2024; Marambaawang et al., 2023; Muhammad Syahroni et al., 2024) . Therefore, this study aims to describe the characteristics of mathematics questions on the power of numbers for Class XI students at SMKN 1 Mojoanyar.

METHOD

The type of method used in this study is quantitative descriptive. According to (Sugiyono, 2016, 2017) descriptive research means research conducted to obtain the value of independent variables, either one or more variables without making comparisons or linking them to other variables. According to (Creswell, 2015) , quantitative descriptive research aims to see, review and describe the numbers of the objects studied as they are, then draw conclusions based on the phenomena that arise when conducting research.

Based on this statement, it can be concluded that descriptive research Quantitative is a research method that aims to obtain the value of independent variables about a condition objectively described by numbers. The research took place in Class XI at SMKN 1 Mojoanyar. The sample in this study was 30 Class XI students at SMKN 1 Mojoanyar. The object of this study was the quality of mathematical questions on the power of numbers. This research was conducted by analyzing mathematical questions on the power of numbers through validity,

reliability, level of difficulty, and distinguishing power. The data collection technique used was a multiple-choice test. The researcher gave a test sheet containing 25 multiple-choice questions to students and then analyzed the validity, reliability, level of difficulty, and distinguishing power using the SPSS Statistics 27 application program.

The validity test of the mathematical questions on the power of numbers in this study used SPSS Statistics 27. Based on the research that has been conducted (Creswell, 2015) the questions that he tested were in the form of essay questions so that the validity or otherwise of each question item was determined by comparing the significance of the SPSS output with $\alpha = 0.05$. The validity test of the instrument in this study used the Pearson product moment correlation formula (Creswell, 2015)

The benchmarks for interpreting the validity categories of test items are briefly presented in Table 1.

Table 1. Product Moment Correlation Coefficient Criteria

No	R_{xy}	Category
1	$0.80 \leq rxy \leq 1.00$	Very high
2	$0.60 \leq rxy < 0.80$	Tall
3	$0.40 \leq rxy < 0.60$	Enough
4	$0.20 \leq rxy < 0.40$	Low
5	$0.00 \leq rxy < 0.20$	Very Low

The reliability test of the question items was also conducted using SPSS statistics 27. The reliability value of the question items can be seen in the reliability statistics table. While the reliability criteria of the question items can be seen in Table 2.

Table 2. Reliability Criteria for Question Items

No	Reliability Coefficient	Interpretation
	$0.00 \leq ri < 0.50$	Low level of reliability
	$0.50 \leq ri < 0.70$	Moderate level of reliability
	$0.70 \leq ri < 0.90$	High level of reliability
	$0.90 \leq ri \leq 1.00$	Very high level of reliability

In preparing tests, a teacher must be able to produce good questions by analyzing their level of difficulty. (Angelina et al., 2022; Ernawati, 2023; Kurniawan, 2022) defines the level of difficulty as how simple or complex a question item is for a group of students. The level of difficulty of a question is usually determined by how easy it is to ask it to a group of students. The formula for the level of difficulty of essay questions used in this study uses the formula:

$$\text{Tingkat Kesukaran} = \frac{Mean}{Skor\ maksimum\ yang\ ditetapkan}$$

According to (Lestari et al., 2023; Padmadewi et al., 2022) the level of difficulty is categorized into three groups which are presented in Table 3.

Table 3. Difficulty Level Index

Difficulty Level Range	Difficulty Level Category
$0.00 - 0.32$	Difficult
$0.33 - 0.66$	Currently
$0.67 - 1.00$	Easy

In addition to the level of difficulty, the next stage of analysis is to analyze the discriminatory power of the questions. A test is said to be good if its discriminatory power is also good.

According to (Arwansyah et al., 2022; Himawan & Nurgiyantoro, 2022; Wulandari et al., 2022) the ability of test items to differentiate between students who have mastered the relevant material and students who have not

have not mastered the material being tested is known as the item's discriminatory power. The ability of a question item to discriminate between a group of high-scoring test takers (the top group) and a group of low-achieving test takers is indicated by a measure known as item differentiation.

Discriminatory power refers to the capacity of question items to differentiate between students who have mastered the subject matter and those who have not. In this study, the researcher used the criteria of the magnitude of the discriminatory power coefficient presented in Table 4.

Table 4. Differential Power Index

Power Category	Relation Coefficient
Good	0.40 – 1.00
Currently	0.30 –0.39
Needs to be revised	0.20 – 0.29
Not good	0.19-0.00

RESULTS AND DISCUSSION

This study was conducted to analyze the quality of multiple-choice questions used in the mathematics test of power numbers for Class XI at SMKN 1 Mojoanyar. Therefore, this study involved validity tests, reliability tests, difficulty level tests, and discriminating power tests for each question item evaluated.

Question Validity Test

This validity test was conducted using multiple-choice questions consisting of 20 Grade 4 Students of Class XI at SMKN 1 Mojoanyar. This validity test uses correlation. Questions can be said to be valid if the correlation value r > r table with the results obtained from 2-5 questions. The description of the validity test of questions with SPSS is as follows:

Table 1. Results of the Validity Test of the Test Instrument

Question Number	r-table	r-count	Sig	Question Item Status
1.	0.2960	.663[**]	0.000	Valid
2.	0.2960	.635[**]	0.000	Valid
3.	0.2960	.948[**]	0.000	Valid
4.	0.2960	.948[**]	0.000	Valid
5.	0.2960	.516[**]	0.004	Valid
6.	0.2960	.736[**]	0.000	Valid
7.	0.2960	.663[**]	0.000	Valid
8.	0.2960	.635[**]	0.000	Valid
9.	0.2960	.948[**]	0.000	Valid
10.	0.2960	.541[**]	0.002	Valid
11.	0.2960	.948[**]	0.000	Valid
12.	0.2960	.920[**]	0.000	Valid
13.	0.2960	.373[*]	0.042	Valid
14.	0.2960	.775[**]	0.000	Valid
15.	0.2960	.665[**]	0.000	Valid
16.	0.2960	.774[**]	0.000	Valid
17.	0.2960	.383[*]	0.037	Valid
18.	0.2960	.663[**]	0.000	Valid
19.	0.2960	.775[**]	0.000	Valid
20.	0.2960	.497[**]	0.005	Valid
21	0.2960	.718[**]	0.000	Valid
22	0.2960	.948[**]	0.000	Valid
23	0.2960	.774[**]	0.000	Valid

24	0.2960	.718 ** 0.000	Valid
25	0.2960	.948 ** 0.000	Valid

With the results of the question validity analysis:

Table 2. Results of Test Instrument Validity Analysis

Category	Amount	Presentation	Question number
Valid	25	100%	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25
Invalid	0	0%	
Amount	2 5	100%	25

From the table above, the data shows that 100 % of the questions fall into the valid category, while the remaining 0 % are categorized as invalid. Since most of the questions are classified as valid, it can be concluded that the overall validity level of the questions can be considered good.

Reliability Test

The results of the reliability analysis for multiple-choice questions on mathematics on the topic of exponents, which were carried out using SPSS software, are listed in the following table.

Table 3. Reliability Statistics

Reliability Statistics

Cronbach's Alpha	N of Items
.963	25

Based on the table above, the reliability test on students consisting of 25 the question item obtained a value of 0.963 which is greater. As is known that R < 0.2960 then the question is reliable.

Difficulty Level

The results of the analysis of the level of difficulty of the multiple-choice test instrument on mathematics on the topic of exponents analyzed using SPSS 27 software is available in the following table:

Table 4. Results of the Level of Difficulty of the Test Instrument

Question Number	Difficulty Level	Decision Making Criteria		Question Item Status
1.	0.7667	Difficulty level index		Easy
2.	0.7667	0.00 – 0.32	Difficult	Easy
3.	0.4000	0.33 – 0.66	Currently	Currently
4.	0.4000	0.67 – 1.00	Easy	Currently
5.	0.8333			Easy
6.	0.5000			Currently
7.	0.7667			Easy
8.	0.7667			Easy
9	0.4000			Currently
10	0.8667			Easy
11.	0.4000			Currently
12.	0.4333			Currently
13.	0.6667			Currently
14.	0.6333			Currently
15.	0.5000			Currently
16.	0.6667			Currently
17.	0.6333			Currently

18.	0.7667		Easy
19.	0.6333		Currently
20	0.6333		Currently
21	0.6333		Currently
22	0.4000		Currently
23	0.6667		Currently
24	0.6333		Currently
25	0.4000		Currently

Based on the results of the difficulty level test, 7 questions are in the easy category, 18 questions are in the medium category.

Distinguishing Power

By using SPSS 27, the results of the differentiating power of the multiple-choice mathematics test instrument for exponent numbers can be seen in the following table:

Table 5. Results of the Discriminatory Power of the Test Instrument

No Question	R Calculation Results	Interpretation criteria for differential power	Validity
item01	0.633		Good
item02	0.603		Good
item03	0.942		Very well
item04	0.942		Very well
item05	0.483		Good
item06	0.707		Very well
item07	0.633		Good
item08	0.603		Good
item09	0.942		Very well
item10	0.511		Good
item11	0.942	Interpretation criteria for differential power 0.70-1.00 = very good 0.40-0.69 = good 0.20-0.39=sufficient 0.00-0.19=bad	Very well
item12	0.911		Very well
item13	0.324		Enough
item14	0.751		Very well
item15	0.630		Good
item16	0.750		Very well
item17	0.333		Enough
item18	0.633		Good
item19	0.751		Very well
item20	0.452		Good
item21	0.688		Good
item22	0.942		Very well
item23	0.750		Very well
item24	0.688		Good
item25	0.942		Very well

So, the number of questions that fall into the categories of very good, good, and sufficient discriminatory power are as follows:

Table 6. Results of the Analysis of the Distinguishing Power of the Test Instrument

Number of Questions	Distinguishing Power Category		
	Very well	Good	Enough
2 5	12	11	2
Presentation	48%	44 %	8 %

The results of the evaluation of the discriminating power, as depicted in the table above, reveal that in the multiple-choice and essay test instruments that tested the mathematics of the material on exponents of numbers in Class XI students in the 2024/2025 academic year. Class XI at SMKN 1 Mojoanyar, 4.8 % or 12 questions were classified as having low discriminating power, 44 % or 11 questions had a moderate level of discriminating power, and 8 % or 2 questions were considered to have good discriminating power.

CONCLUSION

Based on the results of the analysis of mathematical questions on the material of numbers with powers, it can be concluded that the quality of the questions is classified as good. This is indicated by the results of the analysis of the test items from 25 questions tested on 30 students of Class XI at SMKN 1 Mojoanyar. Class XI is known that, (1) The validity of the content of 2 validators with 5 categories for 25 questions all got a score of 1 (valid); (2) The level of difficulty of the items for 25 questions, there are 7 items in the easy category (28 %), 18 items in the medium category (72 %), (3) For the level of discriminatory power, there are 1 2 items in the very good discriminatory power category (48 %), 11 items in the good discriminatory power category (44 %), 2 items in the sufficient discriminatory power category (8 %), (4) Reliability obtained a correlation coefficient of 0.963, including the Reliable category, and (5) Meanwhile, for construct validity using factor analysis, all items have a coefficient > 0.5 (valid).

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