

THE VALIDITY AND RELIABILITY OF FOUR-TIER FORMAT MISCONCEPTION DIAGNOSTIC TEST INSTRUMENT FOR MOMENTUM AND IMPULSE CONCEPTS

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Abstract

Misconception is the main problem that often occurs in physics concepts including in the concepts of Momentum and Impulse. Misconceptions that experienced by students can be identified using a four-tier format of misconception diagnostic test. This study aims, *first*, to develop a misconception diagnostic test instrument using four-tier format for Momentum and Impulse concepts. *Second*, to determine the validity and reliability of the developed instrument. Twenty numbers of test items has been developed. The theoretical validity was obtained by asking 3 physics lectures to evaluate the content, the construct and the language of the instrument. While the empirical validity and the reliability of the instrument was examined by 65 students from SMAN 4 Sidoarjo. The result shows that 94,4% of the theoretical validity was achieved. False positives and false negatives was 6,3% and 6,1% indicate that the instrument was empirically valid. The reliability coefficient (r_{exp}) was 0,61 which is bigger the $r_{table} = 0,24$, showing that the instrument was reliable.

Keywords : Misconception, Momentum dan Impulse, Four-Tier Misconception Diagnostic Test.

Abstrak

Miskonsepsi merupakan masalah utama yang sering terjadi dalam konsep Fisika termasuk pada materi Momentum dan Impuls. Miskonsepsi yang dialami oleh peserta didik (PD) dapat diidentifikasi dengan menggunakan instrumen berformat four-tier misconception diagnostic test (FTMDT). Penelitian ini bertujuan, *pertama* untuk mengembangkan instrument tes diagnostic miskonsepsi berformat *four-tier* pada materi Momentum dan Impuls. *Kedua*, menentukan validitas dan reliabilitas dari instrument yang telah dikembangkan. Butir soal yang dikembangkan sebanyak 20 soal. Validitas teoritik diperoleh dari proses validasi kepada 3 Dosen Fisika terkait aspek konten, konstruk dan bahasa. Sedangkan validitas empiric diujikan kepada 65 orang peserta didik SMAN 4 Sidoarjo. Hasil menunjukkan bahwa persentase validitas teoritik yang dicapai sebesar 94,4%. *False positives* dan *false negatives* masing-masing sebesar 6,3% dan 6,1% yang mengindikasikan bahwa instrument dinyatakan valid secara empiris. Nilai koefisien reliabilitas instrument (r_{xy}) sebesar 0,61 yang mana nilai tersebut lebih besar dari $r_{tabel} = 0,24$, yang menunjukkan bahwa instrument yang telah dikembangkan adalah reliabel.

Kata Kunci : Miskonsepsi, Momentum dan Impuls, *Four-Tier Misconception Diagnostic Test*.

INTRODUCTION

Students before studying at school have had an initial understanding of a concept based on their daily experience and interactions with their surroundings (Utari and Ermawati, 2018). This initial understanding will be formed in the mind of PD and is called as preconception. In school, teacher will teach physics concepts that may be in accordance with their

preconceptions. The concepts and preconceptions that have been accepted will be understood by student as conception. Thus, conception is student's interpretation of a concept (Wiyono, et al., 2016). If the student conceptions are not accordance with the conception whose truth has been universally recognized, the student is considered to have a misconception. Misconception is a discrepancy between the concepts that from the beginning have been understood by the

students with the universal physics concept (Suparno, 2013). Misconception occurs when someone who has been taught a concept, but still can not accept the truth of the concept as a whole. The existence of this misconception will disturb student's understanding of subsequent concepts (Anggrayni, 2019).

Based on the pre-research conducted by the researcher at SMAN 4 Sidoarjo with giving an open-ended test to students class XI, it was found potential student misconceptions on Momentum and Impulse chapter. For example, when the student given a problem about perfect collision from two balls with equal mass ($m_1 = m_2 = m$) that moving closer to each other at the same velocity, so student considers that after collision two ball will be silent because of the because of its mass and velocity that same. However, according to the physics concept, two ball after perfect colliding will move at the same speed in the opposite direction because both of the ball occurs same energy transfer. The discrepancies between the initial understanding of student with the physics concept that taught in school is called as misconceptions. The misconception can be identified as early as possible by using a four-tier misconception diagnostic test instrument (Isfara and Ermawati. 2018).

Based on the above description of the background, especially about potential misconceptions on Momentum and Impulse chapter, the researcher intends to develop a diagnostic test instruments misconceptions four-tier format in that material. This study aims to determine the feasibility instruments in term aspect of validity and reliability so that the instrument can be used to identify students misconceptions profile.

METHOD

The design of this work is to develop a four-tier misconception diagnostic test instrument fon Momentum and impulse chapter with the Research and Development method. The instrument was then tested on 65 students of class XI of SMAN 4 Sidoarjo who had received Momentum and Impulse chapter. Data analysis techniques in this study is determine the theoretical and empirical validity and reliability of the instrument. The theoretical validity conducted by three lecturers Validator from Department of Physics to determine the percentage of the theoretical validity consist of aspect content, constructs and languageThe results of percentage teoritical validity that has been obtained then interpreted in Table 1 below.

Tabel 1. Interpretation of Percentage Theoretical Validity (Riduwan dan Akdon. 2013)

Percentage	Criteria
0% – 20%	Very invalid

Percentage	Criteria
21% - 40%	Invalid
41% - 60%	Quite valid
61% - 80%	Valid
81% - 100%	Very valid

While the empirical validity analyzed consist of the content and construct empirical validity. Empirical validity of content can be determined from the percentage of false positives (FP) and false negatives (FN). The instrument is valid of empirical conten if the percentage FP and FN are each smaller than 10% (Hesetenes and Halooun. 1995). Empirical validity of constructs for each item test can be determined by Pearson product moment equation (r_{exp}). According Arikunto (2016), The instrument is valid of construct empirical if the value of $r_{exp} > r_{table}$. Furthermore, the reliability analysis can be calculated using Cronbach Alpha equation (Siregar. 2013). Instrument reliability coefficient calculation results (r_{exp}) then interpreted in Table 2 below.

Tabel 2. Reliability Coefficient Criteria using Cronbach Alpha (Turker, 2005).

Reliability Coefficient	Criteria
-1,000 – 0,199	Very low
0,200 – 0,399	Low
0,400 – 0,599	Medium
0,600 – 0,799	High
0,800 – 1,000	Very high

The instrument is reliable if the reliability coefficient (r_{exp}) is greater than the value r_{table} . The r_{table} value used is 0.24 with a significant level of 5%.

RESULTS AND DISCUSSION

Before being tested on students in school, the misconception diagnostic test instrument that had been developed was first validated by 3 Validators of the Physics Department. The results of the validation activities obtained a percentage of theoretical validity which includes aspects of content, constructs and language. The recapitulation of the percentage of theoretical validity and its criteria is shown in Table 3 below.

Table 3. Percentage Recapitulation and Criteria of Assessment Theoretical Validity

Aspect	Percentage (%)	Criteria
Contents	90.63	very valid
Construct	92.50	very valid
Language	100.00	very Valid

According to Riduwan and Akdon (2013), a good instrument if the percentage of validity is greater than

61%. Thus it can be concluded that the instruments that have been developed are declared valid because based on Table 4.5 above the percentage of theoretical validity of the instrument obtained ranges from 90-100%. The instrument that has been validated, furthermore tested to 65 students of class XI SMAN 4 Sidoarjo which aims to determine the percentage of empirical validity which includes aspects of content and constructs.

From the testing activities of the instruments obtained student answer data which were then analyzed by researchers to determine the empirical validity of the content and construct. The results of the empirical validity of the contents can be shown in the Table. 4 below.

Table 4. The Results of Empirical Validity Content

Question Number	False Positives (FP)	False Negatives (FN)	Question Number	False Positives (FP)	False Negatives (FN)
1	0	10	11	1	0
2	12	3	12	2	0
3	3	0	13	0	5
4	0	4	14	1	0
5	0	22	15	3	1
6	5	0	16	1	9
7	0	2	17	17	2
8	3	4	18	6	14
9	2	1	19	3	0
10	22	0	20	1	2
Total				82	79
Percentage				6,3%	6,1%

In Table 3, the values of FP and FN are 6.3% and 6.1% respectively. The percentage of FP and FN shows that the percentage is less than 10% (Hesten and Halloun. 1995). The percentage of FP and FN is seen that less than 10% (Hesten and Halloun. 1995). Thus, the diagnostic test instruments that have been developed are valid of contents empirically. Empirical validity of of construct for each item test was determined using Pearson product moment correlation (r_{exp}). Test items are declared valid if the value of $r_{exp} > r_{table}$. The mapping of results for the empirical validity of construct per item question can be seen in Table 4 below.

Table 5. Value of pearson Product Moment Correlation (rxy) Per Item and its Criteria.

No.	r_{exp}	r_{table}	Criteria
1	0,30	0,244	Valid
2	0,48		Valid
3	0,40		Valid
4	0,15		Invalid
5	0,19		Invalid
6	0,31		Valid
7	0,35		Valid

No.	r_{exp}	r_{table}	Criteria
8	0,55	0,244	Valid
9	0,29		Valid
10	0,10		Invalid
11	0,42		Valid
12	0,38		Valid
13	-0,005		Invalid
14	0,33		Valid
15	0,121		Invalid
16	0,46		Valid
17	0,34		Valid
18	0,50		Valid
19	0,33		Valid
20	0,45		Valid

From Table 5, the results show that of the 20 questions that have been developed there are 15 questions declared valid and 5 other questions declared invalid. Five questions are declared invalid due to the value of $r_{exp} \leq r_{table}$.

Instrument reliability can be determined using the Cronbach Alpha Equation. Based on the calculation results of reliability of the instrument obtained the value of the reliability coefficient of 0.61. According to Arikunto (2016), an instrument is declared to be reliable if the value of $r_{exp} \geq r_{table}$. The value of r_{table} is 0.244 with $n = 65$ and a significant level of 5%. Thus, the results obtained show that $r_{exp} \geq r_{table}$, so that the diagnostic test instruments that have been developed are declared reliable with **high** categories.

COVER

Conclusion

Based on the results that have been obtained, it shows that the instruments are valid of theoretically and empirically. The instrument reliability coefficient value is 0.605 which indicates that it is greater than the r_{table} value so that the instrument is also declared reliable. Thus, the four tier misconception test instrument is ready to be used to identify students' misconceptions profile.

Suggestion

The suggestions for further researchers, are a) to develop a diagnostic test instrument for misconception on sub concept of partially collisions, b) to conduct research to reduce the misconceptions experienced by students on Misconceptions can be reduced through a learning with cognitive conflict approach so that the assimilation process occurs in the students brain and c) for Physics teachers, to provide conceptual learning so that students have a complete understanding and teacher should'nt be wrong in teaching in Physics concept.

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