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Five-Tier Multiple-Choice Instrument for Assessing Students' Understanding of the Straight Motion

Hidayatullah[1]*, Fatni Mufit[2]
[1,2] Department of physics, Padang State University, JL. Prof. Hamka Padang, Padang, 2513, Indonesia
*Corresponding author: fatni_mufit@fmipa.unp.ac.id

Abstrak

Miskonsepsi pada konsep gerak garis lurus merupakan masalah yang sering terjadi dalam pembelajaran fisika. Instrumen penilaian yang secara khusus bertujuan untuk menilai pemahaman konseptual konsep gerak pada garis lurus belum banyak tersedia. Penelitian ini bertujuan untuk mengembangkan instrumen pilihan ganda lima tingkat yang valid dan praktis untuk menilai pemahaman siswa tentang konsep gerak garis lurus. Penelitian ini merupakan penelitian pengembangan/desain (DR) dengan menggunakan model Plomp. Model tersebut divalidasi oleh tiga orang ahli. Instrumen pengumpulan data berupa angket observasi, tes konsep siswa, lembar evaluasi diri, lembar validasi, dan lembar praktik. Hasil analisis validitas menunjukkan bahwa instrumen berada pada kategori sangat valid pada aspek penyajian, isi, konstruksi/grafik, dan bahasa. Kemudian hasil analisis kepraktisan menunjukkan bahwa instrumen berada pada kategori kemudahan, daya tarik, efisiensi, dan kegunaan. Berdasarkan hasil tersebut, instrumen memenuhi kategori valid dan praktis untuk menilai pemahaman konsep gerak garis lurus siswa dan diharapkan dapat menjadi referensi alternatif untuk meningkatkan kualitas pembelajaran fisika dan bidang ilmu lainnya.

***Kata kunci*:** *Pilihan Ganda Bertingkat Lima, Miskonsepsi, Gerak Lurus.*

Abstract

The misconception in the concept of straight motion is a problem that often occurs in physics learning. An assessment instrument that specifically aims to assess conceptual understanding of the concept of straight motion is not widely available. Therefore, this research aims to develop a valid and practical five-tier multiple-choice instrument for assessing students' understanding of the concept of straight motion. This research was development/design (DR) using the Plomp model. The model was validated by three experts. The data collection instruments were observation questionnaires, student concept tests, self-evaluation sheets, validation sheets, and practicality sheets. The results of the validity analysis showed that the instrument is in a very valid category in the aspects of presentation, content, construction/graphics, and language. Then the results of the practicality analysis show that the instrument is in the categories in terms of convenience, attractiveness, efficiency, and usefulness. Based on these results, the instrument fulfills the valid and practical category for assessing students' understanding of the concept of straight motion and is expected to be an alternative reference to enhance the quality of physics learning and other fields of science.

Keywords: Five-Tier Multiple-Choice, Misconception, Straight Motion.

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1. INTRODUCTION

Physics is not a memorizing subject but is more demanding for factual, conceptual, principal, and procedural mastery of the material (Mufit & Syamsidar, 2022; Raehan et al., 2020). This comprehensive mastery of the material is often not able to be possed by students due to their misconceptions. Understanding the concept and having a positive attitude towards studying physics is a requirement to succeed in studying physics (Capriconia & Mufit, 2022; Mufit et al., 2023). One of the physics learning materials that often have misconceptions is straight motion. Straight motion in physics learning material observes natural phenomena related to the motion of an object that forms a straight trajectory. Studying motion material on straight-line material requires understanding the right concepts in building students' knowledge in a structured way to solve various phenomena that occur in this linear motion (Apriyanti et al., 2020; Festiyed et al., 2019). It is hoped that the concepts understood by students are the same as the theories put forward by experts so that there are

no misconceptions in students' understanding. Misconceptions are students' misunderstandings in understanding the concepts of physics learning material so that the concepts understood by students are not in accordance with the theories put forward by experts in their fields. In physics, misconceptions can be interpreted as the use of physical concepts that are not in accordance with the concepts put forward by experts or physicists that have been accepted as a whole (Mufit et al., 2023; Mufit & Fauzan, 2019). Misconceptions in the learning process will hinder the process of receiving new knowledge which results in the process of understanding students' concepts. This misconception can also persist in students' understanding so that if it is not remedied from the start, it will have an impact on the next learning process (Alfiani, 2015; Sholihat et al., 2017). Therefore, the teacher as the person in charge of the learning process is required to be more sensitive to the understanding of the students' concepts.

In this research a literature study was conducted by reviewing several articles used to determine students' understanding of the concept of straight motion material, it was found that students experienced many misconceptions about this straight motion material. Misconceptions occur in the indicators of distance and displacement of 48.3%, speed, speed and acceleration of 38.3%, accelerated straight motion 48.9%, straight straight 37.8% and free fall motion 58.3% (Rahmah et al., 2020). In this study, initial observations were also made at school and the results were in line with the results of the literature study, and at school there were also no instruments that could be used to analyze students' understanding of concepts.

To improve students' understanding of concepts and reduce misconceptions that occur in students, further analysis needs to be carried out. Identifying misconceptions that occur in students, it can be done using a diagnostic test instrument (Alwan, 2011; Maharani et al., 2019). The tests made are arranged in the form of Multiple Choice or multiple choice. Multiple-choice tests are a more efficient way of identifying conceptual understanding than interviews (Kirbulut, Z. D. & Geban, 2014; Saepuzaman et al., 2019). However, this multiple-choice also still has several weaknesses, such as when working on the problem, the answer can be guessed by students without the need to understand the material from the problem being worked on, and the teacher also has difficulty making homogeneous and functional distracting answers. Multiple choices also have several weaknesses, such as the answers chosen by students can be guessed. This is because the answers are already available, not answers that are understood by students. Ordinary multiple choice tests are less effective in detecting student misconceptions because they cannot tell whether students guess (don't understand the concept) or if there are misconceptions (Guswina & Mufit, 2020; Mufit & Syamsidar, 2022).To overcome these weaknesses, multiple-choice tests were developed into several levels, ranging from one level (one-tier), two-tier (two-tier), three-tiered (three-tier), to four-tiered (four-tier) (Agustina et al., 2021; Kaltakci-Gurel et al., 2017). The four-level test consists of questions and answers choices, the level of confidence in choosing the answers, the choice of reasons in choosing the answers, and the level of confidence in choosing the reasons.

The process of analyzing students' misconceptions and understanding of concepts needs to be strengthened, therefore the four-level test was developed into the fifth level or (five-tier). Answers to questions can be reconfirmed at the fifth level, either in the form of questions about pictures or questions about conclusions. From the fifth level answers, results will be obtained about students' conceptual understanding of the material provided, so that the five-tier test instrument can diagnose students' conceptual understanding more deeply (Anam et al., 2019; Noriyatus et al., 2020). Based on the description above, it can be concluded that this misconception greatly influences students, both directly and continuously on the material students understand. The test instrument for analyzing students' conceptual

understanding that already exists is still not optimal in analyzing students' conceptual understanding because there are still opportunities for students to guess the answers from the test, it is necessary to use a five-level multiple choice instrument in detecting misconceptions experienced by students and analyzing students' understanding of straight motion. It is hoped that the results of this study can contribute to the advancement of education in the field of physics studies, especially in straight motion material. This study aims to develop a five-tier multiple-choice instrument in straight motion material to assess the conceptual understanding of SMA/MA students.

2. METHODS

This research is a Development/Design Research using the Plomp model. The Plomp model consists of three stages, including: (1) preliminary research, namely conducting a needs analysis and reviewing the literature; (2) the development or prototyping phase is the stage of designing solutions to solving problems put forward by preliminary researchers, which consists of prototype design and formative evaluation and prototype revision; (3) the assessment phase is the phase tested and evaluated in practice (Plomp & Nieveen, 2013). At the preliminary research stage, questionnaires were given to teachers related to the learning process in class. In addition, an analysis of students' understanding of the concept of straight motion was also carried out. At the prototype stage an analysis of the validity and practicality of the prototype is carried out. Data collection uses several instruments, including observation questionnaires, self-evaluation sheets, validation sheets, and product practicality sheets.

The sample in this study was 30 students from 2 different schools. The first school was a superior school based on accreditation, student achievement and the number of alumni who passed at state universities. The second school is a medium-level school based on school accreditation, student achievement and the number of alumni accepted at state universities. In this study also involved a validator to validate the products that had been made by researchers, the validators in this study were 3 expert lecturers from Padang State University. Product validity was carried out on 4 aspects, namely the instrument presentation aspect, the content feasibility aspect, the construction/graphic feasibility aspect, and the language feasibility aspect. Validity and practicality are arranged using a Likert scale, as shown in Table 1.

Table 1. Likert Scale

Likert Scale	Evaluation
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

Aiken's V equation is used to analyze product validity and practicality based on expert judgment results. From the analysis, it was found that the results of Aiken's V decisions were in the less (≤ 0.4), moderate ($0.4 < V \leq 0.8$) to high ($0.8 < V$) categories (Retnawati, 2016).

3. RESULTS AND DISCUSSION

Results

From the results of the questionnaire, it was found that 93.3% of teachers had used various learning models but teachers still had not used the student's conception of understanding the test because the test instrument was not yet available. The two-tier and three-tier multiple-choice test instruments were already known by the teacher to be but the teacher still has not applied them in the process of identifying students' conceptual understanding because this instrument is not available in schools. As for the four-tier and five-tier test instruments, the information is not yet known by the teacher because this type of instrument is still relatively new and developed by researchers in the city of Padang. Based on the literature study on students' conceptual understanding, it was found that the percentage of students understood concepts, misconceptions, and did not understand concepts. Students are categorized as understanding the concept if the understanding understood by students is by the theory put forward by the expert, whereas if the concept understood by the student is not in accordance with the concept put forward by the expert, the student is categorized as a misconception.

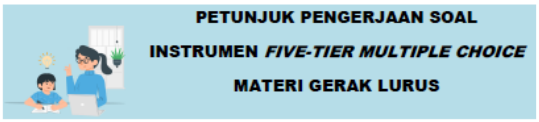
The prototype was designed based on the results of the analysis at the preliminary research stage, namely through needs analysis and literature review. In this study, the product produced is an instrument to analyze students' conceptual understanding, namely a five-tier multiple-choice instrument. The activities carried out at this stage include 1) making a grid of questions; 2) compiling working instructions; 3) arranging questions; 4) creating an answer key; 5) creating a scoring rubric; 6) creating guidelines for interpretation of results. In designing the question grid for the five-tier multiple-choice instrument, it is matched with indicators on basic competence with the subject matter of linear motion. The question grid is equipped with basic competencies, indicators, essential materials, indicators of concept understanding, question numbers, and cognitive categories. Based on the designed grid, 17 questions will be arranged with cognitive levels varying from C2 to C5 as in Table 2.

Table 2. Question Grid

Basic competencies	Indicator	Essential Material	Concept Understanding Indicator	Question Number	Cognitive Category
3.4 Analyzing physical quantities in straight motion with constant (fixed) speed and straight motion with constant (fixed) acceleration and their application in everyday life such as traffic safety	3.4.1 Explaining about linear motion	Concept, characteristics, and application of motion	Explain	1	C2
			Classify	2	C3
			Conclude	3	C4
	3.4.2 Explaining quantities in linear motion	Quantities in linear motion	Explain	4	C2
		Differences and similarities between one quantity and another in linear motion	Compare	5	C5
			Compare	6	C5
	3.4.3 Determining the characteristi	Application of uniform motion in	Summarize	7	C2
			Summarize	8	C2

Basic competencies	Indicator	Essential Material	Concept Understanding Indicator	Question Number	Cognitive Category
	cs of Uniform Motion	daily life Characteristics of uniform motion	Classify	9	C3
		Examples of objects that move in uniform motion in daily life	exemplify	10	C2
	3.4.4 Analyzing the characteristics of straight motion Changing Regular	Determining the value of the quantities in uniformly changing motion in a straight motion based on the illustration given	Interpret Interpret Interpret	11 12 13	C5 C5 C5
		Examples of the application of uniform straight motion in everyday life	exemplify	14	C2
	3.4.5 Analyzing free fall motion, vertical upward motion, and vertical downward motion	The magnitudes of the free fall motion, the upward vertical motion, and the downward vertical motion	Conclude Conclude Summarize	15 16 17	C4 C4 C2

Before working on the instrument, students are required to first understand the instructions for working on the questions. Instructions for working on these questions are very important for students to help them in working on the questions. The instructions for working on this question consist of 11 items that contain what things are allowed or not while working on the questions, besides that it also contains instructions on how to work on the questions as in Figure 1.

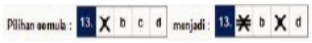


Sebelum mengerjakan soal, peserta didik diharapkan untuk membaca petunjuk pengerjaan dibawah ini :

1) Berdoalah sebelum mengerjakan soal tes
2) Melengkapi identitas pada lembar jawaban
3) Periksalah kelengkapan soal sebelum mengerjakan soal
4) Bacalah soal dengan teliti dan pahami pertanyaan yang telah disediakan
5) Soal dijawab langsung pada lembar soal yang telah disediakan.
6) Pilih opsi jawaban yang benar dengan memberi tanda (X), Jika mau mengubah pilihan jawaban, tambahkan (=) pada jawaban awal yang dipilih kemudian dilanjutkan dengan memberi tanda (X) pada jawaban pengganti yang dirasa benar.

Contoh menyilang yang benar

Contoh cara mengubah jawaban yang benar



7) Kerjakan 5 tingkatan soal sebagai berikut :
   a. Tingkat pertama, berisi tentang pilihan jawaban
   b. Tingkat kedua, berisi tentang tingkat keyakinan dalam memilih jawaban
   c. Tingkat ketiga, berisi pilihan alasan dari jawaban yang dipilih
   d. Tingkat keempat, berisi tentang tingkat keyakinan dalam memilih alasan
   e. Tingkat kelima, berisi konfirmasi jawaban.
8) Kerjakan semua soal yang tersedia pada lembar jawaban dan dahulukan menjawab soal-soal yang anda anggap mudah
9) Dilarang menggunakan alat bantu seperti buku, *handphone*, laptop atau alat bantu lainnya
10) Dilarang mencotek maupun kerjasama dengan teman
11) Soal dikerjakan selama 90 menit

Figure 1. Instructions for Working on Problems

The questions on this designed instrument consist of 5 levels, namely questions and answer choices at level 1, the level of confidence in giving answers at level 2, at level 3 is the reason for giving answers, the level of confidence in giving reasons at level 4 and confirmation of answers in the form of pictures. or conclusions at level 5. Questions on this test instrument are designed questions that can reveal students' understanding of concepts, therefore questions that use numbers are very minimized. For answers from each level, the students answered directly on the question sheet provided, for tier-1 to tier-4, a box containing the answer choices was given which the students were expected to cross according to their answer, while for tier-5 an empty box was given. for students to answer questions as in Figure 2.

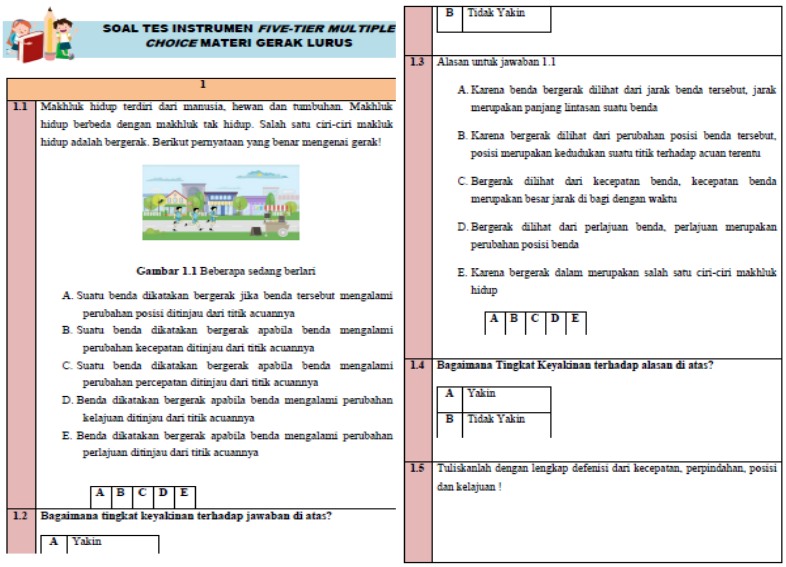


Figure 2. Five-Tier Multiple Choice Instrument

The next step is to make an answer key for the questions designed on the five-tier multiple choice instrument. The answer keys made are for all levels of questions, by giving a different color to the correct answer box, while for the tier-5 answer key it is only a correct answer so that if you answer according to the answer key, students are classified as understanding the concept as in Figure 3.

KUNCI JAWABAN INSTRUMEN *FIVE-TIER MULTIPLE CHOICE*
PADA MATERI GERAK LURUS

No	Pilihan Jawaban					Tingkat keyakinan terhadap jawaban		Alasan jawaban					Tingkat keyakinan terhadap alasan		Konfirmasi jawaban	Penilaian pemahaman konsep
1	A	B	C	D	E	A	B	A	B	C	D	E	A	B	Benar	Paham Konsep
2	A	B	C	D	E	A	B	A	B	C	D	E	A	B	Benar	Paham Konsep
3	A	B	C	D	E	A	B	A	B	C	D	E	A	B	Benar	Paham Konsep
4	A	B	C	D	E	A	B	A	B	C	D	E	A	B	Benar	Paham Konsep
5	A	B	C	D	E	A	B	A	B	C	D	E	A	B	Benar	Paham Konsep

Figure 3. Five-Tier Multiple Choice Instrument Answer Key

Next, compile a scoring rubric. This scoring rubric is useful for determining the category of students' conceptual understanding. This scoring rubric has a range of values from 0 to 3. A score of 0 is for the wrong student and a value of 3 is for the correct student for the 3 item questions. This scoring rubric contains a description of the correct answers for tier-1, tier-3, and tier-5 as in Figure 4.

RUBRIK PENSKORAN JAWABAN INSTRUMEN FIVE-TIER MULTIPLE CHOICE PADA MATERI GERAK LURUS

NO	TIER-1	TIER-3	TIER-5	Skor Maks
1	Makhluk hidup terdiri dari manusia, hewan dan tumbuhan. Makhluk hidup berbeda dengan makhluk tak hidup. Salah satu ciri-ciri makluk hidup adalah bergerak. Berikut pernyataan yang benar mengenai gerak!  Gambar 1.1 Beberapa sedang berlari **Jawaban: A**	Suatu benda dapat di katakan bergerak apabila kedudukannya senantiasa berubah terhadap titik acuan tertentu. Gerak merupakan perubahan posisi benda dari titik acuannya. **Jawaban: B**	Tuliskanlah dengan lengkap defenisi dari kecepatan, perpindahan, posisi, kelajuan! ➢ Kecepatan adalah perpindahan yang ditempuh tiap satuan waktu, kecepatan ini adalah besaran vektor ➢ kelajuan diartikan sebagai jarak yang ditempuh tiap satuan waktu, kelajuan ini adalah besaran skalar ➢ posisi adalah letak suatu benda terhadap titik acuan tertentu. Posisi ini adalah besaran vector	3

Figure 4. Five-tier Multiple Choice Instrument Scoring Rubric

The next stage is the Formative Evaluation and Prototype Revision stage. The results obtained are 1) Self-evaluation results, 2) Content validity 3) Instrumental practicability. Self-evaluation is the first step taken by researchers at this stage. Self-evaluation is an independent evaluation or checking carried out on the completeness and instruments that have been made. This self-evaluation was carried out before carrying out the content validation stage by 3 lecturers. At this stage, check the completeness of the instrument that has been made, repair or revise the parts of the instrument that are deemed inadequate or not appropriate. This self-evaluation consists of 4 components that will be checked with each component having an assessment indicator item as in Table 3.

Table 3. Self-Evaluation Results

	Rating Indicator	Evaluation available	Evaluation not available
1	**Test Instrument Structure**		
	a. Question grid	√	
	b. Instructions for doing questions	√	
	c. test questions	√	
	d. Answer key	√	
	e. Scoring guidelines	√	
	f. Assessment Guidelines (interpretation of results)	√	
2	**Instrument Equipment**		
	a. The instrument consists of 5 answer choices on tier-1	√	
	b. The instrument consists of 5 answer choices on tier-3	√	
	c. The instrument consists of 2 choices of confidence levels	√	
	d. the instrument consists of confirmation of answers which can be in the form of pictures, analysis, or conclusions on tier-5	√	
3	**language**		
	a. Sentence writing is by good and correct Indonesian rules	√	
	b. Using a standard language	√	
4	**Graphics**		
	a. The use of the font (type and size) of writing on the instrument is legible	√	
	b. The image presented on the instrument is visible	√	
	c. Color display on contrasting instruments	√	

The validation of the five-tier multiple choice instrument was carried out by 3 experts consisting of physics lecturers, FMIPA UNP. The results of this validation are used as a guide in revising the five-tier multiple choice instrument to create an instrument that is suitable for distribution to students. Expert in conducting content validation using validation instruments. This content validation instrument consists of 4 aspects, namely construction, content, product display, and language of this five-tier multiple choice instrument. Each aspect of the validation instrument consists of several indicators. The next step is to do a validation analysis based on the item questions using Aiken's V formula. The assessment consists of 4 aspects with a total of 30 points of assessment indicators. The results of the validation by the three validators are for each of the following aspects.

Instrument Presentation Aspects

In the aspect of presenting the instrument consisting of 7 assessed criteria, this aspect that is assessed is related to the presentation of the instrument, namely (1) Questions are equipped with reasons (tier-3) and the level of confidence in the answers (tier-2 and tier-4) and confirmation of answers (tier-4) -5), (2) The test questions can identify students' conceptions, (3) The rationale options (tier-3) presented can reveal the causes of students' misconceptions, (4) Reason distractors (tier-3) are rational and homogeneous with questions (tier-3) 1), (5) Questions on (tier-5) can confirm student answers, (6) Questions on (tier-5) are related to questions on (tier-1), (7) Questions on (tier-5) are by straight motion material. Aiken's V value is based on the value for each item, which amounts to 17 questions with 3 validators as shown in Table 4.

Table 4. Aiken's V Value Aspects of Instrument Presentation

Question Number	V Aiken's Value	Category
1-3	0.87	Very Valid
4	0.90	
5	0.88	
6	0.90	
7	0.87	
8	0.90	
9&10	0.87	
11&12	0.86	
13-16	0.90	
17	0.87	

Based on Table 4, it can see that V Aiken's value obtained for all question items is above 0.8, which means that if we look at the category rules, this value is included in the very valid category. The presentation of this instrument gets a very valid category because before the evaluation by the validator, the instrument has been carefully examined.

Content Aspect

The content aspect is assessed based on 7 assessment criteria, all of which cover the contents of the test instrument, namely (1) questions according to learning indicators, (2) questions according to the concept of linear motion, (3) questions asked according to the material studied in SMA/MA , (4) The material asked is by the composition (urgency, relevance, continuity, high daily use), (5) The distractor functions, (6) The question (tier-1) only has one correct answer, (7) Reason (tier-3) has only one correct answer. The results of content validation for the content aspects of the three validators are shown in Table 5.

Table 5. Value of Aiken's Content Aspect

Question Number	V Aiken's Value	Category
1&2	0.88	Very Valid
3	0.91	
4&5	0.88	
6	0.87	
7	0.88	
8	0.91	
9	0.88	

Question Number	V Aiken's Value	Category
10	0.91	
11-13	0.88	
14&15	0.91	
16&17	0.87	

Based on Table 5 the assessment of content validity given by 3 validators for the content aspect, we can see that Aiken's V score obtained for each item ranges from 08 to 0.9, so if we look at the category scale to Aiken's V value, then for all questions are in the very valid category.

Construction/Graphics Aspects

The third aspect that is assessed as content validity by the validator is the construction/graphic aspect, this construction or graphic aspect consists of 12 question items. This graphic aspect includes the beauty and clarity of the instrument, namely (1) the type of font, size, and spacing used is appropriate, (2) the image is clear and functional, (3) the image and the like are by the problem presented, (4) the image is attractive and the color composition is appropriate, (5) the subject matter (tier-1), the reason (tier-3) and confirmation of the answer (tier-5) are formulated, (6) the subject matter does not provide a correct answer, (7) the main question does not contain double negative statements, (8) The sentences used do not cause multiple interpretations, (9) The length of the answer choices is relatively the same, (10) The answer choices presented are homogeneous and logical, (11) The answer choices do not contain the statement "all the answers above true‟ or “all of the answers above are wrong”, (12) The item does not depend on the answer to the previous question. The results of this validation assessment are processed using V Aiken's and also by paying attention to the category of construction/graphical aspects for each item as shown in Table 6.

Table 6. Aiken's V Value Aspects of Construction/Graphics

Question Number	V Aiken's Value	Category
1	0.90	Very Valid
2	0.92	
3	0.90	
4&5	0.91	
6	0.92	
7	0.91	
8	0.92	
9&10	0.91	
11	0.92	
12-15	0.91	
16	0.92	
17	0.91	

Based on the Table 6, it can see that Aiken's V value for each item in the category is very valid. At the value of V Aiken's for the construction/graphical aspect, the score is almost perfect, which is all at a value of 0.9.

Language Aspect

The last aspect that is assessed is the language aspect. The language aspect in an instrument is very necessary to be assessed because of the language used is not valid then there will be difficulties for students in using the instrument. The assessment criteria for this language aspect consist of 4 criteria, namely (1) the language used is communicative, (2) the language used is by the Indonesian language rules, (3) does not use the language that applies in the local area, (4) the sentences used do not offend a person's personality, ethnicity, race, and religion. The value given by each validator is analyzed using V Aiken's so that the validity value for the language aspect is obtained as shown in Table 7.

Table 7. Aiken's V Value Aspects of Language

Question Number	V Aiken's Value	Category
1-17	0.96	Very Valid

Base on Table 7 Aiken's V value for the content validity of the language aspect obtained from 3 experts tends to be stable, which is at a value of 0.958333, which if we look by category, then this value is included in the very valid category. Furthermore, to be clearer and to be able to see the comparison between one aspect and another for each item, the researcher made a bar chart based on the values obtained from 3 validators, as shown in Figure 5.

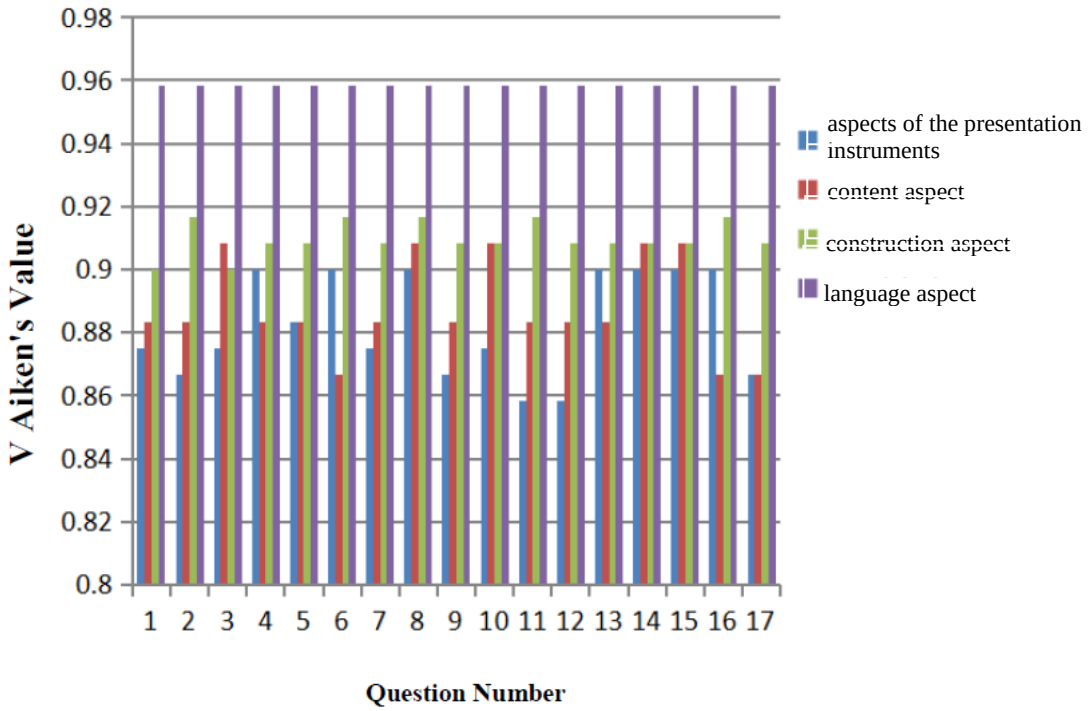


Figure 5. Content Validity

In conducting this one-to-one test, the product was tested on 3 sample students who are currently studying at SMAN 12 Padang. The requirements for this sample are that students have studied straight motion material at their school, besides that these 3 students are also students who have low ability, medium ability, and high ability which are assessed based on UH scores and practice scores at school. The results of this practicality test are shown in Table 8.

Table 8. Practicality test results

No	Rated aspect	Total Score	Mark (%)	Category
1.	**Convenience**			
	The instructions for the five-tier multiple choice instrument are easy to understand.	15	100	Strongly agree
	The questions presented are easy to understand.	13	86.67	Strongly agree
	Easy answer filling	13	86.67	
2.	**Attractiveness**			
	The design of the five-tier multiple choice instrument is attractive.	14	93.33	Strongly agree
	The display of the contents of the five-tier multiple choice instrument is neatly arranged.	14	93.33	
	The type of font used is clear and attractive	13	86.67	
	Interesting picture illustration	13	86.67	
	The color display on the five-tier multiple choice instrument is attractive	12	80	agree
3	**Efficiency**			
	the five-tier multiple choice instrument streamlines the teacher's time to assess students' conceptual understanding	14	93.33	Strongly agree
4.	**Benefit**			
	a five-tier multiple choice instrument can be used to assess concept understanding	13	86.67	Strongly agree
	a five-tier multiple choice instrument can be used to identify misconceptions	14	93.33	

Based on Table 8, it can be seen that the scores obtained for each item ranged from 12 to 15 from the maximum score of 15. After searching for the percentages ranging from 80% to 100%, which means it can be concluded that the product is practical for assessing students' conceptual understanding, especially in straight motion material.

Discussion

Based on the literature study, it was found that students in physics material still had misconceptions and did not understand the concept. which states that students in understanding the material often experience difficulties, so that students do not understand the material or there are misconceptions in their understanding (Fortuna et al., 2013; Rohmah & Handhika, 2018). Based on the results of a preliminary study conducted by giving questionnaires to 3 teachers who teach physics at SMAN 12 Padang, it was found that teachers still rarely do tests to analyze students' conceptual understanding, this is caused by several factors. The factor that causes teachers to rarely analyze students' conceptual

understanding is the lack of time to analyze this understanding because it takes a long time, teachers have problems in identifying students' conceptual understanding so that diagnostic tests are needed to facilitate identification (Nurulwati & Rahmadani, 2020; Suparman, 2016). In addition, teachers are still not too familiar with several methods that can be used in analyzing students' conceptual understanding. who stated that in the learning process students often experience misconceptions but the teacher does not realize it and does not know how to diagnose these misconceptions (Erwinsyah et al., 2020; Rohmah & Handhika, 2018).

In identifying students' conceptual understanding, the most recent and most widely used method is to use a five-tier multiple choice instrument which has the characteristics of 5 levels of questions for each item. The research conducted by previous study is a two-tier multiple choice instrument whose test instrument consists of 2 levels of questions, namely tier-1 in the form of questions and answer choices and tier-2 in the form of reasons for the answers given (Dirman et al., 2022). The disadvantage of this research is that there is still an opportunity for students to guess the answers to the questions given so that it is less accurate to analyze students' understanding of concepts. In addition, this two-tier also have a weakness to analyze or understand the reasons given by students. The next research carried out is a three-tier multiple choices namely questions and answers at the first level, the reason for choosing the answer at the second level, the level of confidence in giving answers to the first level (Nurulwati & Rahmadani, 2020). The disadvantage of this study is that students can only provide an overall level of confidence so that the rater cannot detect if they have different levels of confidence in giving answers. The drawback of this test is that the three-level multiple-choice diagnostic test only allows students to choose a single level of confidence in choosing answers and reasons for each item (Dirman et al., 2022; Mufit, F; Asrizal, 2022).

This single level of confidence cannot detect if students have different levels of confidence in choosing answers and reasons. The research developed by other study is a four-tier multiple choice (Rusilowati, 2015). This instrument consists of 4 levels, namely the same as the three-tier instrument but added 1 more level, namely at the fourth level. At this fourth level, namely the level of student confidence in giving reasons for answers. This four-tier multiple choice instruments are quite accurate in analyzing students' conceptual understanding. However, this instrument is still not perfect because we as educators only know understanding of students' concepts without knowing where students do not understand the material and misconceptions in the material. In addition to this four-tier instrument, it has a drawback, namely it is difficult to detect students who do not understand the concept with misconceptions (Guswina & Mufit, 2020; Jubaedah et al., 2017). The four-tier data processing process is less efficient because the teacher must conduct interviews to synchronize student answers, whether due to experiencing misconceptions or due to ignorance of the concept. The five-tier multiple choice instrument was tested by expert review by an expert validator, the instrument was obtained which was very valid from the aspect of instrument presentation, content aspect, construction aspect, and language aspect and was practical through one-to-one test results in terms of convenience, attractiveness, and efficiency. The limitations in this study are that researchers have not tested this product in the real field so that results have not been obtained on the percentage of students' conceptual understanding, especially in straight motion materials.

4. CONCLUSION

The five-tier multiple choice instrument has the characteristics of consisting of five-tiers, tier-1 is a question/statement equipped with multiple choices, tier-2 is the level of confidence in choosing an answer, tier-3 is the reason students give that answer, tier-4 is the

level of confidence students give reasons and tier-5 is confirmation of student answers which can be in the form of conclusions or pictures. The results of the five-tier multiple choice instrument validity test on straight motion material are at high validity criteria in terms of content, construct, and language. This means that the learning instrument has met the criteria of relevance and consistency. The results of the five-tier multiple choice instrument test on straight motion material are in the criteria of high practicality and meet the criteria of convenience, usefulness, and usability.

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