Analysis of Students' Misconception and Strategic Thinking Skill on Parabolic Motion Material Using Two-Tier Multiple Choice Items Instrument

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Abstract. This study aims to develop an instrument test in the form of two-tier multiple-choice items that can be used to analyze students' misconceptions and measure students' strategic thinking skills. This research uses the research and development method with the ADDIE model. The resulting test instrument has ten questions that refer to indicators of strategic thinking skills. The results of the validation of the average score of 89.20% with very good criteria. The results of the Rasch Model analysis report that the test instrument that has been developed is declared feasible with acceptable criteria, all items that have been developed have reliability in the good category, and all items that have been developed are valid. The results of the Rasch Model analysis are also informed that in the implementation of the test, it is implausible that cheating, carelessness, and lucky phenomena will occur when doing the test. The results of the Rasch Model analysis also group students into three, namely high, medium, and low abilities, which convey information on students' strategic thinking skills. The analysis results showed that 13.64% of students understood the overall concept of parabolic motion, 69.32% of students had misconceptions about the parabolic motion material, and 11.36% of students did not understand the parabolic motion material at all. The remaining 5.68% cannot be predicted with certainty whether the student understands, has misconceptions, or does not understand at all. This study concludes that the two-tier multiple choice items instrument developed is valid, reliable, and feasible to be used in analyzing students' misconceptions and measuring students' strategic thinking skills on parabolic motion material.

1. Introduction
Today, education in Indonesia is growing. Even during this pandemic, education in Indonesia must continue to be developed. Many studies have contributed to the world of education. Many educational products are able to analyze problems in the learning process, such as students' misconceptions. In addition, many educational products can foster important abilities that students should possess, one of which is strategic thinking skills.

Student misconceptions are one of the urgent problems to be discussed. Misconceptions become a critical issue to be discussed because the concepts that have been obtained previously can affect the new concepts that will be obtained [1]. There are still many students who often experience misconceptions [2]. Misconceptions have a significant impact on student performance in learning [3]. Misconceptions in students contribute to causing other errors that students will face [4].
Misconceptions in students can also make students frustrated [5]. This, of course, clearly states that misconceptions hinder students in the learning process [6,7]. Strategic thinking skill can sort out problems and find the right solution to solve these problems. Strategic thinking skills usually consist of correct data, analyze problems, and structured ways to solve these problems [8]. Strategic thinking skills are the ability to think creatively, critically, and analytically, which triggers solving a problem [9,10].

Parabolic motion is one of the most challenging physics materials. The preliminary study results showed that 137 out of 162 students stated that the parabolic motion material was problematic. The previous study results also showed that the average score on the Daily Test material for the parabolic motion was low, namely 53.

In order to solve these two problem topics, a new research product is needed that can analyze students' misconceptions and students' strategic thinking skills. One product that can be developed is a test instrument in the form of two-tier multiple-choice items. Based on the descriptions above, this study aims to develop a test instrument in the form of two-tier multiple-choice items that can be used to analyze students' misconceptions and measure students' strategic thinking skills.

2. Method
This research uses the research and development method with the ADDIE model. The ADDIE model was chosen because it is easy to implement [11]. The ADDIE model consists of five steps: Analyze, Design, Development, Implementation, and Evaluation.

In the analyze stage, this research begins by analyzing the needs and problems that are often encountered in the world of education. At this stage, it is known that the problem of misconceptions and strategic thinking skills is one of the problems that must be solved. The solution offered is the development of a test instrument in the form of two-tier multiple-choice items. At the design stage, this study develops a blueprint of the test instrument in the form of two-tier multiple-choice items that will be developed. At the development stage, the test instrument in two-tier multiple-choice items began to be developed. After being developed, the test instrument will be theoretically validated by several experts to determine its feasibility. At the implementation stage, the theoretically validated test instrument will be tested on many students. The test results will then be analyzed using the Rasch Model measurement model, which focuses on determining students' validity, reliability, and strategic thinking skills. The results of the trial will also be analyzed to determine the possibility of student misconceptions. At the evaluation stage, an evaluation of each step has been carried out to conclude at each stage.

3. Results and Discussion
3.1. Two-Tier Multiple Choice Items Instrument
This research produces educational products in the form of two-tier multiple-choice items instrument. The resulting test instrument has ten questions. Each item developed refers to indicators of strategic thinking skills. Each item has two levels of answers. The first level requires students to provide answers to the problems given. The second level requires students to give reasons in choosing the answers given at the first level.
3.2. Theoretical Validation

The test instrument that has been developed will then be validated theoretically by several experts. The validation results show an average score of 89.20%, with very good criteria. The score is divided into material aspects of Physics by 89.58%, media aspects by 86.36%, and assessment aspects by 91.67%, with all three having very good criteria.
3.3. Rasch Model Analysis

The test instrument that has been declared valid is then tested on many students. The answers given by students will be analyzed using the Rasch Model measurement model.

3.3.1. Unidimensionality. The Rasch model provides information about whether or not a test instrument that has been developed is valid. The results of the Rasch Model analysis give a unidimensionality value of 21.07%. This value informs that the test instrument that has been developed is declared feasible with acceptable criteria.

3.3.2. Item Reliability. The Rasch model provides information about the reliability of the items that have been developed. The results of the analysis of the Rasch Model give an item reliability value of 0.83. This value informs that all the items that have been developed have good reliability.

3.3.3. Item-Fit. The Rasch model provides information about whether or not each item developed is valid. The results of the Rasch Model analysis show that each item developed meets at least one of the item-fit criteria. This informs that all the questions that have been developed are valid.

3.3.4. Person-Fit. The Rasch model provides information about whether or not students taking the test are valid in working on the test instrument that has been developed. The results of the Rasch Model analysis show that each student taking the test meets at least one of the person-fit criteria. This informs that every student taking the test has a fit ability. It also informs that in implementing the test, it is implausible that cheating, carelessness, and lucky phenomena will occur when taking the test.

3.3.5. Person Measure. The Rasch model provides information about the abilities of each student taking the test. The results of the Rasch Model analysis classify test-taking students into three categories. The categories are categories of students with high, medium, and low abilities. The results of the Rasch Model analysis regarding student abilities also inform students' strategic thinking skills.

3.4. Students' Misconception

The answers obtained from the test results are also used to obtain how big the student's concept is. The analysis results showed that 13.64% of students understood the whole concept of parabolic motion, 69.32% of students had misconceptions about the parabolic motion material, and 11.36% of students did not understand the parabolic motion material at all. The remaining 5.68% cannot be predicted with certainty whether the student understands the concept, has misconceptions, or does not understand at all. The results of the analysis for each item are as follows.

| Item Number | Fully Understanding (%) | Misconception (%) | No Understanding (%) | Unpredictable (%) |
|-------------|-------------------------|-------------------|----------------------|-------------------|
| 1           | 25.00%                  | 56.82%            | 11.36%               | 6.82%             |
| 2           | 6.82%                   | 78.41%            | 13.64%               | 1.14%             |
| 3           | 18.18%                  | 53.41%            | 23.86%               | 4.55%             |
| 4           | 4.55%                   | 88.64%            | 4.55%                | 2.27%             |
| 5           | 7.95%                   | 81.82%            | 5.68%                | 4.55%             |
| 6           | 20.45%                  | 35.23%            | 29.55%               | 14.77%            |
| 7           | 1.14%                   | 84.09%            | 10.23%               | 4.55%             |
| 8           | 12.50%                  | 72.73%            | 5.68%                | 9.09%             |
| 9           | 12.50%                  | 78.41%            | 7.95%                | 1.14%             |
| 10          | 18.18%                  | 63.64%            | 4.55%                | 13.64%            |
3.5. Discussion

This research produces educational products in the form of two-tier multiple-choice items instrument. The resulting test instrument has ten questions. Each item developed refers to indicators of strategic thinking skills. Each item has two levels of answers. The first level requires students to provide answers to the problems given. The second level requires students to give reasons in choosing the answers given at the first level.

Based on some previous studies, the development of a two-tier multiple-choice items instrument can measure High Order Thinking Skills (which requires strategic thinking skills) [12–14] and also student scientific literacy [15]. This is in line with a study that states that developing a two-tier multiple choice item instrument can help identify students' misconceptions [16]. This certainly supports that with developing a two-tier multiple-choice item instrument, measurement of strategic thinking skills and analysis of student misconceptions can be carried out.

The test instrument that has been developed will then be validated theoretically by several experts. The validation results show an average score of 89.20%, with very good criteria. The score is divided into material aspects of Physics by 89.58%, media aspects by 86.36%, and assessment aspects by 91.67%, with all three having very good criteria. These results inform that when viewed from the aspect of physics material, media aspect, and assessment aspect, the two-tier multiple-choice items instrument that has been developed can be declared feasible with very good criteria.

The results of the Rasch Model analysis give a unidimensionality value of 21.07%. This value informs that the test instrument that has been developed is declared feasible with acceptable criteria. The results of the analysis of the Rasch Model also provide an item reliability value of 0.83. This value informs that all the items that have been developed have good reliability. In addition, the results of the Rasch Model analysis show that each item developed meets at least one of the item-fit criteria. This informs that all the questions that have been developed are valid. Based on the study results, the two-tier multiple-choice items instrument can be declared valid, reliable, and can be used in the learning process.

The results of the Rasch Model analysis are also able to show that each student taking the test meets at least one of the person-fit criteria. This informs that every student taking the test has a fit ability. It also informs that in implementing the test, it is implausible that cheating, carelessness, and lucky phenomena will occur when taking the test. The results of the Rasch Model analysis classify test-taking students into three categories. The categories are categories of students with high, medium, and low abilities. The results of the analysis of the Rasch Model also inform students' strategic thinking skills. Based on the results of this study, the two-tier multiple-choice items instrument that has been developed can measure students' strategic thinking skills.

Strategic thinking skills have proven to be one of the skills needed to face challenges in this era of globalization [17]. Students' strategic thinking skills are proven to change student behaviour in digging for information [18]. Strategic thinking skills are currently needed; given that evaluation questions are developed with the HOTS category, students must think strategically in solving a problem. [19]. Several opinions above indeed become the basis that the need for a tool to measure students' strategic thinking skills is critical. So that with the development of the two-tier multiple-choice items instrument has answered the problem of measuring students' strategic thinking skills.

The answers obtained from the test results are also used to obtain how big the student's concept is. The analysis results showed that 13.64% of students understood the whole concept of parabolic motion, 69.32% of students had misconceptions about the parabolic motion material, and 11.36% of students did not understand the parabolic motion material at all. The remaining 5.68% cannot be predicted with certainty whether the student understands the concept, has misconceptions, or does not understand at all. Based on the study results, the two-tier multiple choice items instrument that has been developed can also analyze the students' misconceptions.

Students' misconceptions have become a common phenomenon in the learning process [20]. Misconceptions of a concept have been shown to affect student performance [21] directly. Identifying misconceptions in students can help teachers determine gaps in the curriculum [22]. If the misconception is maintained, then the concept to be studied next will be wrong and create difficulties in the learning process [23]. This is supported by recommendations from a previous study that asked...
to pay attention to the learning model to minimize misconceptions in students [24]. So with the development of a two-tier multiple-choice item instrument, it can help teachers analyse students who have misconceptions.

4. Conclusion
Based on the results of the research that has been obtained and the discussions that have been described, it can be concluded that the two-tier multiple-choice items instrument that has been developed is valid and reliable. The two-tier multiple-choice items instrument that has been developed is also suitable for analyzing student misconceptions and measuring students' strategic thinking skills on parabolic motion material.

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