JPPIPA 12(2) (2026)

Jurnal Penelitian Pendidikan IPA

http://jppipa.unram.ac.id/index.php/jppipa/index

Development of Instrument Test to Measure Student's Critical Thinking Ability in Solar System Material

Yonatan Vari[1*], Toni Dwi Fauzi[1]

[1] Department of Physics Education, Faculty of Teacher Training and Education, Palangka Raya University, Palangka Raya, Indonesia.

Received: August 15, 2025
Revised: January 28, 2026
Accepted: February 25, 2026
Published: February 28, 2026

Corresponding Author:
Yonatan Vari
yonatan.vari@fkip.upr.ac.id

DOI: 10.29303/jppipa.v12i2.12542

Abstract: Industrial Revolution (IR) 4.0 Era required student to develop critical thinking ability. Indonesian student have a very low ranking PISA in critical thinking ability. The Development of student's critical thinking need to be done through habituation of learning process to use critical thinking instrument test. Objective of this research is 1) feasibility of critical thinking instrument 2) Measuring students' critical thinking abilities in each indicator of critical thinking abilities developed 3) Instrument quality testing includes difficulty level, discrimination power, and reliability. The development research method used limited to the development stage. It does not reach the full implementation and evaluation stages. This instrument was tested for its feasibility by lecturers and teachers using the Aiken V index, and its quality was tested involving eighth-grade students of SMP Negeri 8 Palangka Raya. The findings obtained in the study include 1) the suitability of the critical thinking instrument for use; 2) Students' critical thinking abilitys are low in each indicator; 3) The quality test shows the need for improvement of the test instrument on 2 questions in the pre-test and 6 questions in the post-test because they have low discriminatory power. This research contributes to outlining the need for instrument quality testing stages in developing critical thinking instruments in addition to the validation stage. Based on the existing findings, it can be concluded that the developed test instrument has undergone improvements based on the validation stage and the instrument quality testing stage used to measure students' critical thinking abilitys on the solar system material, so that it can be a measuring tool that supports the development of science learning that improves students' critical thinking abilitys.

Keywords: Critical thinking ability; Instrument critical thinking; Test instrument

Introduction

The Industrial Revolution (IR) 4.0 era is an era of Digital Technology, Internet of Things (IoT) and Artificial Intelligence experiencing rapid development (Hermawan, 2021). The development of digital technology and IoT causes information to be distributed widely and quickly. The rapid development of the information distribution process in IR 4.0 is a new challenge for the world of education, especially for students. Students in the IR 4.0 Era are expected to have the ability to process and evaluate any informatio obtained outside. Potter (2010) suggests that every process in evaluating and making decisions based on the right information requires critical thinking ability (Poernomo et al., 2018) The ability to think critically is an ability that is needed in solving various problems of human life.

Critical thinking ability as one of the abilities needed in the IR 4.0 Era can be developed through science learning. Science learning has the aim of directing students to have critical thinking ability (Julianto et al., 2023). Students' critical thinking ability can be known through measurement based on an indicator. Critical thinking ability according to Facione et al. (2013) is self-regulation in deciding something that results in interpretation, analysis, evaluation, and inference, as well as explanation using evidence,

How to Cite:
Vari, Y., & Fauzi, T. D. Development of Instrument Test to Measure Student's Critical Thinking Ability in Solar System Material. *Jurnal Penelitian Pendidikan IPA*, *12*(2), 97-105. https://doi.org/10.29303/jppipa.v12i2.12542

concepts, methodologies, criteria, or contextual considerations that are the basis for making decisions (Nuryanti et al., 2018) Indicators in developing critical thinking ability include interpretation, explanation, analysis, inference and evaluation.

The critical thinking ability of Indonesian students based on PISA conducted by OECD in 2019 showed that Indonesia was ranked 72 out of 79 countries (Lestari & Annizar, 2020) The PISA scores obtained by Indonesian students are in accordance with the initial preliminary study conducted by researchers that most students' critical thinking ability are in the low category. Based on interviews and observations conducted by researchers, teachers rarely develop questions that develop critical thinking ability so that students are not familiar with critical thinking ability test instruments.

The development of critical thinking ability test instruments requires developing test instruments that meet validity and reliability standards (Kurniahtunnisa et al., 2024). Validity is needed to ensure that the instrument actually measures the intended ability, while reliability is needed to demonstrate the consistency of the measurement results (Herdiansyah et al., 2025). The learning material selected in the development of the critical thinking ability test instrument is the solar system material.

The solar system is one of the subjects taught in science in junior high schools. It is a subject that continues to evolve with the latest discoveries in the space field. The abstract concepts in the solar system learning material require the development of critical thinking instruments that provide illustrations of phenomena found in the solar system. The instrument development differs from the test instruments in previous studies conducted by Pradana et al. (2017), Prasetya et al. (2022), and Rif'atul et al. (2024) where the learning material did not require illustrations in the test instruments. The development of critical thinking test instruments for solar system materials requires illustrations that meet the Facione indicators used, namely interpretation, analysis, explanation, conclusion, and evaluation. The critical thinking instrument developed in this study presents novelty in three main aspects: (1) development of a critical thinking instrument based on illustrations of solar system phenomena linked to news issues about astronomical phenomena that arise in society, (2) systematic integration of Facione indicators in each test item, and (3) testing the quality of the instrument through comprehensive psychometric analysis. This approach is expected to provide a methodological contribution to the development of critical thinking assessment instruments in junior high school science learning.

Based on the description above, the aim of this research is to develop a critical thinking ability test instrument that meets the following criteria: 1) the feasibility of the critical thinking instrument, 2) the test instrument can measure students' critical thinking abilities on each indicator of critical thinking abilities developed, and 3) the quality of the critical thinking instrument. The implication of the research is that the developed test instrument can measure critical abilities by using illustrations related to phenomena that arise in everyday society so that students' critical thinking skills are measured in a relevant context and not only against existing concepts.

Method

Time and Location

This research was conducted at SMP Negeri 8 Palangka Raya on students of grades VIII.8 and VIII.9 in the second semester of the 2024/2025 academic year in January. Both classes were selected using a random sampling technique. The random sampling method is a sampling method that is carried out randomly because all members of the population have an equal chance of being selected (Asrulla et al., 2023).

Research Methods

This research is a type of development research that uses the ADDIE model. The research design used is ADDIE consisting of 5 main steps, namely Analysis, Design, Development, Implementation, and Evaluation (Martatiyana et al., 2023).The development research method used limited to the development stage. It does not reach the full implementation and evaluation stages.

In the development phase, data was collected using a validator assessment questionnaire for the critical thinking skills instrument, namely the pre-test and post-test critical thinking skills. Based on the feasibility test results, instrument quality testing was conducted, including difficulty level, discriminating power, and reliability.

Research Stages

The development of Critical Thinking Ability Instruments is at the analysis, design and development stages. The description of each stages are showed in figure 1.

Development of student critical thinking ability test instruments at the Analysis stage through interviews, observations and questionnaires to students and teachers. The distribution of questionnaires to teachers and students was carried out with the aim of knowing the needs of students for instruments that measure critical thinking ability and become a basic reference in the learning media design process. The results of the analysis stage are followed up with the design stage.

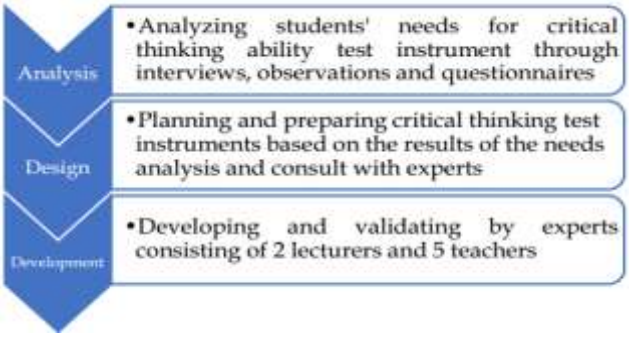

Figure 1. Research stage

The design stage is the stage where researchers plan and prepare critical thinking test instruments based on the results of the needs analysis and consult with experts. Based on the development stage, researchers develop critical thinking abilitys test instruments. At the development stage, the planned instrument was then developed and validated by experts consisting of 2 lecturers and 5 teachers. Lectures are experts in instrument development and are experts in the material and construction aspects of test instruments. Teachers who serve as validators are teachers who have more than 15 years of teaching experience. Teachers who serve as validators are those who are linguistically competent to assess whether the questions presented can be understood by students.

The validated critical thinking ability test instrument at the development stage was then piloted on students in grades VIII.8 and VIII.9. The pilot test was conducted on both classes to measure students' critical thinking abilities across each indicator and the quality of the test instrument. Therefore, a pre-test and post-test were not administered to one class because there had been no improvement efforts in the development of this instrument.

Data Analysis

The data collected during the research phase included the validation and quality testing of the critical thinking ability test instrument. The validation results were analyzed using Aiken V with the critical thinking ability test instrument items is declared valid if the V value> 0.82 (Aiken, 1985). Test instruments deemed suitable for use were then subjected to instrument quality testing, which included the level of difficulty, discriminatory power, and reliability of the instrument. The quality of critical thinking ability instruments including reliability, differentiation, and difficulty levels instrument using the Iteman application. An instrument is declared as a reliable instrument if the test reliability coefficient is at 0.70 or more (Azwar, 2011). The level of difficulty (P) of the item is seen from the value of Prop. Correct with the help of the Iteman program (Purniasari et al., 2021). The results of the analysis of the level of difficulty of the Iteman program are interpreted according to the classification in the table as follows.

Table 1. Criteria for Difficulty Index (P) (Magdalena et al., 2021; Purniasari et al., 2021)

Difficulty Index (P)	Criteria
0.00 - 0.30	Difficult
0.31 - 0.70	Medium
0.71 - 1.00	Easy

The distinguishing power (D) of the question is seen from the point biserial value with the help of the Iteman program (Purniasari et al., 2021). The results of the differentiating power analysis of the Iteman program are interpreted according to the classification in the Table as follows.

Table 2. Classification of Differentiating Power (D) of Test Items (Magdalena et al., 2021; Purniasari et al., 2021)

Differentiating Power (D)	Criteria
Negatively marked	Very Bad
0 - 0.19	Not Good
0.20 - 0.39	Fair
0.40 - 0.69	Good
0.70 - 1.00	Excellent

Testing the quality of the critical thinking ability instrument was carried out using a one group pre-test post-test design (Bile & Suharharjana, 2019) where there was an initial objective multiple choice test before students were given treatment using inquiry-based learning media to determine students' initial critical thinking ability, and a final test. The results of testing the quality of the instrument from the development stage are used to state whether the critical thinking ability instrument in science learning is feasible to use or not. The critical thinking ability instrument which is declared feasible is then carried out an Instrument Quality Test which includes Differentiating Power and Level of Difficulty to find out which instrument items are fallen or not.

Result and Discussion

Development of Critical Thinking Ability Instruments is at the analysis, design and development stages. The analysis stage of the development process began with a preliminary study, which involved administering a questionnaire to teachers. The results of the questionnaire indicated that teachers had never developed a critical thinking ability test instrument. The results of the questionnaire are one of the reasons for the low level of students' critical thinking ability based on PISA because students are not used to being given tests that develop students' critical thinking ability.

Based on Analysis Based on the analysis results, the researcher designed a critical thinking ability test instrument based on Facione indicators. The Facione indicators of students' critical thinking ability iconsist of; 1) Interpretation (Interpretation), 2) Analysis, 3) Evaluation, 4) Inference and 5) Explanation. Researchers defined critical thinking ability indicators and then created sub-indicators that were developed into operational terms in the question indicators. The operational terms in the question indicators play a role in ensuring that the critical thinking ability test instrument development stage aligns with the critical thinking indicators. The indicator table containing definitions and sub indicator used as the design of the critical thinking ability test instrument is in the following table.

Table 3. The Indicator Table Containing Definitions and Sub Indicator (Facione et al., 2013)

Indicator	Definition	Sub Indicator
Interpretation	The ability to understand and convey the meaning of a problem or phenomenon that occurs.	Interpreting information
Analysis	the ability to identify ideas or arguments to be analyzed and tested in order to express beliefs, decisions, reasons, information or opinions.	Identify arguments analyze arguments
Inference	The ability to search for and collect important elements used in drawing a conclusion or making a temporary assumption (hypothesis) while still using relevant information as a reference.	Predicting Alternatives Make decisions/conclusions
Evaluation	The ability to assess the credibility of a statement, fact or information through inductive and deductive reasoning.	Assessing the facts of information Assessing the quality of information
Explanation	The ability to state the results of one's process, the ability to present a statement based on evidence, concepts, methodologies, and certain criteria; to present one's reasons with convincing arguments.	Stating the results Explaining the procedure Explaining the arguments

The development stage of the student critical thinking ability instrument is compiled with a student critical thinking ability test instrument consisting of Pre-test and Post-test. The development of critical thinking ability test instruments is adapted to the abstract material of the solar system, so that in the test instrument development stage, researchers develop illustrations that are adapted to the items in the test instrument so that it makes it easier for students to visualize the context of the abstract Solar System material.

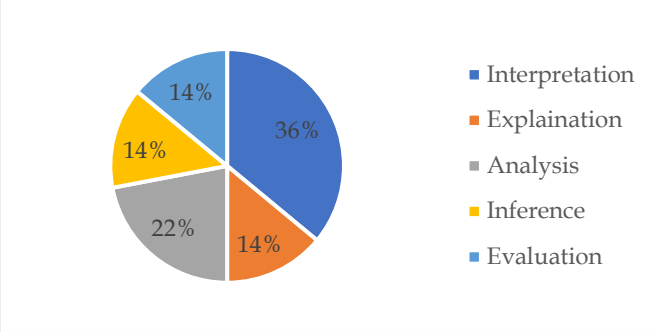

Figure 2. Distribution of critical thinking indicators on test items

The student critical thinking test instrument consists of 15 items of the initial test (PreTest) and 15 items of the final test (Post-Test) which are in accordance with the indicators of students' critical thinking ability including; 1) Interpretation, 2) Analysis, 3) Evaluation, 4) Inference and 5) Explanation. Indicators of critical thinking ability are distributed in 15 items of the Pre-Test and Post-Test of the critical thinking ability instrument developed as in the figure 2.

The initial test (Pre-Test) and the final test (Post-Test) used parallel item indicators in measuring students' critical thinking abilitys. The test instrument was validated by two expert lecturers, and 5 teachers from SMP Negeri 2 Palangka Raya, SMP Negeri 8 Palangka Raya and SMP Katolik Santo Paulus Palangka Raya as validators to assess the feasibility of the test items of students' critical thinking ability instruments.

The results of the assessment given by the validator were then analyzed using Aiken V statistics (Azwar, 2011). Based on the analysis using Aiken V statistics, it is obtained that all items of the student critical thinking ability test instrument are in the valid criteria in the table 4.

The critical thinking abilitys instrument feasibility assessment questionnaire has several aspects including material, construction and language aspects to be declared a critical thinking abilitys instrument worth using. The material aspect in the critical thinking test instrument is in accordance with the learning material implemented during the learning process. The construction aspect in the critical thinking test instrument reviews the preparation of test items and answer choices. The language aspect is used to determine the use of language in the test instrument can be understood, does not cause misinterpretation and is in accordance with Indonesian language rules. The results of item validity in each aspect show that the critical thinking ability instrument is on valid criteria as shown in the table 5.

Table 4. Critical Thinking Ability Test Instrument Validity Results

Pre-Test Item	Pre-Test Validity	Description	Post-Test Item	Post-Test Validity	Description
1	0.96	Valid	1	0.97	Valid
2	0.96	Valid	2	0.96	Valid
3	0.94	Valid	3	0.94	Valid
4	0.96	Valid	4	0.97	Valid
5	0.94	Valid	5	0.96	Valid
6	0.95	Valid	6	0.98	Valid
7	0.96	Valid	7	0.96	Valid
8	0.95	Valid	8	0.96	Valid
9	0.97	Valid	9	0.95	Valid
10	0.93	Valid	10	0.95	Valid
11	0.95	Valid	11	0.96	Valid
12	0.99	Valid	12	0.98	Valid
13	0.95	Valid	13	0.95	Valid
14	0.96	Valid	14	0.96	Valid
15	1.00	Valid	15	1.00	Valid

Table 5. Aspects of Validity of Critical Thinking Ability Test Instrument

Aspects of Critical Thinking Ability Instrument	Pre-test Item Validity	Post-test Item Validity
Material Aspect	0.96	0.97
Construction Aspect	0.96	0.96
Language Aspect	0.94	0.95
Overall Aspect	0.95	0.96

Valid test instruments can be used to measure students' critical thinking ability. The eligibility results are in line with the opinion of Jazuli et al. (2015) which states the feasibility of developing critical thinking test instruments in terms of material and language in accordance with the stages of development research (Lestari et al., 2022). The valid test instrument was then tested the quality of the instrument by giving the pre-test instrument to class VIII.7 and post-test instrument to class VIII. 9 of SMP Negeri 8 Palangka Raya. The quality test given to students at the instrument development stage provides an overview of the abilities of class VIII.9 students at SMP Negeri 8 Palangka Raya with a description of the abilities per critical thinking ability indicator in the following figure.

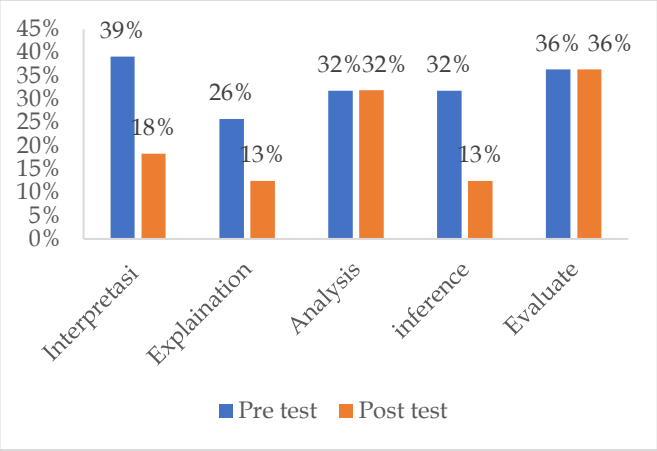

Figure 3. Percentage of indicators of students' thinking ability

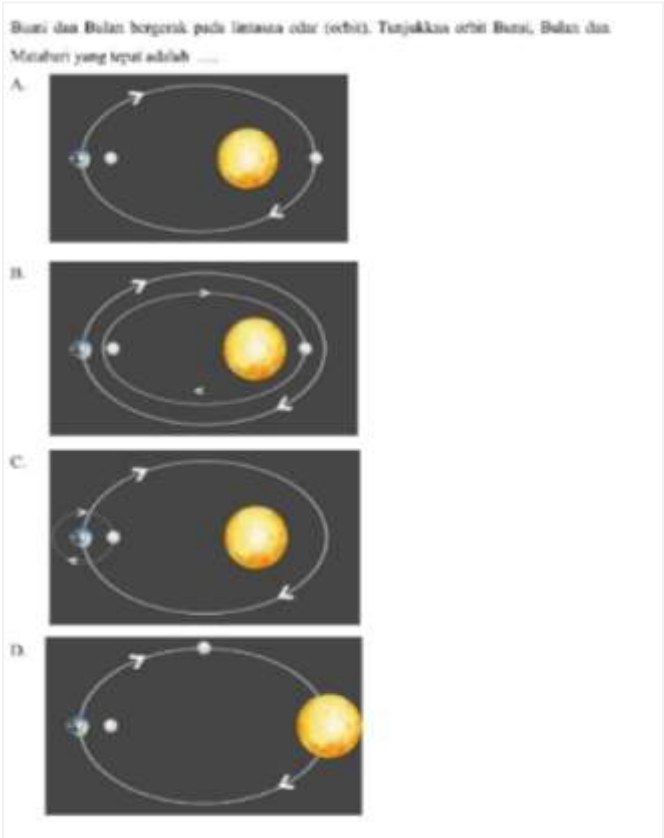

Figure 4. One of the interpretation indicator questions on students' thinking ability

The graph in the figure 3 shows that students have low critical thinking ability in all indicators. The graph in the image above shows that students have low critical

thinking ability across all indicators. These results align with Indonesia's PISA scores, which indicate low student abilities (Yusmar & Fadilah, 2023). Students' interpretation ability in understanding and expressing the meaning of various problems (Yennita et al., 2023) show a low percentage. The low level of students' interpretation ability can be seen in the test items shown in the following image, where students are asked to choose the correct illustration to interpret the position of the Earth and the Moon moving in an orbit.

The results of students' weak interpretation ability result in students' weak ability to explain a statement based on evidence or concepts reflected in the explanation indicators contained in the following image. The low level of students' ability in the explanation indicator was seen from one of the item, when students were asked to explain the reason why the left side of the Moon appeared brighter, after previously being given assistance in the form of illustrations. The explanation ability indicator falls into the "poor" category, as most students are not yet able to provide explanations related to the questions given to express their own thinking (Astuti et al., 2022).

Figure 5. One of the explaination indicator questions on students' thinking ability

The weak interpretation ability also have an impact on the low percentage of Analysis. Analysis Indicators show students' ability to identify relationships between available ideas or concepts (Susilowati et al., 2019; Arsyad, 2023). One of the analysis indicator items tested on students is to analyze the relationship between the elements that form the surface temperature of the planet Venus, which is the highest in the solar system. Analyisis indicator show that students do not yet have the ability to identify ideas for analysis and testing in order to express beliefs.

Students on the inference indicator show insufficient ability to draw conclusions or make tentative assumptions (hypotheses) based on relevant information. The result of students being unable to draw conclusions affects their inability to assess the credibility of a statement, fact, or information through the reasoning process, which is reflected in the evaluation indicators. The low percentage of students' critical thinking skills in the inference and evaluation indicators shows that students' thinking processes have not reached the stage of in-depth analysis (Zebua et al., 2024).

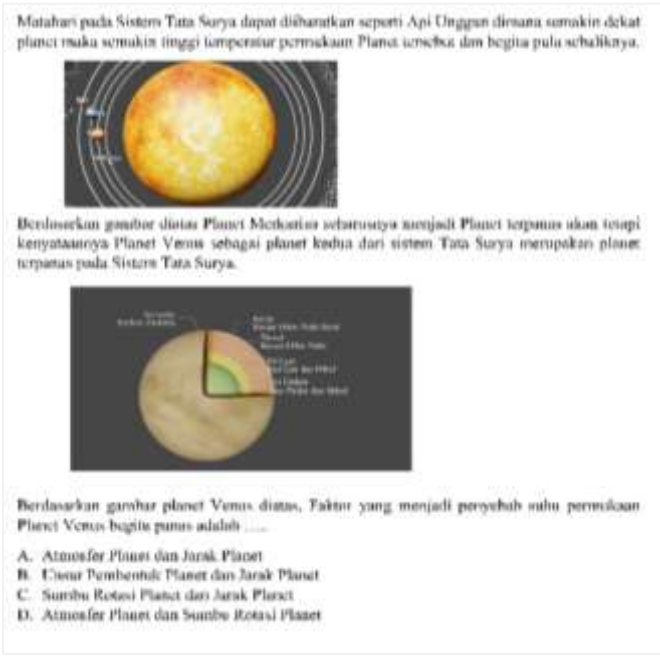

Figure 6. One of the analysis indicator questions on students' thinking ability

The results of the test instrument were analyzed using the Iteman application to determine the quality of the instrument. the quality of critical thinking ability instruments including reliability, differentiation, and difficulty levels. The pre-test and post-test instruments that were tested obtained a reliability of 0.78 and 0.81, so they can be stated as reliable instruments. an instrument that can measure what is to be measured accurately (validity) and produces consistent data (reliability) so that the measured data does not cause errors in drawing conclusions (Azizah & Chalimatusadiah, 2025). The developed instrument can be used but requires analysis of the level of difficulty and discriminatory power to see the quality of the questions. The table below shows the results of the analysis of the initial test instrument (Pre-Test) and the final test (Post-Test) of critical thinking ability using the Iteman Application.

Based on the results of data analysis conducted using the obtained that the initial test items and the final test have difficulty levels are in the medium and difficult criteria. The critical thinking test instrument does not have test items that are in the easy criteria. The

level of difficulty on the critical thinking ability test instrument which is in the medium and difficult criteria has several test items that have poor differentiating power. The low level of difficulty means that students with low and high abilities cannot be distinguished because the questions can be answered by both groups of students. The initial test on items number 6 and 10 and the final test on items number 4, 6, 7, 8, 9 and 13 have poor differentiating power.

Table 6. Critical Thinking Ability Instrument Quality Test Analysis Results

Test Item	Pre Test		Post-Test	
	Level Difficulties	Distinguishing Power	Level Difficulties	Distinguishing Power
1	0.500	0.669	0.292	0.621
2	0.364	0.325	0.250	0.385
3	0.455	0.528	0.333	0.455
4	0.500	0.561	0.167	0.134
5	0.227	0.249	0.125	0.217
6	0.182	0.179	0.167	0.195
7	0.409	0.353	0.083	0.007
8	0.227	0.379	0.167	0.134
9	0.227	0.335	0.208	0.068
10	0.318	0.143	0.458	0.620
11	0.500	0.380	0.520	0.491
12	0.227	0.249	0.167	0.257
13	0.182	0.320	0.083	0.173
14	0.364	0.250	0.083	0.339
15	0.364	0.475	0.125	0.356

The poor differentiating of the test items, based on the analysis results, indicates that some test items were difficult for students to understand, leading to students responding either correctly or incorrectly (Ashari, 2021). Furthermore, the distractors were not functioning effectively, allowing students who lacked understanding to guess correctly (Magdalena et al., 2021). so they need to be improved to be used in measuring students' critical thinking ability. The ability test instruments before and after the improvement process can be seen in the figure 7.

The improved test instrument as in the picture above is adjusted to the results of the analysis of the instrument test to then be used in the learning process in the classroom. The improvements made include suggestions and input from the validator in the feasibility test related to aspects of material, question construction and language and further improvements were made based on the instrument quality test in which improvements were made to the answer choice options that did not make students interpret that there were 2 correct answer choices and changing the answer options to ensure the effectiveness of the distractor could work well.

Test instruments that are valid and reliable and have been improved based on quality testing can be used to measure critical thinking abilitys. The development of critical thinking abilitys according to Sudjana in Lestari et al. (2022) requires a test instrument as a tool to measure and develop students' critical thinking abilitys. The development of test instruments that are suitable for use in the learning process needs to be done in order to obtain information about students' critical thinking abilitys accurately. The development of a feasible test instrument is supported by the opinion (Febriano et al., 2021) which states that the test instrument must be able to measure what you want to measure.

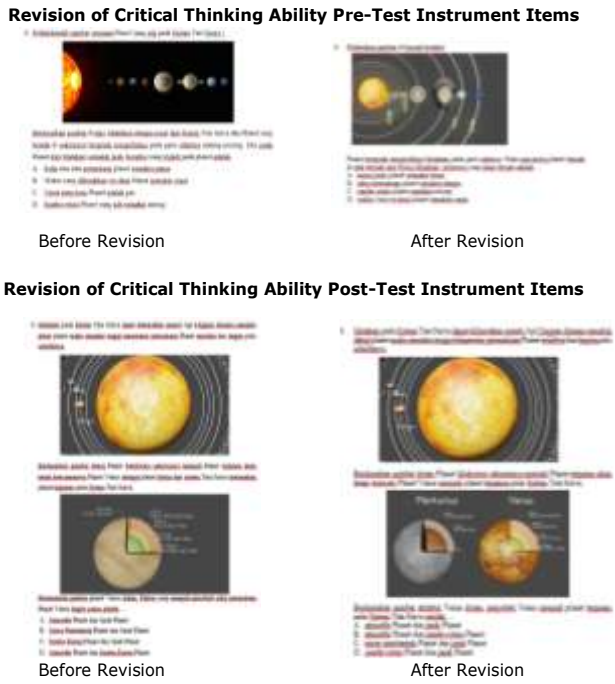

Figure 7. Revision of critical thinking instrumen test

The test instrument that has been developed has the aim of being a good measuring tool in measuring students' critical thinking abilities, but in the learning process, an appropriate learning model is still needed to improve critical thinking abilities. Developing students' critical thinking skills requires more effective learning strategies, such as integrating problem-based learning, inquiry learning, discovery learning, or collaborative learning methods to encourage critical thinking (Zebua et al., 2024).

Conclusion

Based on the results of the research and data analysis, it is known that all critical thinking ability test instruments, namely pre-test and post-test, are in valid criteria. Test items that are declared valid are tested for quality against the level of difficulty and distinguishing power. The results of critical thinking ability measurements validated by experts show that students' critical thinking abilities are low across all indicators. The seemingly large difference in percentage scores between the pre-test and post-test indicators requires testing the quality of the instruments. Instrument quality testing shows that the critical thinking ability test instruments need for improvement because there were several items that had distinguishing power in poor criteria. The development of the improved critical thinking ability test instrument is a test instrument that is suitable for use to measure students' critical thinking ability. The development of an improved critical thinking ability test instrument is suitable for measuring students' critical thinking abilities in the solar system material because in the test instrument illustrations are developed that are adjusted to the items in the test instrument so that it makes it easier for students to understand the context of the abstract Solar System material with the help of visualization.

Acknowledgments
The author would like to express his deepest gratitude to SMP Negeri 8 Palangka Raya for providing the opportunity to conduct a quality test of the critical thinking test instrument.

Author Contributions
The first author contributed to the development of the critical thinking skills instrument and collected data from the validator and trial of the test instrument. The second author contributed to the analysis of instrument feasibility data from the validation results and instrument quality data from the trial results.

Funding
This research was funded independently and did not receive funding from external parties

Conflicts of Interest
There is no conflict of interest.

References

Arsyad, M. (2023). Correlation between numerical interpretation and analysis abilities with critical analysis ability on biology education students. *BIO-INOVED : Jurnal Biologi-Inovasi Pendidikan*, *5*(2), 164–170. https://doi.org/10.20527/bino.v5i2.15476

Ashari, S. D. (2021). *Tingkat Kesukaran, Daya Pembeda dan Efektivitas Pengecoh Soal Ulangan Akhir Semester PJOK Kelas IV dan V SD Negeri Ngombol, Purworejo Tahun Ajaran 2020/2021*. Universiras Negeri Yogyakarta. Retrieved from https://eprints.uny.ac.id/71423/

Astuti, D. W., Zuhri, M. S., & Wulandari, D. (2022). Analisis Berpikir Kritis Siswa dalam Menyelesaikan Soal Open Ended Materi SPLTV Ditinjau dari Adversity Quotient. *Imajiner: Jurnal Matematika dan Pendidikan Matematika*, *4*(5), 393–400. https://doi.org/10.26877/imajiner.v4i5.10978

Azizah, N., & Chalimatusadiah, C. (2025). Uji Validitas dan Uji Reliabilitas Instrumen Penelitian Pemahaman Konsep Dasar Aljabar. *Jurnal Pendidikan Tambusai*, *9*(1), 6637–6643. https://doi.org/10.31004/jptam.v9i1.25533

Azwar, S. (2011). *Reliabilitas dan Validitas*. Pustaka Pelajar.

Bile, R. L., & Suharharjana, S. (2019). Efektivitas Penggunaan Model Latihan Kebugaran "Bbc Exercise" Untuk Pemeliharaan Kebugaran Jasmani Mahasiswa. *SPORTIVE: Journal of Physical Education, Sport and Recreation*, *3*(1), 30. https://doi.org/10.26858/sportive.v3i1.16857

Facione, P.A. & Gittens, C. A. (2013). *Think Critically*. Prentice Hall.

Febriano, R., Tandililing, E., & Enawaty, E. (2021). Pengembangan Instrumen Tes Kemampuan Berpikir Kritis Matematis dengan Menggunakan Analisis Model Rasch pada Siswa SMP. *Jurnal Pendidikan Dan Pembelajaran Khatulistiwa*, *10*(9), 1–12. https://doi.org/10.26418/jppk.v10i9.49587

Herdiansyah, A. A., Nurfauzi, D., Khoirunnisa, N. A., Putri, H. E., & Rahayu, T. G. (2025). Pengembangan Instrumen untuk Mengukur Kemampuan Berpikir Kritis Siswa melalui Konsep Operasi Hitung Perkalian dan Pembagian Pecahan pada Siswa Kelas VI SD 3 Babakan Sari. *Jurnal Review Pendidikan dan Pengajaran*, *8*(1), 191–200. https://doi.org/10.31004/jrpp.v8i1.41091

Hermawan, M. A. (2021). Analisis Respon Siswa Terhadap Pengembangan Media Pembelajaran Videoscribe Berpendekatan STEM Materi

Termodinamika. *Jurnal Penelitian Pembelajaran Fisika*, *12*(2), 138–142. https://doi.org/10.26877/jp2f.v12i2.8067

Julianto, Hidayati, F., Rahmawati, J. F., Cahyaningsih, R., & Surrahman, I. (2023). Melatih Kemampuan Berpikir Kritis Siswa Melalui Model Inkuiri untuk Meminimalisir Miskonsepsi IPA. *Jurnal Penelitian Pendidikan IPA*, *9*(11), 1011–1015. https://doi.org/10.29303/jppipa.v9i11.3757

Kurniahtunnisa Kurniahtunnisa, Zusje Wiesje Merry Warouw, & Musma Rukmana. (2024). Pengembangan Instrumen Tes Kemampuan Berpikir Kritis pada Materi Sistem Pernafasan. *Eduproxima (Jurnal Ilmiah Pendidikan IPA)*, *6*(2), 448–456. https://doi.org/10.29100/.v6i2.5224

Lestari, A. C., & Annizar, A. M. (2020). Proses Berpikir Kritis Siswa dalam Menyelesaikan Masalah PISA Ditinjau dari Kemampuan Berpikir Komputasi. *Jurnal Kiprah*, *8*(1), 46–55. https://doi.org/10.31629/kiprah.v8i1.2063

Lestari, D., Berlian, L., & Berlian, L. (2022). Pengembangan Instrumen Tes Kemampuan Berpikir Kritis Siswa Kelas VIII Pada Tema Maknanku Kesehatanku. *Biodik*, *8*(2), 81–89. https://doi.org/10.22437/bio.v8i2.17335

Lewis. R. Aiken. (1985). Three Coefficients For Analyzing The Reliability And Validity Of Ratings. *Educational and Psychological Measurement*, *45*(1), 131–141. https://doi.org/10.1177/0013164485451012

Magdalena, I., Fauziah, S. N., Faziah, S. N., & Nupus, F. S. (2021). Analisis Validitas, Reliabilitas, Tingkat Kesulitan dan Daya Beda Butir Soal Ujian Akhir Semester Tema 7 Kelas III SDN Karet 1 Sepatan. *BINTANG : Jurnal Pendidikan Dan Sains*, *3*(2), 198–214. https://doi.org/10.36088/bintang.v3i2.1291

Martatiyana, D. R., Usman, H., & Lestari, H. D. (2023). Application of the ADDIE Model in Designing Digital Teaching Materials. *Journal of Education & Teaching Primary School Teachers*, *6*(1), 105–109. https://doi.org/10.55215/jppguseda.v6i1.7525

Nuryanti, L., Zubaidah, S., & Diantoro, M. (2018). Analisis Kemampuan Berpikir Kritis Siswa SMP. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *3*(2), 155–158. https://doi.org/10.17977/jptpp.v6i3.14579

Poernomo, J. B., Rusilowati, A., & Saptono, S. (2018). The Development of Integrated Science Learning Instrument Based on Project-Based Learning to Measure Critical Thinking Skills. *International Conference on Science and Education and Technology 2018 (ISET 2018)*, *247*(Iset), 268–273. https://doi.org/10.2991/iset-18.2018.57

Pradana, S. D. S., Parno, P., & Handayanto, S. K. (2017). Pengembangan tes Kemampuan Berpikir Kritis pada Materi Optik untuk Mahasiswa Fisika. *Jurnal Penelitian Dan Evaluasi Pendidikan*, *21*(1), 51–64. https://doi.org/10.21831/pep.v21i1.13139

Prasetya, P. M., Parmiti, D. P., & Bayu, G. W. (2022). Terpikir STEM: Instrumen Tes Berpikir Kritis IPA Berorientasi Pendekatan STEM. *Jurnal Ilmiah Pendidikan Profesi Guru*, *5*(2), 363–371. https://doi.org/10.23887/jippg.v5i2.50063

Purniasari, L., Masykuri, M., & Ariani, S. R. D. (2021). Analisis Butir Soal Ujian Sekolah Mata Pelajaran Kimia Menggunakan Model Iteman dan Rasch. *Jurnal Pendidikan Kimia*, *10*(2), 205–214. https://doi.org/10.20961/jpkim.v10i2.48244

Rif'atul, N. M., & Setyarsih, W. (2024). Analisis Butir Soal Instrumen Tes Kemampuan Berpikir Kritis Siswa Pada Tema Usaha Kuliner Penerapan Materi Suhu dan Kalor. *Inovasi Pendidikan Fisika*, *13*(1), 8–13. https://doi.org/10.26740/ipf.v13n1.p6-13

Susilowati, N., Rochmad, R., & Rusilowati, A. (2019). Kemampuan Berpikir Kritis Peserta Didik pada Pembelajaran Learning Cycle 7E dengan Scaffolding. *Prosiding Seminar Nasional Pascasarjana UNNES*. Retrieved from https://proceeding.unnes.ac.id/snpasca/article/view/276

Yennita, Y., Zulirfan, Z., Irianti, M., Tukan, M. I., Ananda, T., & Naza, K. A. (2023). Preliminary Study: Profile of Students' Interpretation Skills on the Topic of Kinematics. *Jurnal Penelitian Pendidikan IPA*, *9*(1), 186–191. https://doi.org/10.29303/jppipa.v9i1.2509

Yusmar, F., & Fadilah, R. E. (2023). Analisis Rendahnya Literasi Sains Peserta Didik Indonesia: Hasil PISA dan Faktor Penyebab. *LENSA (Lentera Sains): Jurnal Pendidikan IPA*, *13*(1), 11–19. https://doi.org/10.24929/lensa.v13i1.283

Zebua, J. Y., Zega, Y., & Telaumbanua, Y. N. (2024). Analisis Kemampuan Berpikir Kritis Siswa dalam Menyelesaikan Soal Matematika. *Didaktik: Jurnal Kependidikan*, *13*(1), 587–594. https://doi.org/10.58230/27454312.1212