JPPS (Jurnal Penelitian Pendidikan Sains)
Homepage : https://journal.unesa.ac.id/index.php/jpps
Email : jpps@unesa.ac.id

p-ISSN : 2089-1776 ; e-ISSN : 2549-1597
JPPS, Vol. 11, No. 2, May 2022 : 130-141

Critical Thinking Skills Students on Solar System Material

Ilmi Kurniati[1,*], Yuliani[2], Suyono[3], Zahidah Mahroini[4]
[1,2,3] State University of Surabaya, Surabaya, Indonesia
[4] National Taipei University, Taipei, Taiwan

DOI : https://doi.org/10.26740/jpps.v11n2.p130-141

Sections Info
Article history:
Submitted: April 25, 2022
Final Revised: May 05, 2022
Accepted: May 25, 2022
Published: May 29, 2022

Keywords:
Critical thinking skills
Junior high school students
Solar system

ABSTRACT
Critical thinking skills are one of the aims of the 21st century. Learning the solar system is one of the science materials that cannot be separated from critical thinking skills. Therefore, research on the students' initial critical thinking skills is essential after the pandemic. The subjects in this research were Junior High School students. Descriptive methods were used in this research. The data collection instruments used interview methods and research tests—the results of research ability critical thinking students of junior high school in the very low category. The achievement of the interpretation indicator shows a high proportion of 77%. In contrast, the lowest value is found in the analysis indicator, 55%, and the other indicator, like inference, shows 60%. The evaluation and explanation indicators have the same value of about 64%. The research implication is that there is evidence that students' critical thinking skills still need to be improved, especially in the solar system.

INTRODUCTION

Learning activities are reciprocal interactions between teacher and student when the learning process. Teacher as a facilitator, moderator, and educator who delivers exciting material. Teachers must have the creativity to produce innovations during the learning process (Handayani, 2020). Over the past two years, the pandemic has impacted all aspects of life, including the world of education. All human movement is little face-to-face contact to stop covid-19 (Anugrahana, 2020). In the end, all activities must be switched online and technology-oriented. School learning activities must be transferred online (Mar'ah et al., 2020).

There are 209,5 million students worldwide whose learning activities are disrupted due to the spread of covid-19. Distance learning is carried out using educational platforms to overcome academic obstacles during the pandemic (Anugerah & Wahyu, 2021). Suddenly the conventional learning system was shifted online without preparation. Teachers and students are not ready to carry out online learning. But all of that must be done to keep the learning process running even under the pandemic covid-19. Although online learning is less effective than face-to-face learning, teachers and students will use online learning media that are packaged effectively, easy to use and understand by all students (Mu'minah, 2021). Learning during a pandemic that can be applied includes an online method, offline method, face-to-face pure, home visits, and blended learning (Andin et al., 2021). Learning innovations during the pandemic need to be prepared for online learning activities (Yantoro et al., 2021). Online learning is interactive learning through the internet (Nyarko, 2019). Technology information is essential as a learning medium as alternative learning to make the student more active (Ramdani et al., 2020). Supporting factors for the bold learning process include mobile phones, quotas, and internet networks (Putria et al., 2020). Fearless learning is not

effective enough and has many challenges. Lack of interaction between teachers and students and interaction between students (Adarkwah, 2021). Several problems that interfere with the learning process will affect learning effectiveness (Abidin et al., 2020). These obstacles include exciting and fun interactive media based on technology based on 21st century needs.

Era globalization in the 21st century has advanced science and technology. Competitiveness can be increased by developing the quality of human resources (Hendriani et al., 2019). Many challenges must be faced, such as ways of thinking, drafting concepts, and actions. To meet global competition, competencies that must be mastered include critical thinking, independence, teamwork, creativity, independent learning, and information and communication (Kivunja, 2015). So educational institutions are required to produce quality human resources to adapt and be able to compete globally. Technological developments in the 21st century have had a massive impact on education (Hidayat et al., 2017). Technological development influences the field of education. The learning process based on technology can create a pleasant learning atmosphere and develop potential, personality, self-control, character, intelligence, and skill (Harahap & Anggi, 2020). One of the skills needed in the 21st century is a critical thinking skill. Human resources with critical thinking skills must decide and check the truth of information (Kamalia & Wasis, 2021). Students can be responsible for their opinions based on logic (Hendriana et al., 2017). So the curriculum applied in schools contains several competencies that are the aim of the 21st-century, like critical thinking skills, problem-solving skills, collaboration, communication skills, and creativity (Pradana et al., 2017).

Critical thinking skills in learning Natural Science have been regulated in the number 41 of 2007 of Regulation of the Minister of Education of the Republic of Indonesia as a standard process for academic units (Zaini, 2016). By developing critical thinking skills, students can respond to realistic situations and apply scientific concepts scientifically according to logic (Nurhayati et al., 2022). In the learning activities, critical thinking skills are analyzing, evaluating, synthesizing, determining conclusions, and reflecting to assess phenomena in everyday life (Prameswari et al., 2018). Integrated critical thinking skills train students' high-order thinking skills (Subekti, 2018). Critical thinking skills are related to higher-order cognitive abilities such as analytical, evaluation, and synthesis skills (Sutama, 2014). Thinking skills are based on criteria assessment and acute problems (Sulastri et al., 2022). Students' critical thinking skills are low. This is because students are still unfamiliar with issues related to critical thinking (Permata et al., 2019). Early critical thinking skills can be known before reaching the maximum goal. In the learning process, can be trained critical thinking skills (Ridho et al., 2020). Aim This research analyzes initial critical thinking students in Junior High School Taking.

RESEARCH METHOD

The research is descriptive and quantitative and uses survey methods. The resulting test data describes the initial critical thinking skill's students on the Solar system material. The method doesn't need treatment (Santoso et al., 2021).

Participants

Participants in this research were 32 students in seventh grades A and B of Junior High School Tikung in the 2021-2022 school year with a random sample determination. The

population was seventh grade A until F of Junior High School Taking, which consists of 6 classes with the number of each class as many as 192 students.

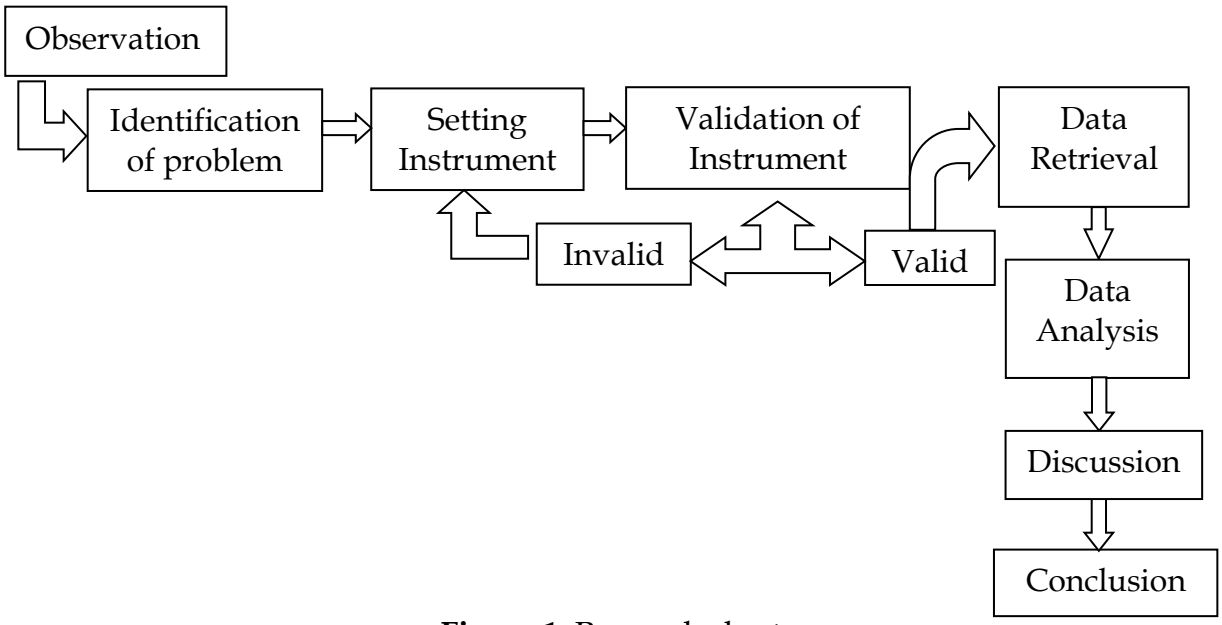


Figure 1. Research chart.

Instrument and Procedures

The research flowchart is shown in Figure 1. The research instrument formed of 5 description questions based on the critical thinking skills indicator. Researchers use critical thinking skills indicators proposed by Lismaya: self-management interpretation, inference, explanation, analysis, and evaluation. The interpretation indicator is in question number 1, the analysis indicator in question number 2, the inference indicator in number 3, the evaluation indicator in number 4, and the explanation indicator in number 5. The instrument question has been developed by researchers and validated by one science teacher and three validators postgraduate lecturers.

Data Analysis

Instruments analysis using SPSS version 22 to test the validity and reliability of respondents. Comparison of $r_{\text{-count}}$ and $r_{\text{-table}}$ with a significant level of 5% as the reason for making decisions on the validity instrument. If $r_{\text{-count}} \geq r_{\text{-table,}}$ it can be concluded that the question instrument is valid (Arikunto, 2007). In addition to the validity test, reliability testing is also needed. The instrument can be reliable if it gives the same results when tested again at different times (Arifin, 2016). The calculation reliability of the critical thinking test instrument using Cronbach Alpha analysis with a value >0,6 (Utami & Derius, 2020). Data analysis of student's critical thinking skills on solar system material based on the CCST test manual book is shown in Table 1.

Table 1. Category of critical thinking ability.

Answer Presentation (%)	Rating Category
≤20	Very Low
21-40	Low
41-60	Moderate
61-80	High
81-100	Very High

(Arini & Fikri, 2018)

RESULTS AND DISCUSSION

The ability to solve problems, analyze, and evaluate is someone who has critical thinking skills (Rachmadtullah, 2015). It looks for logical evidence and doesn't easily believe in others (Feridia et al., 2017). By this definition, the abilities student's initial critical thinking can be known from description test questions that have been validated by the validator—validity and reliability analysis critical thinking instruments in Table 2 and 3.

Table 2. Validity analysis result.

Critical Thinking Question	r-table	r-count	Category
1	0,349	0,595	Valid
2		0,424	Valid
3		0,558	Valid
4		0,554	Valid
5		0,417	Valid

Table 3. Reliability analysis result.

Critical Thinking Question	Cronbach-α	Cronbach-α if item deleted	Category
1	0,6	0,618	Reliable
2		0,670	Reliable
3		0,630	Reliable
4		0,629	Reliable
5		0,669	Reliable

Table 4. Critical thinking skills result.

Answer Presentation (%)	Amount	Rating Category
≤20	29	Very Low
21-40	2	Low
41-60	1	Moderate
61-80	-	High
81-100	-	Very High

Table 2 shows that the validity analysis of the r-table is 0.349. If the r-count is greater than the r-table in all items, the instrument tested is valid. In addition to being tested for validity, the instrument is also tested for reliability. The result of analysis reliability instruments shows measurement consistency, as shown by the coefficient value of Cronbach Alpha having a value of more than 0,6. Based on data, the critical thinking skill's students were measured using a description test question instrument.

As a result, students' initial critical thinking skills and the material on the solar system are still very low. The table data shows that 29 students are very low criteria, two students are low criteria, and one student is moderate criteria. Furthermore, each critical thinking indicator is analyzed for each indicator presented in Figure 2. The achievement of critical thinking indicators has been presented in Figure 2 shows that the interpretation indicator has the highest value of 77%. The lowest value is found in the analysis indicator, which is 55%. The inference indicator shows 60%, then the evaluation indicator and explanation indicator have a value of 64%. In Figure 2, the initial critical thinking ability is relatively low.

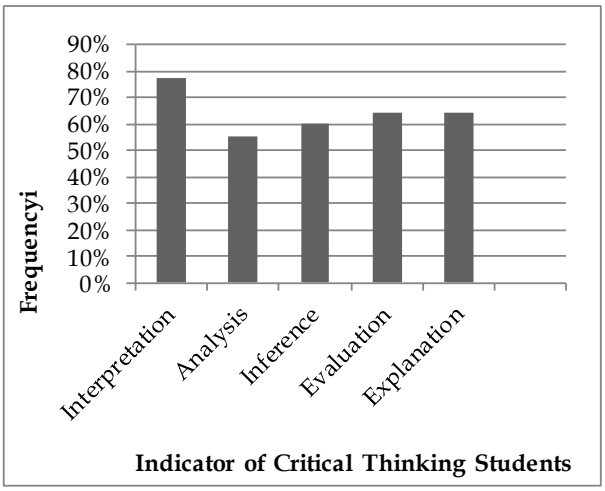


Figure 2. Critical thinking indicator achievement analysis.

Indicator 1: Interpretation

Interpretation indicator is the ability to explain the situations and identify relevant information available. Interpretation indicator represented in number 1 question. Based on the research and interpretation indicator, the students can describe the experience situations, events, decisions, and procedures with a value of 77%. Figure 2 shows that the interpretation indicator has the highest percentage compared to other indicators. This result also indicates that interpretation indicators can be mastered by students, even though there are still some students who have low value—the measurement of interpretation indicators by presenting pairs of name sky objects with their characteristics. The students can match the sky object according to the correct characteristics.

Indicator 2: Analysis

The analysis indicator has the lowest value, which is 55%. The low score on analysis indicators is because those students are rarely trained in analysis indicators, so the students can't analyze the problem and choose the right strategy to solve the problem. The measurement of analysis indicators is presented issues related to the solar system. Students must identify some statements, descriptions, concepts, and other models to express information, reasons, and opinions that can be related to the solar system.

Indicator 3: Inference

Inference indicators in moderate category critical thinking skills show 60%. Generally, students can identify and solve the problem until a conclusion has reason to diagnose and decide the consequence from data, events, concepts, and opinions. The students can conclude that Pluto is categorized as a dwarf planet based on its characteristics.

Indicator 4: Evaluation

The evaluation indicator has a value of 64%, with a high category in critical thinking skills. The students can test the statement's truth used to express thoughts, perceptions, decisions, reasons, and opinions. Students can evaluate their minds and compare them with the facts and ideas from another person—however, less than half of students cannot solve the problem in evaluation indicators.

Indicator 5: Explanation

An explanation indicator is the ability to express the results of thoughts and explain considerations containing evidence, conceptual, methodological, or contextual, including the ability to deliver results, explain procedures, and present arguments. The explanation indicator has a value of 64%, so the category of critical thinking skills is high. The students can explain the relationship between the moon's revolution and spring tide, or neap wave becomes a strong opinion.

Students' critical thinking ability is still low because they prioritize the memory and understanding process during the learning process. Students still focus on memorizing concepts that only come from books and teachers (Afriana et al., 2021). The instrument developed by the teacher still dominates Bloom's low-level operational verbs, which are C1 and C2, so students cannot analyze the questions. In addition, it can be influenced by internal factors, namely low motivation, interest, talent, attention, and readiness of students in the learning activities, so that learning is not optimal (Amijaya et al., 2018).

Improving students' critical thinking can be done by actively involving students in investigations using cognitive abilities and applying concepts in solving problems. The first step is to identify the problem through questions, analyze, and clarify. Next, consider and observe the situation. The next step in inference is to induce and determine the next step to choose conclusions through action (Sumarna et al., 2016). Teachers carry out critical thinking skills developed through the 2013 Curriculum to facilitate critical thinking indicators in education (Agnafia, 2019). Teachers must pay attention to the characteristics of students first before developing critical thinking skills. Each student has its advantages and limitations. Teachers should understand these limitations and provide differences in collective treatment (Firdaus et al., 2019).

The results of the researcher's interview with one of the science teachers at Junior High School Tikung stated that online learning was less effective than face-to-face learning. Students have difficulty understanding the material that is only delivered through digital content. Some teachers also often give assignments instead of explaining the material, causing students to get bored because assignments pile up. The nature of science learning that should be observing, asking, trying, reasoning, and communicating becomes hampered during the online learning process. So that students do not get direct experience in understanding natural phenomena. The scientific concept developed should include observation activities, experiments with scientific procedures, and scientific attitudes (Megawati, 2018). Lack of exploration significantly affects critical thinking skills.

CONCLUSION

The average initial ability of critical thinking skills students on the solar system material is still very low category. The achievement of the interpretation indicator shows a proportion of seventy-seven percent. While the lowest value is found in the analysis Indicator, which is fifty-five percent. The inference indicator shows sixty percent, then the evaluation indicator and explanation indicator have a value of sixty-four percent. Students' critical thinking abilities are still low and can be influenced by learning models, types of instruments, teaching materials, and the learning media used. The research implication is that there is evidence that students' critical thinking skills still need to be improved, especially in the solar system. The limitation of this research is the number of trial samples. Further research needs to be done with a larger number of pilot samples and different levels of education.

REFERENCES

Abidin, Z., Adeng, H., & Dinda, A. (2020). Efektifitas pembelajaran jarak jauh pada masa pandemi covid-19. *Research and Development Journal of Education, 1*(1), 131-146. http://dx.doi.org/10.30998/rdje.v1i1.7659

Adarkwah, M.A. (2021). I'm not against online teaching, but what about us?: ICT in ghana post covid-19. *Education and Information Technologies, 26*, 1665-1685. https://doi.org/10.1007/s10639-020-10331-z

Afriana, N., Halim, A., & Syukri, M. (2021). Analysis of the characteristics of students' critical thinking skills in completing national exam questions. *Journal of Research in Science Education 7*(2), 196-201. http://doi.org/10.29303/jppipa.v7i2.627

Agnafia, D.N. (2019). Analisis kemampuan berpikir kritis siswa dalam pembelajaran biologi. *Florea: Jurnal Biologi & Pembelajarannya 6*(1), 45-53. http://doi.org/10.25273/florea.v6i1.4369

Amijaya, L.S., Agus R., & Wayan, M. (2018). Pengaruh model pembelajaran inkuiri terbimbing terhadap hasil belajar dan kemampuan berpikir kritis peserta didik. *Jurnal Pijar MIPA, 13*(2), 94-99. http://doi.org/10.29303/jpm.v13i2.468

Andin, A.F., Hesthy, O., Nurkholis., & Rima, S. (2021). Penerapan sistem home schooling sebagai inovasi pembelajaran di masa pandemi covid-19. *Prosiding dan Web Seminar (Webinar) "Standarisasi Pendidikan Sekolah Dasar Menuju Era Human Society 5.0", 3*(1), *108*-114.

Anugrahana, A. (2020). Hambatan, solusi, dan harapan: Pembelajaran daring selama masa pandemi covid-19 oleh guru sekolah dasar. *Jurnal Pendidikan dan Kebudayaan, 10*(3), 282-289. https://doi.org/10.24246/j.js.2020.v10.i3.p282-289

Anugerah, R.P., & Wahyu, A.K. (2021). Keefektivitasan penggunaan platform lms sebagai sarana penunjang pembelajaran jarak jauh dengan metode literature review. *Jurnal Komputer dan Informatika 9*(2), 127-132. http://doi.org/10.35508/jicon.v9i2.4319

Arifin, Z. (2016). *Evaluasi pembelajaran.* Bandung: PT. Remaja Rosdakarya.

Arikunto, S. (2007). *Dasar – dasar evaluasi pendidikan.* Jakarta: Rineka Cipta.

Arini, W., & Fikri, J. (2018). Analisis kemampuan berpikir kritis pada mata pelajaran fisika untuk pokok bahasanvektor siswa kelas X SMA negeri 4 Lubuklinggau, Sumatera Selatan. *Berkala Fisika Indonesia 10*(1), 1-11. http://dx.doi.org/10.12928/bfi-jifpa.v10i1.9485

Feridia, Edy Y., & Dede, S. (2017). Kemampuan berpikir kritis ditinjau dari aspek eskplanation dalam penyelesaian masalah perbandingan di SMP. *Jurnal Pendidikan dan Pembelajaran Khatulistiwa 6*(8), 1-10. http://dx.doi.org/10.26418/jppk.v6i8.21358

Firdaus, A., Lulu C.N., & Nadhifah. (2019). Kemampuan berpikir kritis pada materi barisan dan deret berdasarkan gaya berpikir. *Jurnal Matematika Kreatif-Inovatif 10*(1), 68-77. https://doi.org/10.15294/kreano.v10i1.17822

Handanyani, L. (2020). Peningkatan motivasi belajar ipa melalui model pembelajaran project based learning pada masa pandemi covid-19 bagi siswa SMP Negeri 4 Gunungsari. *Jurnal Penelitian dan Pengembangan Pendidikan 7*(3), 168-174. https://doi.org/10.33394/jp.v7i3.2726

Harahap, L.K., & Anggi, D.S. (2020). Pengembangan media pembelajaran interaktif berbasis adobe flash cs6 untuk meningkatkan motivasi dan hasil belajar pada materi kesetimbangan kimia. *Jurnal Penelitian Pendidikan Sains (JPPS), 10*(1), 1910-1924. https://doi.org/10.26740/jpps.v10n1.p1910-1924

Hendriana, H., Rohaeti, E. E., & Sumarmo, U. (2017). *Hard skills and soft skills matematika siswa*. Bandung: Refika Aditama.

Hendriani, A., Etty, R., Ernalis., & Yusuf, T. H. (2019). Critical multiliteration model based on project-based learning approach in developing basic school of metacognition thinking skills. *International Journal of Science and Applied Science: Conference Series, 3*(1), 1-7. https://doi.org/10.20961/ijsascs.v3i1.34897

Hidayat, S.R., Setyadin, A.H., Hermawan, H., Kaniawati, I., Suhendi, E., Siahaan, P., & Samsudin, A. (2017). Pengembangan instrumen tes keterampilan pemecahan masalah pada materi getaran, gelombang, dan bunyi. *Jurnal Penelitian & Pengembangan Pendidikan Fisika, 3*(2), 157–166. https://doi.org/10.21009/1.03206

Kamalia, N., & Wasis. (2021). Analisis profil keterampilan berpikir kritis peserta didik sma dalam menyelesaikan soal fluida statis. *Inovasi Pendidikan Fisika, 10*(1), 90-98. https://doi.org/10.26740/ipf.v10n1.p90-98

Kivunja, C. (2015). Teaching students to learn and to work well with 21 century skills: Unpacking the career and life skills domain of the new learning paradigm. *International Journal of Higher Education 4*(1), 2-11. http://doi.org/10.5430/ijhe.v4n1p1

Mar'ah, N. K., Ani, R., & Woro, S. (2020). Perubahan proses pembelajaran daring pada siswa sekolah dasar di tengah pandemi covid-19. *Seminar Nasional Pascasarjana UNNES,* 445-452.

Megawati. (2018). Pentingnya pengakomodasian pengalaman belajar pada pembelajaran IPA. *Jurnal Tunas Pendidikan, 1*(1), 21-30.

Mu'minah, I. H. (2021). Pemanfaatan media pembelajaran berbasis video sebagai alternatif dalam pembelajaran daring IPA pada masa pandemi covid-19. *Prosiding Seminar Nasional Penelitian dan Pengabdian 2021, 1*(1), 1197-1211.

Nurhayati, Rudiana, A., & Elok S. (2022). Analysis of critical thinking skills of middle school students on environmental pollution materials. *International Journal of Recent Educational Research (IJORER), 3*(1), 100-109. https://doi.org/10.46245/ijorer.v3i1.186

Nyarko, E. A. (2019). Learner access to resources for learning and preference for learning delivery model in distance education programs in ghana. *International Journal of Educational Technology, 6*(2), 1-8. https://doi.org/10.37256/ser.3120221315

Permata, A.R., Muslim, M., & Suyana, I. (2019). Analisis kemampuan berpikir kritis peserta didik SMA pada materi momentum dan impuls. *Prosiding Seminar Nasional Fisika (E-Journal), 8*. https://doi.org/10.21009/03.SNF2019.01.PE.02

Pradana, S.D.S., Parno, P., & Handayanto, S.K. (2017). Pengembangan tes kemampuan berpikir kritis pada materi optik geometri untuk mahasiswa fisika. *Jurnal Penelitian dan Evaluasi Pendidikan, 21*(1), 51-64. https://doi.org/10.21831/ep.v21i1.13139

Prameswari, S.W., Suharno., & Sarwanto. (2018). Inculcate critical thinking skills in primary schools. *Social, Humanities, and Educational Studies (SHEs): Conference Series 1*(1), 742-750. https://doi.org/10.20961/shes.v1i1.23648

Putria, H., Luthfi, H.M., & Din, A.U. (2020). Analisis proses pembelajaran dalam jaringan (daring) masa pandemi covid-19 pada guru sekolah dasar. *Journal of Elementary Education, 4*(4), 861-872. https://doi.org/10.31004/basicedu.v4i4.460

Rachmadtullah, R. (2015). Kemampuan berpikir kritis dan konsep diri dengan hasil belajar pendidikan kewarganegaraan siswa kelas V sekolah dasar. *Jurnal Pendidkan Dasar, 6*(2), 287-296. https://doi.org/10.21009/JPD.062.10

Ramdani, A., Wahab J., & Jamaludin. (2020). Pengembangan media pembelajaran berbasis android pada masa pandemi covid-19 untuk meningkatkan literasi sains peserta didik. *Jurnal Kependidikan: Jurnal Hasil Penelitian dan Kajian Kepustakaan di Bidang Pendidikan, Pengajaran dan Pembelajaran, 6*(3), 433-440. https://doi.org/10.33394/jk.v6i3.2924

Ridho, S., Rumiyatun, R., Subali, B., & Marwoto, P. (2020). Analisis keterampilan berpikir kritis pokok bahasan klasifikasi materi dan perubahannya. *Jurnal Penelitian dan Pendidikan IPA, 6*(1), 10-15. https://doi.org/10.29303/jppipa.v6i1.194

Santoso, R., Fenny R., & Siswanto, J. (2021). Analisis literasi lingkungan siswa smp. *Jurnal Penelitian Pendidikan Sains (JPPS), 10*(2), 1976-1982. https://doi.org/10.26740/jpps.v10n2.p1976-1982

Subekti. (2018). *Mencetak generasi cerdas melalui berpikir kritis*. Surabaya: CV. Cipta Media Edukasi.

Sulastri, A., Badruzsaufari, B., Dharmono, D., Aufa, M.N., & Saputra, M.A. (2022). Development of science handouts based on critical thinking skills on the topic of the human digestive system. *Jurnal Penelitian Pendidikan IPA*, *8*(2), 475–480. https://doi.org/10.29303/jppipa.v8i2.1156

Sumarna, N., Wahyudin., & Herman, T. (2017). The increase of critical thinking skills through mathematical investigation approach. *Journal of Physics: Conference Series 755*(1), 1-9. https://doi.org/10.1088/1742-6596/755/1/011001

Sutama, I.N., Ida, B.P.A., & Ida, B.J.S. (2014). Pengaruh model pembelajaran inkuiri terhadap keterampilan berpikir kritis dan kinerja ilmiah pada pelajaran biologi Kelas XI IPA SMA negeri 2 Amplapura. *E-Journal Program Pascasarjana Universitas Pendidikan Ganesha Program Studi IPA, 4*(1), 1-6.

Utami, Y.P., & Derius D.A.C. (2020). Belajar di rumah: Analisis kesulitan matematika pada proses pembelajaran berani. *Jurnal Ilmiah Matematika Realistik, 1*(1), 20-26. https://doi.org/10.33365/ji-mr.v1i1.252.

Yantoro, Y., Ahmad, H., Zakiah, W., & Mohammad, M. (2021). Inovasi guru dalam pembelajaran di era pandemi covid-19. *Jurnal Penelitian Pendidikan Indonesia, 7(1),* 8-15. https://doi.org/10.29210/02021732

Zaini, M. (2016). Urgensi penelitian pengembangan dalam menggali keterampilan berpikir kritis. *Prosiding Seminar Nasional Pendidikan IPA 2016, 10.*

***Ilmi Kurniati, S.Pd. (Corresponding Author)**
Postgraduate Programe of Science Education,
State University of Surabaya,
Kampus Lidah Wetan, Jalan Kampus Lidah Unesa, Surabaya 60213, Indonesia
Email: ilmi.20020@mhs.unesa.ac.id

Dr. Yuliani, M.Si.
Postgraduate Programe of Science Education,
State University of Surabaya,
Kampus Lidah Wetan, Jalan Kampus Lidah Unesa, Surabaya 60213, Indonesia
Email: yuliani@unesa.ac.id

Prof. Dr. Suyono, M.Pd.
Postgraduate Programe of Science Education,
State University of Surabaya,
Kampus Lidah Wetan, Jalan Kampus Lidah Unesa, Surabaya 60213, Indonesia
Email: suyono@unesa.ac.id

Zahidah Mahroini
International program on urban Governance
National Taipei University,
No. 151號, Daxue Rd, Sanxia District, New Taipei City, 237, Taiwan
Email: zahidamahroini@gmail.com

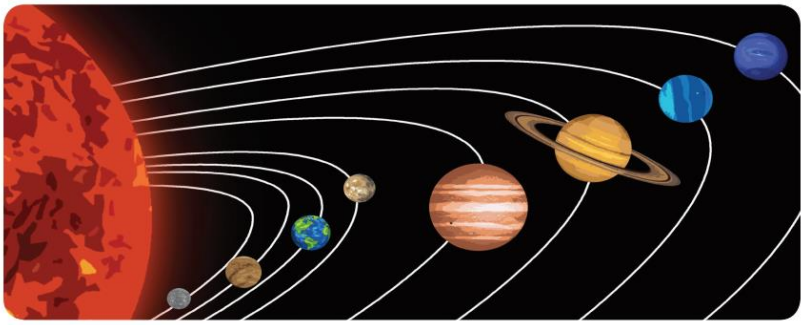
Attachment

Instrument Test

1. Which pair of names of sky objects with the correct characteristics?

Sky objects	Characteristics
A. Sun	1. Around the sun in a very elliptical orbit
B. Comet	2. Star in the form of a hot and glowing ball of gas as the center of the solar system surrounded by planets and other sky objects
C. Planet	3. Sky objects are consisting of pieces of rock or metal debris that move through outer space
D. Asteroid	4. Pieces of rock that are similar to the material that makes up the planets
E. Metroid	5. Sky objects that cannot emit its own light

2. Look at the arrangement of pictures of solar system below!



Based on your observations, answer the following questions!
   a. Write down the names of solar system arrangement!
   b. Explain the meaning of solar system!
   c.

3. Check out the following news!
   KOMPAS.com – An astronomical object must meet a number of criteria in order to be called a planet.

   The criteria are orbiting a star that is large enough to have its own gravity, not too large to create thermonuclear fusion, and has "cleared" the environment around its orbit.
   There are eight planets in the solar system, namely Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.
   Previously, Pluto was classified as a planet, so there are nine planets in the solar system.
   However, since 2006, The International Astronomy Union (IAU) no longer refers to Pluto as a planet.
   Reporting from NASA, February 15, 2021, Pluto is no longer called a planet because it has not "cleaned" its orbital environment of other objects.
   However, Pluto meets the IAU criteria for classification as a dwarf planet. According to the IAU, a dwarf planet is a celestial body that orbits the Sun directly so that its shape is controlled by the force of gravity, but has not "cleared" its orbital environment of other objects.

   So, what is meant by not "cleaning" its orbital environment of other objects?
   Reporting from the Library of Congress, September 19, 2019, the criteria mean the planet must be gravitationally dominant so that there is no other object of comparable size, other than its own satellite or the object under its gravity, in the vicinity of its orbital space.

   In this case, Pluto shares an orbital environment with Kuiper belt objects such as plutino. So, any celestial body that does not meet these criteria, will not be called a planet and will be classified as a dwarf planet, including Pluto.

   Based on the news above, Explain why Pluto is included in the group of dwarf planets? What are the groups of dwarf planets?

4. Observe the following statements!
   If you notice, when the position of the moon is dead, the moon is not visible in the sky at night. During a lunar eclipse, the appearance of the moon is not visible at night. In your opinion, is a lunar eclipse the same as a dead moon? Does the lunar eclipse always coincide with the moon in the position of the dead moon?

5. Look at the arrangement of pictures of solar system below!

   Describe the following things!
   a. The relationship between the moon's revolution and spring tide
   b. The relationship between the moon's revolution and neap tide