IJESES 1(1) (2024)

International Journal of Science Education and Science

https://journals.balaipublikasi.id

Effectiveness of E-Module to Improve Students' Critical Thinking Skills in High School Science Learning: Literature Study

Ainun Diniyatushoaliha[1*]

[1] Master of Science Education, Postgraduate, University of Mataram, West Nusa Tenggara, Indonesia

Received: August 10, 2023
Revised: February 10, 2024
Accepted: March 25, 2024
Published: March 30, 2024

Corresponding Author:
Ainun Diniyatushoaliha
ainundini20@gmail.com

Abstract: This literature review article (literature study) aims to identify the effectiveness of e-modules in improving students' critical thinking skills in high school science learning (Biology, Physics, Chemistry). A literature study was carried out to find and understand articles discussing the effectiveness of e-modules and critical thinking skills in high school science learning. The research results show that the Android-based Selvo E-Module (Volta Cell) and the HOTS-based physics e-module are effective in improving students' critical thinking skills in high school science learning with an increase in test results in the 61-65 range.

Keywords: Critical thinking skills; Effectiveness; E-module; Science; Literature study

Introduction

The rapid development of technology, information and communication in this century has influenced various areas of life, one of which is education, especially science education. Science is a learning activity through natural phenomena that can be identified systematically through scientific steps (Yulianti & Zhafirah, 2020). Biology, Chemistry and Physics are scientific disciplines that are branches of Natural Science (PA). The skills that students in the 21st century need to have in learning science are the 4C skills (Critical Thinking & Problem Solving, Creativity & Innovation, Collaboration, Communication). The focus of improving skills that are important to have in the 21st century is critical thinking skills because they are one of the targets of implementing the 2013 curriculum (Pratiwi & Endah, 2022) and are among the most important parts that are very hotly discussed by scientists both in the education and field of education. general (Selviani, 2019).

In Indonesia, there is a lot of research on critical thinking skills, especially in the context of science education. Some studies focus on the distribution of students' critical thinking levels (Susetyarini & Ahmad, 2020), and others discuss the influence of specific learning designs on students' critical thinking skills (Wulandari et al., 2017 in Susetyarini & Ahmad, 2020). There is also research that discusses the relationship between critical thinking skills and other parameters of learning achievement (Naimnule & Corebima, 2018 in Susetyarini & Ahmad, 2020). Improving critical thinking skills can be trained continuously because only with practice can critical thinking skills become a habit. Critical thinking is a thinking habit that should be instilled from an early age.

Critical thinking skills are closely related to students' scientific literacy, because the focus of scientific literacy is to train individuals to have a mindset that is responsive and critical towards knowledge (Rahma, 2022). It is known that the scientific literacy scores of students in Indonesia are still low. The test carried out by PISA (Program for International Student Assessment) on students in Indonesia (average age 15 years) in 2018 showed a reading score of 371, mathematics 379, and scientific literacy 396 (OECD, 2019). Focusing on the

How to Cite:
Diniyatushoaliha, A. (2024). Effectiveness of E-Module to Improve Students' Critical Thinking Skills in High School Science Learning: Literature Study. *International Journal of Science Education and Science (IJSES)*, *1*(1), 6–12. Retrieved from https://journals.balaipublikasi.id/index.php/ijse/article/view/106

scientific literacy category, Indonesia is ranked 9th from the bottom, namely 71st out of 79 countries (OECD, 2019). So, it can be seen that the scientific literacy abilities of students in Indonesia are still very far below international standards (China, Singapore and Macau which get an average score of 500 and above). The low scientific literacy scores of Indonesian students are a serious problem considering that students' scientific literacy is one of the skills that students should have in the 21st century.

The results of the PISA test on students' scientific literacy skills must of course be used to follow up on effective strategies to increase students' scientific literacy. In connection with this, the initial strategy for students to have scientific literacy skills is to first improve their critical thinking skills. Therefore, critical thinking skills are the key in education to solve a problem (Sujanem, et al. 2022), in this case the scientific literacy of students in Indonesia.

Critical thinking skills are very important in a learning process because students can examine various opinions, situations and existing problems (Azizzah, 2021). Therefore, students' bright ideas are needed to think of solutions to everyday problems in the surrounding environment. These ideas are explored through questions that can train students' critical thinking skills. Therefore, teaching materials or learning resources are needed that can train students' critical thinking skills. One product that can be developed to improve critical thinking skills is an electronic module (e-module). The advantage of e-modules is that they can reduce the use of paper in the learning process, and their use is also flexible and can be accessed via computer or smartphone, which in the current technological era is very easy for students to access (Adilah, et al. 2022).

Several research results regarding electronic modules include those carried out by Fathurrohmi (2019), developing an electronic module with the overall results of the questionnaire stating "very interesting". Syamsiah et al., (2019) developed an electronic module and found that teacher responses obtained very strong criteria, while student response data obtained very strong criteria. This means that the resulting e-module can be implemented by teachers and students as teaching material as well as media used in the learning process. The effectiveness of e-modules in high school science learning shows various findings. So, the author took the initiative to review various articles related to e-modules in high school science learning (Biology, Physics, Chemistry) to improve students' critical thinking skills.

Method

The method used in this research is a literature study or literature review of research results that have been published in various scientific articles. This literature study is limited to articles related to high school science e-modules to improve students' critical thinking skills. Articles were obtained from various national journals and international journals which were accessed via the internet on the SINTA search page, Google Scholar, Science Direct, and Research Gate. With the keywords e-module, science e-module, effectiveness of e-module, critical thinking, critical thinking. Researchers limited the articles reviewed to articles from the last four years, namely from 2019 to 2023.

Result and Discussion

The results of searching for articles in various national and international journals, researchers obtained a total of 20 articles. All search results for articles relevant to the effectiveness of E-Modules in high school science learning (Biology, Physics, Chemistry) to improve students' critical thinking skills are summarized in the Table 1.

Table 1. Results of tracking the effectiveness of E-modules in improving students' critical thinking skills in high school science learning

Researcher	Material	Model	subjects	*Pre-test*	*Post-test*	Improved Test Results
Pratiwi & Endah, 2022	Human Reproductive System	*Sosio-Scientific Issues* (SSI)	Biology	30.60	73.80	43,20
Selviani, 2019	Respiratory system	*Problem Based Learning* (PBL)	Biology	32.00	85.2	53.20
Amrilizia, *et al*. 2022	Interaction of Living Organisms with Their Environment	*Contextual Teaching and Learning* (CTL)	Biology	62.92	83.33	20.41
Sujanem, *et al.* 2022	Rotational Dynamics and Equilibrium of Rigid Bodies	*Problem Based Learning* (PBL)	Physics	30.60	73.1	42.50
Sujanem, *et al*. 2019	*Momentum* & *Harmonic Vibration*	*Blended Problem Based Learning* (BPBL)	Physics	22.70	59.1	36.40
Irawan, *et al*. 2019	Vibrations and Waves	*Problem Based Learning* (PBL)	Physics	20.30	50.4	30.10

Researcher	Material	Model	subjects	*Pre-test*	*Post-test*	Improved Test Results
Nurlaili, *et al*. 2021	Genetic	*Discovery Learning*	Biology	40.58	84.78	44.20
Oktaviani, *et al*. 2022	Elasticity and Hooke's Law	*Guided Inquiry*	Physics	32.00	68.5	36.50
			Chemistry	50.00	78	28.00
Auliyani, *et al*. 2022	Thermochemical	*Higher Order Thinking Skill (HOTS)*				
Sulistiani, *et al*. 2022	Virus	*Sosio-Scientific Issues* (SSI)	Biology	26.00	44	18.00
Ulfa & Imam (2022)	*Circular motion*	*Higher Order Thinking Skill (HOTS)*	Physics	6.46	70.83	64.37
Cahyanto, *et al*. (2022)	Sound Waves	*Articulate Storyline 3*	Physics	52.67	82.93	30.26
Aisyah, *et al*. (2019)	Electrochemistry (Voltaic Cells)	-	Chemistry	20.14	85.07	64.93
Dibyantini & Sulastri (2022)	Reaction rate	*Problem Based Learning* (PBL)	Chemistry	33.17	73.27	40.10
Putri & Syafriani (2022)	Dynamic electricity	*Science, Environment, Technology, Society (SETS)*	Physics	35.53	83.55	48.02
Nugraheny, *et al*. (2022)	Circular motion	*Attention, Relevance, Confidence, Satisfaction (ARCS)*	Physics	53.09	83.45	30.36
Sari, *et al*. (2023)	Newton's Law: Gravity	*Guided Inquiry*	Physics	31.37	75.66	44.29
Aulia, et al. (2022)	Kinetic Theory of Gases	*Predict, Observe, Explain (POE)*	Physics	36.48	82.86	46.38
Latifah, *et al*. (2020)	-	-	Physics	33.19	73.47	40.28
Putri & Minda (2023)	Acid Base	*Problem Based Learning* (PBL)	Chemistry	42.51	79.31	36.80

Based on Table 1, it was found that the Android-based Selvo e-module was very effective in improving students' critical thinking skills. This is shown by the increase in high school students' test results on electrochemical material (Voltaic Cells), namely 64.93. In research by Aisyah et al. (2019) did not explain the model used in learning activities so the model used and applied in the e-module is unknown. And the HOTS-based e-module on circular motion material got an increase in test results of 64.37, where in use it uses the Sigil application. Below is presented the range of improvement in test results after implementing the Science E-Module with various learning models along with the number of articles

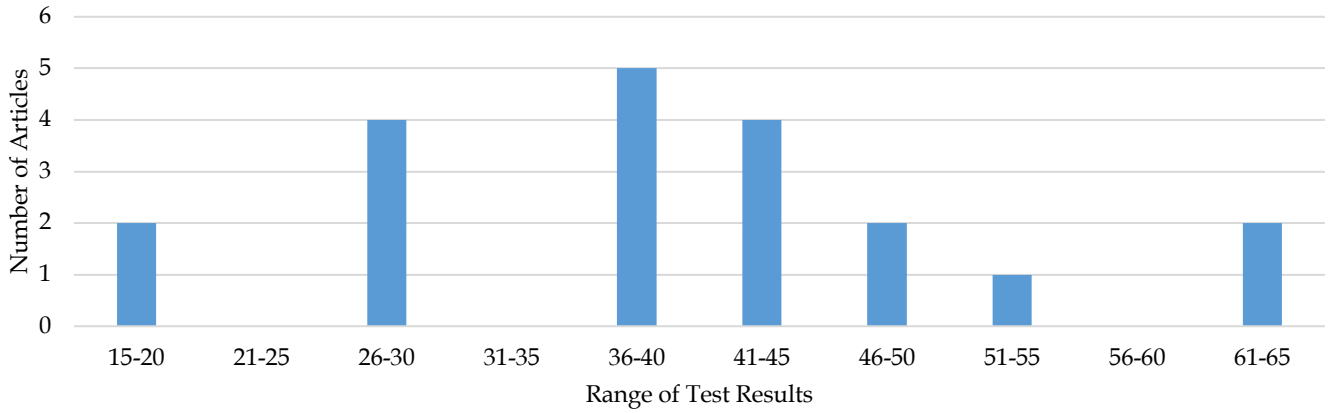

Figure 1. Improved Critical Thinking Skills Test Results

The figure above shows that there are five articles in the range of improving test results 36-40, four articles each in the range 26-30 and 41-45, two articles each in the range of improving test results 15-20, 46-50, and 61-65, one article in the 51-55 range, and no articles in the test result improvement ranges 21-25, 31-35, and 56-60. The increase in test results on students' critical thinking skills after implementing e-modules based on various models

showed that the voltaic cell e-module had the highest increase in results and was followed by the HOTS-based e-module on circular motion physics material in the 61-65 range. And e-modules based on the CTL (Contextual Teaching and Learning) model on the interaction of living organisms with their environment and e-modules based on SSI (Socio-Scientific Issues) on biological viruses are in the lowest range, namely 15-20.

The Selvo E-module application is effectively used by students where the average student score before using the Selvo E-module application (pretest) is 20.14 and the average student score after using the Selvo E-module application (posttest) is 85. 07. The overall increase in student scores after using the Selvo E-module application was a score of 64.93. After using the Selvo E-module application, students are able to answer questions from the posttest questions. Where 70% of students can answer posttest questions. This proves that the use of the Selvo E-module application can influence students' understanding so that students can stimulate their critical thinking skills. Thus, it can be said that the Selvo E-module application is able to stimulate students to carry out the learning process optimally. The indicators of thinking skills used are: interpretation, evaluation, analysis, inference, explanation, self-regulation (Aisyah et al., 2021).

The HOTS-based e-module on circular motion material is designed based on format. The format for this electronic module is: (1) cover; (2) foreword; (3) learning instructions; (4) concept map; (5) core competencies, basic competencies, competency achievement indicators, and learning objectives; (6) materials; (7) practicum; (8) summary; (9) bibliography. The HOTS content in the circular motion module includes: (1) the material begins with critical problems and questions to build critical thinking skills; (2) let HOTS is to form a concept about a material and students are expected to be able to analyze the problem that has been given; (3) let's discuss: HOTS content for students and open discussion space with their friends so that students can analyze everyday problems related to the material; (4) let's practice: HOTS content for students' practice space so that students can analyze HOTS questions; (5) let's prove it: HOTS content to prove concepts or equations so that students can analyze and evaluate a concept from the material; (6) practicum: HOTS content leads to experiments so that students can analyze, evaluate and draw conclusions from experiments (Ulfa and Imam, 2022).

The HOTS-based e-Module using the Sigil application in circular motion material received a score of 4.56 or in the very good category in the material aspect and 4.49 or in the very good category in the media aspect. It turns out that apart from improving critical thinking skills, this e-module can improve the learning outcomes of 35 students at SMAN 2 Bangkalan (Ulfa and Imam, 2022).

E-Module

E-module is a set of digital or non-print learning media that is systematically arranged and used for independent learning purposes, thereby requiring students to learn to solve problems in their own way (Hunaidah, et al. 2022). E-module is an electronic module in digital form where access and use can be done via electronic devices such as computers, laptops, tablets or smartphones (Putri & Syafriani, 2022). Electronic modules can be used as teaching materials for students to study independently because e-modules are equipped with instructions for use and e-modules contain material in video form (Putri & Syafriani, 2022).

Critical Thinking Skills are skills in reflecting thoughts and solving problems (Rahardhian, 2022). He is explains that critical thinking can be formed by combining several habits such as the following. The desire to seek knowledge and understanding. Curious people are never satisfied with their current understanding, but are driven to ask questions and seek answers. Curiosity itself is endless, the better someone understands a particular topic, the more they realize how much more there is to learn.

Humility is the recognition that one's own understanding of knowledge is of limited value. Humility is closely related to curiosity. If someone thinks that they already know everything, then there is no reason to be curious. A humble person is always aware of the limitations and gaps in their knowledge. With humility, a person becomes more receptive to information, becomes a better listener and learner. Skepticism is an attitude of suspicion towards what other people say. Skepticism means the feeling of always demanding proof and not simply accepting what other people say. At the same time, skepticism must also focus inward on one's own beliefs.

Formal logic skills are very necessary for critical thinkers. Skepticism makes one wary of bad arguments, and rationality helps to know exactly why such things happen. Rationality makes it possible to identify good arguments and then helps understand the further implications of those arguments.

Creativity is the ability to produce a combination of new ideas. When someone thinks critically, without realizing it, they often involve the ability to think creatively in solving a given problem. Critical thinking can be applied by trying to see problems from other people's perspectives. By seeing things from another person's perspective, a person can generate more new ideas than relying solely on one's own knowledge.

Critical Thinking Skills of Male and Female Students in the Science Program

Based on the research results of Azizzah et al. (2021), the results of the analysis of the answers to questions from the rubric developed from the basic elements of critical thinking by Ennis (1985) in solving

problems, namely Focus, Reason, Inference, Situation, Clarity, and Overview, obtained data from male students in class XI SMA N 5 Surakarta, there were 18 students (60%) of the 30 male students who had critical thinking skills that had not yet developed while the remaining 12 students (40%) had started to develop and the results showed that gender could influence skills. students' critical thinking. There are meaningful or significant differences in the critical thinking skills of female students and male students. Female students have higher critical thinking skills than male students.

Women tend to be better than men in terms of task performance and verbal fluency, as well as in memory tasks, perceptual speed and language, while men tend to be superior in numeracy and natural knowledge (science) (Azizzah et al., 2021). Language is considered important in thinking skills because it is seen as making it easier to express ideas (Sasser, 2010 in Azizzah et al., 2021). Each person's language ability is different because it is influenced by certain factors, for example gender because men's brain activity is more focused on the left part of the frontal gyrus, while women have activity patterns on the right and left parts of the inferior frontal gyrus. This explanation proves that there are variations or differences in the quality of language processing in women and men (Azizzah et al., 2021).

Conclusion

Based on the literature study that has been carried out, it was found that the Android-based Selvo E-Module on voltaic cell material and the HOTS-based E-Module on circular motion material are very effective in improving students' critical thinking skills in high school science learning with an increase in test results in the range of 60- 65. The Selvo e-Module can stimulate students' critical thinking skills. And the HOTS-based E-Module on circular motion material can also improve the learning outcomes of 35 students at SMAN 2 Bangkalan.

Acknowledgements
The research team would like to thank all parties who have helped in writing this article until it is published.

Author Contributions
This article was prepared by one people. The author carried out each stage cooperatively until this article was completed.

Funding
This research received no external funding.

Conflicts of Interest
The authors declare no conflict of interest.

References

Adilah, N. A., Hardiansyah., & Sri, A. (2022). Pengembangan E-Modul Konsep Keanekaragaman Hayati tentang *Sonneratia caseolaris* Kawasan Mangrove Rambai Center. *Edukatif: Jurnal Ilmu Pendidikan*, 4(5), 7029 – 7041. Doi: https://doi.org/10.31004/edukatif.v4i5.3504

Aisyah, S., Ratna, S. S. A., Imas, E. W. (2019). Learning The Selvo E-Modules To Stimulate Critical Thinking Skills Students. *Journal of Chemistry Education Research*, 3(1), 29-34. Doi:. https://doi.org/10.26740/jcer.v3n1.p29-34

Amrilizia, N., Habiddin, H., & Muhammad, F. M. (2022). Improving Students Critical Thinking Skills Using E-Modules-Contextual Teaching and Learning (CTL) on the Integration of Living Organism with Their Environment. *Journal of Disruptive Innovation (JODLI)*, 3(2), 65-82. Doi: http://dx.doi.org/10.17977/um072v3i22022p%25 p

Aulia, M., Hadma, Y., Nur, I. S., & Nadia, A. (2022). Effectiveness of Using POE-Based E-Modules (Predict, Observe, Explain) on Critical Thinking Ability. *Jurnal Riset Fisika Edukasi dan Sains*, 9(1), 1-9. Retrieved From: https://ejournal.upgrisba.ac.id/index.php/JRFES

Auliyani, A., Abdul, G., & Adlim. (2022). Higher-Order Thinking Abilities for Improved Critical Thinking in Thermochemical Materials Module. *Jurnal Pendidikan Kimia Indonesia*, 6(2), 171-177. https://doi.org/10.23887/jpki.v6i2.42933

Azizzah, H., Maretania, A., Nira, L. P., Nurul, A., Bowo, S. (2021). Critical Thinking Skills of Male and Female Students Senior High School in IPA Program. *Jurnal Phenomenon,* 11(2), 157-168.

Cahyanto, A., Albertus, D. L., & Rif'ati, D. H. (2022). Pengembangan E-Modul Interaktif Berbasis Articulate Storyline 3 untuk Melatihkan Kemampuan Berpikir Kritis pada Pokok Bahasan Gelombang Bunyi. *Jurnal Literasi Pendidikan Fisika*, 3(2), 154-164. https://doi.org/10.30872/jlpf.v3i2.1551

Dibyanti, R. E., & Sulastri. (2022). Pengembangan Bahan Ajar e-modul Berbasis Masalah Terhadap Kemampuan Berpikir Kritis Peserta didik pada Materi Laju Reaksi. *Educenter: Jurnal Ilmiah Pendidikan*, 1(6), 593-598. https://doi.org/10.55904/educenter.v1i6.196

Ennis, R. H. (1985). A Logical Basis for Measuring Critical Thinking Skills. *Educational Leadership*, 43(2), 44-48. https://jgregorymcverry.com/readings/ennis1985assessingcriticalthinking.pdf

Fathurrohmi, U. (2019). *Pengembangan E-Modul Biologi Berbasis Kvisoft Flipbook Maker Pada Materi Fungi Untuk Memberdayakan Berpikir Tingkat Tinggi Peserta*

didik Kelas X di SMAN 11 Bandar Lampung. Institut Agama Islam Negeri Raden Intan, Lampung. Retrieved From: http://repository.radenintan.ac.id/id/eprint/7143

Hunaidah., La Sahara., Husein., Vivi, H. R. M. (2022). Pengembangan E-Modul Model Pembelajaran CinQase Berbasis Flip PDF Professional Untuk Meningkatkan Hasil Belajar Fisika Peserta Didik. Jurnal Dedikasi Pendidikan, 6(1), 137-150. Retrieved From: https://jurnalabulyatama.ac.id/dedikasi

Irawan, S., Jonner, N., & Virman. (2022). Develepment of Integrated Science E-Modules Through Problem-Based Learning to Improve Critical Thinking Ability and Students Learning Outcomes on Vibration and Waves. *Jurnal Ilmu Pendidikan Indonesia*, 10(3), 153-164. Retrieved From: http://ejournal.uncen.ac.id/index.php/JIPI

Latifah, N., Ashari., & Eko, S. K. (2020). Pengembangan e-modul Fisika untuk Meningkatkan Kemampuan Berpikir Kritis Peserta Didik. *Jurnal Inovasi Pendidikan Sains*, 1(1), 1-7. Retrieved From: http://jurnal.umpwr.ac.id/index.php/jips

Nugraheny, I., Sukarmin., & Daru, W. (2022). Teaching Physics Using ARCS-Based Kodular E-Module During COVID-19: An Effort to Develop Student's Critical Thinking Ability. *Italienisch Journal*, 2(2), 708-714. Retrieved From: https://www.italienisch.nl/index.php/VerlagSauerlander/article/view/396

Nurlaili, R., Siti, Z., & Heru, K. (2021). Pengembangan E-Modul Berbasis Discovery Learning untuk Meningkatkan Kemampuan Berpikir Kritis Peserta didik Kelas XII Berdasarkan Penelitian Analisis Korelasi Kanonik dari Persilangan Tanaman Kedelai. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, 6(2), 213-219. Retrieved From: http://journal.um.ac.id/index.php/jptpp/

OECD. (2019). *What is PISA? In PISA 2018 Assesment and analytical framework*. OECD Publishing.

Oktaviani, Y., Ahmad, H., & Wahyudi. (2022). Pengembangan Modul Elastisitas dan Hukum Hooke Berbasis Guided Inquiry untuk Meningkatkan Keterampilan Berpikir Kritis Peserta Didik. *Kappa Journal*, 6(2), 303-311. Retrieved From: http://e-journal.hamzanwadi.ac.id/index.php/kpj/index.

Pratiwi, G. A. A., & Endah, P. (2022). Development of E-Module Based on Socio-Scientific Issues Human Reproductive System Material to Improve Critical Thinking Ability in High School Students. *Journal of Biology Education*, 11(3), 388-396. Retrieved From: http://journal.unnes.ac.id/siu/index.php/ijbe

Putri, M. D., & Minda, A. (2023). Efektivitas Modul Asam Basa Berbasis Problem Based Learning terhadap Hasil Belajar Peserta didik Kelas IX SMA. *Jurnal Pendidikan Tambusai*, 7(1), 1403-1407. Retrieved From: https://jptam.org/index.php/jptam/article/view/5434

Putri, S. R., & Syafriani. (2022). Pengembangan E-Modul Fisika Berbasis SETS (Science, Environment, Technology, Society) untuk Meningkatkan Keterampilan Berpikir Kritis Peserta Didik SMA/MA. *Jurnal Penelitian dan Pembelajaran Fisika*, 8(2), 142-151. https://doi.org/10.24036/jppf.v8i2.119361

Rahardhian, A. (2022). Kajian Kemampuan Berpikir Kritis (Critical Thinking Skill) dari Sudut Pandang Filsafat. *Jurnal Filsafat Indonsia*, 5(2), 87-94. Retrieved From: https://garuda.kemdikbud.go.id/documents/detail/2865384

Rahma, A. A. (2022). Penerapan Model Group Investigation (GI) Berbantuan Simulasi Virtual PhET terhadap Kemampuan Literasi Sains Peserta didik. *Jurnal Pendidikan dan Konseling*, 4(3), 2547-2555. https://doi.org/10.31004/jpdk.v4i3.5128

Sari, D. E., Kartini, H., Viyanti., Doni, A., & Ida, S. (2023). E-module Newton Law of Gravity based Guided Inquiry to Train Critical Thinking Skill. *Physics Education Research Journal*, 5(1), 13-20. https://doi.org/10.21580/perj.2023.5.1.11657

Selviani, I. (2019). Pengembangan Modul Biologi Problem Based Learning Untuk Meningkatkan Kemampuan Berpikir Kritis Peserta Didik SMA. *IJIS Edu: Indonesian J. Integr.Sci.Education*, 1(2), 147-154. https://dx.doi.org/10.29300/ijisedu.v1i2.2032

Sujanem, R., I.N.P, Suwindra., & Iwan, S. (2019). The Effectiveness of Problem Based Interactive Physics E-Module on High School Students Critical Thingking. *Journal of Physics: Conference Series*, 1503,1-10. https://doi.org/10.1088/1742-6596/1503/1/012025

Sujanem, R., I.N.P, Suwindra., & Iwan, S. (2022). Efektivitas E-Modul Fisika Berbasis Masalah Berbantuan Simulasi PHET dalam Uji Coba Terbatas Untuk Meningkatkan Keterampilan Berpikir Kritis Peserta didik SMA. *Jurnal Pendidikan Fisika UNDIKSHA*, 12(2), 181-191. Retrieved From: https://ejournal.undiksha.ac.id/index.php/JJPF/article/view/54395

Sulistiani., Kartini., & Dede, C. S. (2022). E-modules with Android Appy Pie Based on Socio-Scientific Issues to Improve Students Critical Thinking. Journal of Education Technology, 6(2), 372-379. Retrieved From: https://ejournal.undiksha.ac.id/index.php/JET

Susetyarini, E., & Ahmad, F. (2020). Trend of Critical Thinking Skill Researches in Biology Education Journals across Indonesia: from Research Design to Data Analysis. *International Journal of Instruction*, 13(1),535-550. Retrieved From:

https://www.researchgate.net/publication/338372672_Trend_of_Critical_Thinking_Skill_Researches_in_Biology_Education_Journals_across_Indonesia_from_Research_Design_to_Data_Analysis

Syamsiah, Danial, M., dan Hala, Y. (2019). Pengembangan Media Pembelajaran E-Modul Materi Sel Pada Kelas XI MIPA SMAN 3 Baru. *Prosiding Seminar Nasional Biologi VI*, 762–770. Retrieved From: https://onesearch.id/Record/IOS3399.12542?widget=1&institution_id=55

Ulfa, M., & Imam, S. (2022). Development of HOTS Based E-Modules Using Sigil Applications on Circular Motion Materials. *Jurnal Pendidikan Fisika*,10 (2), 130-143. Retrieved From: https://journal.unismuh.ac.id/index.php/jpf.

Yulianti, E., & Zhafirah,N. (2020). Analisis Komprehensif pada Implementasi Pembelajaran dengan Model Inkuiri Terbimbing: Aspek Penalaran Ilmiah. *Jurnal Penelitian Pendidikan IPA*, 6(1), 125-130. https://doi.org/10.29303/jppipa.v6i1.341