



Interactive Multimedia Development Assisted by I Spring Suite 10 Integrated SETS (Science, Environment, Technology, Society) Approach to Improve High School Students' Critical Thinking Skill

Wandika¹, *Yulkifli¹, Desnita¹, Yohandri¹, S Aisyah²

¹Magister of Physics Education, Faculty of Mathematics and Natural Science, Universitas Negeri Padang, Indonesia

²Master of Development Studies, Faculty of Business and Economic, University of Malaya, Malaysia

Article Info

Article history:

Received February 12, 2024

Revised June 20, 2024

Accepted August 27, 2024

Available Online August 31, 2024

Keywords:

Critical thinking skills;

I Spring Suite 10;

Interactive multimedia;

SETS approach;

ABSTRACT

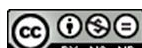
The aim of this research is to develop interactive multimedia assisted by Ispring suite 10 integrated with the SETS approach that is valid, practical and effective in order to advance high school students' critical thinking skills. This type of research is research and development (R&D) using the ADDIE development model. The participants were class XI students. Science at SMAN 2 Padang. The research results show: 1) Validation of interactive multimedia reaches very valid criteria; 2) The practicality of interactive multimedia is determined through learning implementation of 89.74% with practical criteria and student response questionnaires of 87.40% with practical criteria; 3) Interactive multimedia assisted by Ispring Suite 10's integrated SETS approach can increase critical thinking capabilities effectively. The novelty of this research is that teachers can apply interactive multimedia assisted by Ispring suite 10 integrated SETS approach as one way to improve students' critical thinking skills.



Check for updates



OPEN ACCESS

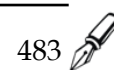


<https://doi.org/10.46627/silet>

INTRODUCTION

Education is one of the determining factors for the success of every nation. Through the realm of education, every nation is capable of having a superior generation in accordance with the needs of the times. Education has a contribution in developing human resources and the progress of every nation. Education as a means of preparing students' future as citizens (Hirschman & Wood, 2018). Education is something that is very important for the life of every nation and the country, in particular, must maximize education in Indonesia so that it can compete with developments over time (Idzhar, 2016). Education demands competition in the fields of politics, culture, law and economics in every nation so that it can be interpreted that education has an influence on all areas of life.

The education provided is adapted to developments in the 21st era which are encountered with the emergence of very fast information technology (Setiawan et al., 2021). Skills that students must master in the 21st century include critical thinking, problem solving, communication, collaboration, creativity and innovation. 21st century education encourages more activities to train students' skills in learning activities (Mardhiyah et al., 2021). Learning is said to be successful if students have these four skills. Successful learning can be seen from the output of students who have creativity, communication skills, high-level thinking skills and solving problems through research or investigation (Yulkifli et al., 2023). The learning that is applied is more directed at students to train students' thinking skills which include critical thinking, creativity, metacognitive, communication, collaboration, innovation, creativity and



information literacy. Students and teachers should adapt to information technology to acquire 21st century skills. Educational technology can be utilized to encourage the success of learning activities. In the 21st century, learning combines aspects of knowledge and skills. Quality human resources can be produced through teachers who can educate and teach in accordance with 21st century learning.

Indonesia strives to advance the quality and quality of various dimensions of life, including education and social life. Educational and social dimensions are interrelated because good education can improve people's standard of living to become prosperous. This can be seen from the curriculum for independent learning sponsored by the Minister of Education of the Republic of Indonesia, who stated the need for the theory of independent learning, namely freedom of action and thought. Teachers have the freedom to interpret the curriculum independently before teaching to students, then teachers can respond to the needs of each student during learning activities (Izza et al., 2020). This freedom to learn is related to the situation of freedom in fulfilling learning objectives, methods, materials and evaluation for both teachers and students. Therefore, learning activities in the independent curriculum tend to be centered on the interests of students, originally educational theory focused on teachers.

Emerged as a response to the intense competition for human resources in the 21st century era. The 21st century era contains three main competencies, including the competencies to think, act and live in the world (Putriani & Hudaiah, 2021). This thinking competency consists of decision making, creative thinking, and problem solving. Action skills consisting of communication, cooperate, digital literacy and technological literacy. After that life skills in the world consist of ideas, self-direction, global knowledge, and social responsibility. These skills should be applied in 21st century learning, this is because an innovative and creative mindset can adapt quickly. The Government of the Republic of Indonesia needs to increase its attention to providing adequate facilities and infrastructure to achieve global development, especially in the era of society 5.0. The right step to create student character in this era is the need for curriculum development.

Each student who takes physics subjects initially has a wrong belief system and thinking. One of the divisions of science learning is physics learning. Physics is a science that covers the empirical world, namely human knowledge that can be achieved. Physics lessons aim to instill scientific thinking and methods in children so they can develop scientific companies and products. The importance of studying physics is because knowledge of physics is more dominant over abstract concepts and principles, therefore students encounter various difficulties when studying physics concepts and principles (Soeharto et al., 2019; Makahinda & Mawuntu, 2023).

One learning resource that can be used in learning Physics is instructional media. The learning media designed is interactive multimedia assisted by I Spring suite 10 which able to advance critical thinking skills containing learning materials, discussion activities and experimental activities. Apart from using interactive multimedia learning media assisted by I Spring Suite, 10 students were also trained to use SETS techniques to support the creation of students' critical thinking skills. The SETS approach is one approach that is required to make it easier for teachers to bring out the competencies and abilities of students. So that interactive multimedia assisted by I spring suite 10 integrated with the SETS approach is able to increase critical thinking capacity.

The government and schools are expected to be able to develop the quality of students' critical thinking. The reality that occurred in the field was not in accordance with expectations. Learning in Indonesia is still very low in the application of 21st century skills. PISA (Program for International Student Assessment) research data found that Indonesia will be ranked 64th out of 65 countries in 2022, whereas in 2015 it was ranked 64th out of 72 countries (OECD, 2022). In 2018 Indonesia was ranked 72nd out of 78 countries (OECD, 2022). This illustrates that the opinion ability of Indonesian students is still at a low level (Yulianti et al., 2022).

It is important to have critical thinking skills because in this 21st era students must have this ability. Critical thinking requires practice and clear direction to build it. Critical thinking must be guided by asking questions, grouping and paying attention (Bean & Melzer, 2021; Polat & Aydin, 2020). This illustrates that the opinion ability of Indonesian students is still at a low level. In the 21st era, it is also called the 6C skills, namely critical thinking, imagination, nationality, cooperation and communication (Evimalinda & Situmorang, 2022; Nganga, 2019). Suanrti et al. (2023) found that students have low critical thinking abilities in theory and practice. Aouaf (2023) found gaps in the development of critical thinking capabilities due to insufficient practice and unclear directions for advancing these skills.

The results of previous research examined by Muchtar et al. (2021) found that interactive multimedia with Ispring bass could increase the critical thinking capabilities of class IV students at SD Muhammadiyah 2 Padang Panjang. Firdaus et al. (2020) stated that the SETS-based interactive multimedia that has been developed is feasible, practical and effective to apply to advance students' critical thinking capabilities. Firdha and Zulyusri (2022) stated that interactive media created using ISRPin is worth developing, because it can motivate and improve learning outcomes.

This research is novel in creating technology-based academic resilience to have a positive influence on the development of science and technology. Based on the background stated, there is a gap between the actual reality and the ideal reality that is expected in achieving educational goals. This research aims to produce interactive multimedia assisted by Ispring Suite 10 integrated with the SETS approach to improve students' critical thinking skills that are valid, practical and effective in learning physics.

RESEARCH METHOD

This research includes development research by applying the ADDIE development model. The ADDIE development model consists of five stages, namely analysis, design, development, implementation and evaluation. The product produced in this studi is ssisted Interactive Multimedia I Spring Suite 10 Integrated SETS (Science, Environment, Technology, Society) Approach, which has been tested for validity. The stages of implementing ADDIE can be explained in Figure 1.

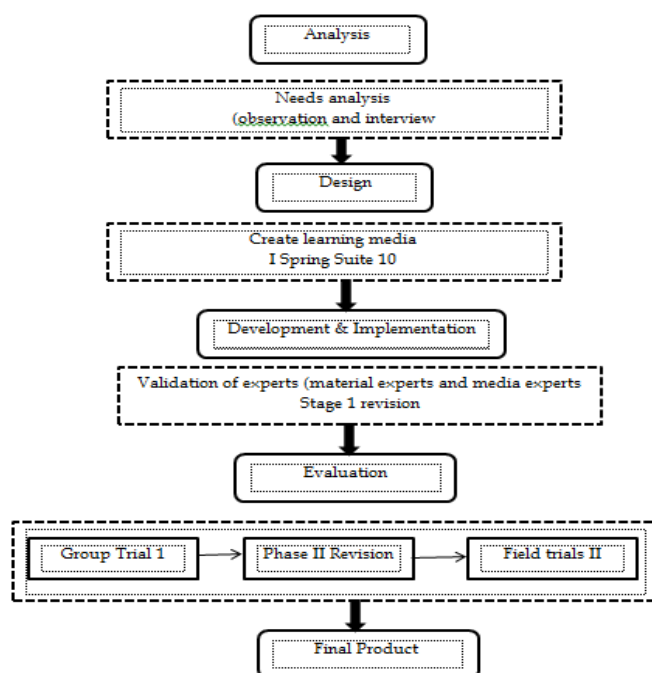


Figure 1. Multimedia development procedures using the addie development model
 (Dick et al., 1996)

This research took the subjects of class XI students at SMAN 2 Padang. The research instruments applied were validator assessment sheets, student assessments and critical thinking skills tests. Data were analyzed using content analysis techniques, descriptive analysis and critical thinking test results.

RESULTS AND DISCUSSION

Results

Findings from observations made on students and teachers, an electronic-based learning media learning approach was developed which was able to advance critical thinking competence. At the school where the observations were made, it was found that the learning media used was still print media and had not been integrated with the learning approach. Therefore, the researcher wants to develop interactive multimedia with the help of I Spring Suite 10 which is integrated with SETS to improve critical thinking skills. The following is an interactive multimedia design assisted by I Spring Suite 10 which is integrated with SETS to foster critical thinking skills that have been created, then its validity, practicality and effectiveness are measured.

The results of interactive multimedia assisted by I Spring Suite 10 integrated with SETS approach to develop high school students' critical thinking capabilities were measured from valid, practical and effective aspects. The validity value of interactive multimedia assisted by I Spring Suite 10 integrated with the SETS approach was obtained from expert validity in the form of physics education at Padang State University (UNP). The practical value of interactive multimedia assisted by I Spring Suite 10 is integrated with the SETS approach from practicality tests given to teachers and students of 2 public high school Padang.

Expert validity test results

Validation test results by three experts, the results showed that the interactive multimedia assisted by I Spring Suite integrated with the SETS approach was valid. In product validation, several aspects are assessed, including the substance of the material, learning design, visual appearance, and use of software. The interactive multimedia that was validated had several revisions to produce the maximum product. After revising several times to get maximum interactive multimedia results. So, the results obtained from product validation by experts in the form of interactive multimedia assisted by I Spring Suite 10 integrated with the SETS approach can be observed in table 4.

Table 4. Interactive multimedia validation results by experts

Component	Final Score	Description
Components of material substance	0,92	Valid
Learning design components	0,81	Valid
Visual communication display components	0,88	Valid
Software utilization components	0,97	Valid
Mean	0,89	Valid

Table 4 outlines the mean value of interactive multimedia validation assisted by I Spring Suite 10 integrated with SETS approach based on the validator assessment is 0.89. So it can be concluded that interactive multimedia assisted by I Spring Suite 10 integrated with the SETS approach is categorized as valid. Therefore, it can be tested in physics learning.

Practicality test results

Practicality test by giving a list of statements to 2 physics teachers at SMA Negeri 2 Padang regarding the practicality of interactive multimedia assisted by I Spring Suite integrated with the SET approach. Several dimensions measured in practicality tests by teachers include usability, ease of use, attractiveness and cost effectiveness. Teacher assessments regarding

interactive multimedia assisted by I Spring Suite 10 integrated with the SETS approach can be seen in Table 5.

Table 5. Practicality by teachers

Component	Final Score	Description
Usability	88 %	Practical
Easy to use	88,18%	Practical
Appealing	88,75%	Practical
Cost effective	94,00%	Practical
Average	89,74%	Practical

Table 5 shows that the practical value of teacher-assisted interactive multimedia I Spring Suite 10 integrated SETS approach has an average value of 89.74%. Interactive multimedia assisted by I Spring Suite 10 integrated with the SETS approach can be said to be practical in physics learning. So interactive multimedia can be applied to develop critical thinking skills.

Not only teacher responses, student responses are also needed for ease and practical application of product. The practicality was tested on classroom students XI.F3 of 2 public high school padang. Practicality test assessments by students are given through students' practicality test sheets. The practical test results of interactive multimedia assisted by I Spring Suite 10 integrated with the SETS approach Observe table 6.

Table 6. Practicality by student

Component	Final Score	Description
Usability	86.7%	Practical
Easy to use	87.9%	Practical
Appealing	88.5%	Practical
Cost effective	86.4%	Practical
Average	87.4	Practical

Table 6 proves that the practical value of interactive multimedia for students assisted by I Spring Suite 10 SETS is integrated approach has an average value of 87.4%. Interactive multimedia assisted by I Spring Suite 10 integrated with the SETS approach can be said to be practical in physics learning.

Effectivity of test results

The implementation stage is carried out if the interactive multimedia assisted by I Spring Suite 10 integrated with the SETS approach has been declared valid and practical. It was tested on students in class XI.F3 at 2 public high school padang. The results of calculating the effectiveness of interactive multi media assisted by I Spring Suite 10 integrated with the SETS approach can be seen from critical thinking skills.

Critical thinking capabilities were measured before and after being exposed to interactive multimedia in learning as shown in table 7.

Table 7. Critical thinking skills analysis

Critical Thinking Indicators	Average value	Category
Identify	86,32	Very good
Defining	85,47	Very good
Evaluate	86,32	Very good
Explore	88,89	Very good
Integrate	87,18	Very good
Average	86,84	Very good

Tabel 7 found that students' critical thinking abilities in applying interactive multimedia assisted by the I Spring Suite 10 integrated SETS approach were obtained. There are five indicators that measure students' critical thinking skills. The indicator identifies with an average value of 86.32 in the very good criteria. The indicator defines mean value of 85.47 in the very good criteria. The indicator evaluates with mean value of 86.32 in the very good criteria. The exploration indicator has an average value of 88.89 in the very good crirteria. The

integrating indicator has an average value of 87.18 in the very good criteria. The overall average critical thinking skills is 86.84 with good criteria. From the N-Gain analysis carried out, an N-Gain value of 0.70 was obtained. This states that critical thinking skills are in the medium category. This explanation can show that critical thinking skills are declared effective because the average value is above 75 and the N-Gain test carried out is in the medium category. So that interactive multimedia assisted by I Spring Suite 10 integrated with the SETS method is said to be effective in developing students' critical thinking capabilities.

Discussion

The research carried out is development research. The product developed is interactive multimedia assisted by I Spring Suite 10 integrated with the SETS approach. Interactive multimedia developed in class XI semester 1 material. The research was carried out at SMA Negeri 2 PADang. Interactive multimedia development assisted by I Spring Suite 10 integrated with the SETS approach is applied in accordance with needs analysis aimed at improving 21st century skills. The product was developed to find out certain needs with detailed specifications, when finalizing the product, it was field tested and revised until a certain level of effectiveness is achieved. Even though the research and development cycle is expensive, it produces quality products designed to meet the needs of the educational sector (Simanjuntak et al., 2018).

The learning needs that are developed should look at students' personalities from various aspects, for example increasing potential, intellectual intelligence and psychology (Cahyanto et al., 2018). Students are enthusiastic about using digital devices, for example laptops and gadgets that support the development of electronic teaching materials. Students do not experience obstacles in applying and studying this teaching material, because with the equipment that students have, they can show the teaching material well. This can encourage online learning, so that teachers can meet learning needs by developing electronic-based teaching materials (Cahyanto & Afifulloh, 2020). The material taught can be useful for students, if the learning tools are perfected in the teaching and learning process it can be applied to improve independent abilities even without face to face contact with the teacher. The learning media developed in this research is teaching media.

Science learning aims to improve students' understanding and intellectual abilities, including critical thinking, innovation, collaboration and communication needed in the 21st century (Yusliani & Desnita, 2022). Learning physics is not just about knowing concepts but also students' efforts to get them and observe these theories, so that learning is more meaningful such as practical activities and discussions (Darmaji et al., 2019).

Quality learning media and using learning models or approaches that suit curriculum demands. The use of learning models or approaches and learning media used by teachers do not fully encourage student activity. So it can be used to increase students' learning independence, learning competence and 21st century skills such as critical thinking skills. In interactive multimedia, learning material is presented in a combination of text, sound, animation and video which is delivered to students using computers or other electronic and digital manipulation equipment (Widyatmojo & Muhtadi, 2017). By combining this media, the learning experience will be more meaningful and demonstrate skills in everyday life (Fathimah & Ishartiwi, 2018). Firdaus et al. (2020) explained that the use of multimedia is to make learning activities more attractive, interactive, teaching time can be minimized, the quality of learning can be improved, learning can be done anywhere and anytime, and student behavior can be better.

Before conducting an interactive multimedia practicality test on teachers and students, a validation test is first carried out on the practicality assessment instrument. The instrument used to assess practicality is said to be valid. The validity of the instrument shows that the contents of the instrument are in accordance with the theory and can measure what it should measure (Novisya & Desnita, 2020). Yusliani and Desnita (2022) state that the validity of a

product development refers to whether the design is based on up-to-date knowledge and whether the various components of the product are appropriate. relate to each other. Validation is the process of requesting approval or confirmation of the product's suitability to needs so that the product is declared suitable and suitable for use in learning (Desmiwati et al., 2017). If an instrument has been declared valid, the instrument can be used to collect research data.

After the product is said to be valid, a practicality test is then applied to teachers and students. The practicality of learning media can be obtained from the results of trials applied to students. The trials produced after implementing interactive multimedia are practical This means that interactive multimedia is seen in terms of usability, easy to use, easy to use and cost effective. Practicality tests take the form of one-on-one evaluations using interviews, small group assessments using practicality instruments and field tests using practicality instruments. The purpose of this measurement is whether teachers and other experts can use the learning media used (Ananda & Usmeldi, 2023).

Testing the effectiveness of interactive multimedia assisted by I Spring Suite 10 integrated into the SETS method was carried out to measure critical thinking skills. The critical thinking skills measured are identifying, defining, evaluating, exploring and integrating. Test the effectiveness of critical thinking skills using essay questions. Students' critical thinking skills can be seen from comparing the scores before using interactive multimedia with the scores obtained after using interactive multimedia. Critical thinking skills are measured using assessment indicators such as identifying problems, defining problems, evaluating problems, exploring problems, and integrating problems (Simanjuntak et al., 2018).

Students use interactive multimedia assisted by I Spring Suite 10 integrated SETS approach in the learning process to improve students' critical thinking skills. The results obtained from the use of interactive multimedia assisted by the I Spring Suite 10 integrated SETS approach show that the interactive multimedia used is effective in increasing students' critical thinking skills. This explanation can be seen from the data found on students' critical thinking skills. Factors that cause effectiveness in the learning process are influenced by the type of media chosen and the learning methods applied in the learning process (Khoir et al., 2020; Qistina et al., 2019). Creatively developed learning tools can motivate effective and independent learning (Wilson & Wilson, 2018). Good learning tools are able to encourage a blended learning process (Diana et al., 2017), where teaching materials will be more easily accessed and studied by students.

Interactive multimedia is one of the electronic learning media that is proven to advance critical thinking capacity The explanation above is supported by the research results obtained in this study as well as research that has been conducted previously. Related research was conducted by which explains that the use of interactive multimedia based on the SETS approach in the learning process is able to foster students' critical thinking abilities. Majid (2014) also explained that interactive multimedia related to real life is effective in increasing motivation, building concepts, and develop critical thinking skills. Pramuji et al. (2018) also explained that interactive multimedia can improve critical thinking skills. This can be seen from the average increase in each indicator of critical thinking skills observed before and after using interactive multimedia. SETS insights applied to the physics learning process are believed to be able to bring the education system to produce graduates who have the ability to apply the knowledge they have gained in real life to improve the quality of human life without having to endanger the environment (Latifah, 2014). Putri and Syafriani (2022) found that the development of a Physics e-module based on SETS to improve the critical thinking skills of SMA/MA students was effective.

CONCLUSION

Based on the results of the analysis and research findings, it can be concluded that the interactive multimedia assisted by Ispring suite 10 integrated with the SETS approach which

was developed to improve the critical thinking skills of high school students is declared valid, practical and effective for use in class XI learning for high school students. The implication of this research is that interactive multimedia integrated learning assisted by the Ispring Suite 10 integrated SETS approach has succeeded in increasing high school students' critical thinking skills. The interactive multimedia developed can contribute to the development of more interesting learning materials, so that students' critical thinking abilities increase.

In future research, we can develop interactive multimedia using other approaches so that physics learning is more effective and efficient in developing students' critical thinking skills. Besides that, more in-depth research is needed regarding multimedia learning which has an impact on the formation of critical thinking skills.

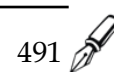
ACKNOWLEDGEMENTS

Thank you UNP physics education master's study program. Thank you to the validator lecturer. Thank you to the physics teacher and class XI students of 2 public high school Padang. Thank you to those who have contributed to this research.

REFERENCES

- Ananda, P. N., & Usmeldi. (2023). Validity and practicality of e-module model inquiry based online learning to improve student competence. *Jurnal Penelitian Pendidikan IPA*, 9(4). <https://doi.org/10.29303/jppipa.v9i4.3563>
- Aouaf, S. (2023). Perceived barriers to critical thinking development: the student's view. *International Journal of Linguistics, Literature and Translation*, February, 63–69. <https://doi.org/10.32996/ijllt>
- Bean, J. C., & Melzer, D. (2021). *Engaging ideas: The professor's guide to integrating writing, critical thinking, and active learning in the classroom*. Jossey-Bass.
- Cahyanto, B., & Afifulloh, M. (2020). Electronic module (e-modul) berbasis component display theory (cdt) untuk mata kuliah pembelajaran terpadu. *JINOTEP (Jurnal Inovasi Teknologi Pembelajaran)*, 7(1), 49–56. <https://doi.org/10.17977/um031v7i12020p049>
- Cahyanto, Bagus, Akbar, S., & Sa, C. (2018). Desain fisik kelas berbasis tema untuk Sekolah Dasar. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, 3(1), 15–20. <https://doi.org/10.17977/jptpp.v3i1.10354>
- Darmaji, Kuriawan, D. A., & Suryani, A. (2021). Effectiveness of basic physics ii practicum guidelines based on science process skill. *JIPF (Jurnal Ilmu Pendidikan Fisik)*, 4(1), 1–7. <https://doi.org/10.26737/jipf.v4i1.693>
- Desmiwati, R., Ratnawulan, & Yulkifli. (2017). Validitas LKPD Fisika SMA menggunakan model problem based learning berbasis teknologi digital. *Jurnal Eksata Pendidikan (JEP)*, 1(1), 33–38.
- Diana, P., Luit, V., & Johannes, E. H. (2017). The effects of digital learning material on students' mathematics learning in vocational education. *Cogent Education*, 4(1), 1–10. <https://doi.org/10.1080/2331186X.2017.1313581>
- Evimalinda, R., & Situmorang, E. L. (2022). The role of christian religious education teachers in building student's 6 skills in the era 4.0. *Advances in Social Science, Education and Humanities Research*, 669, 192–196. <https://doi.org/https://doi.org/10.2991/assehr.k.220702.044>
- Fathimah, N. S., & Ishartiwi. (2018). Pengembangan multimedia permainan interaktif pembelajaran berhitung bagi anak diskalkulia usia prasekolah. *Jurnal Inovasi Teknologi Pendidikan*, 5(2), 115–128. <https://doi.org/10.21831/jitp.v5i2.15541>
- Firdaus, F. Z., Suryanti, & Azizah, U. (2020). Pengembangan multimedia interaktif berbasis pendekatan sets untuk meningkatkan kemampuan berpikir kritis siswa Sekolah Dasar. *Jurnal Basicedu*, 4(3), 681–689. <https://doi.org/10.31004/basicedu.v4i3.417>
- Hirschman, K., & Wood, B. E. (2018). 21st century learners: changing conceptions of knowledge, learning and the child. *New Zealand Annual Review of Education*, 23(June), 20–35.

- <https://doi.org/10.26686/nzaroe.v23i0.5280>
- Idzhar, A. (2016). Peranan guru dalam meningkatkan motivasi belajar siswa. *Jurnal Office*, 2(2), 222–228.
- Irma, Meriyati, & Irwandani. (2021). Model pembelajaran discovery based unity of science (dbus) dengan pendekatan sets : pengaruh terhadap kemampuan berpikir kritis pada masa pandemi COVID-19. *U-Teach: Journal Education of Young Physics Teacher*, 2(1), 29–35. <https://doi.org/10.30599/uteach.v2i1.36>
- Izza, A. Z., Falah, M., & Susilawati, S. (2020). The effects of digital learning material on students' mathematics learning in vocational education. *Konferensi Ilmiah Pendidikan Universitas Pekalongan*, 11–15.
- Khoir, H. M., Murtingugraha, R. E., & Musalamah, S. (2020). Pengembangan media pembelajaran e-learning berbasis moodle pada mata kuliah metodologi penelitian. *Jurnal Pendidikan Teknik Sipil (JPenSil)*, 9(1), 1–7. <https://doi.org/10.21009/jpensil.v9i1.13453>
- Latifah, S. (2014). Implementasi pembelajaran bervisi SETS di sekolah sri. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni*, 3(1), 1–12.
- Majid, A. (2014). *Strategi pembelajaran*. Remaja Rosdakarya.
- Makahinda, T., & Mawuntu, V. J. (2023). Development of thermodynamics learning with empirical approach and portfolio assessment techniques. *Studies in Learning and Teaching (SiLeT)*, 4(2), 285–295.
- Mardhiyah, R. H., Aldriani, S. N. F., Chitta, F., & Zuldikar, M. R. (2021). Pentingnya keterampilan belajar di abad 21 sebagai tuntutan dalam pengembangan sumber daya manusia. *Lectura: Jurnal Pendidikan*, 12(1), 30–40. <https://doi.org/10.31849/lectura.v12i1.5813>
- Nganga, L. (2019). Preservice teachers' perceptions and preparedness to teach for global mindedness and social justice using collaboration, critical thinking, creativity and communication (3cs). *Journal of Social Studies Education Research*, 10(4), 26–57.
- Novisya, D., & Desnita. (2020). Penilaian instrumen efektifitas video pembelajaran fisika berbasis contextual teaching and learning (CTL) materi fluida. *Jurnal Inovasi dan Pembelajaran Fisika*, 7(2), 129–139.
- OECD. (2022). PISA 2022 mathematics framework. OECD. <https://pisa2022-maths.oecd.org/files/PISA%202022%20Mathematics%20Framework%20Draft.pdf>
- Pramuji, L., Permanasari, A., & Ardianto, D. (2018). Multimedia interaktif berbasis STEM pada kosnep pencemaran lingkungan untuk meningkatkan kemampuan berpikir kritis siswa. *Journal of Science Education and Practice*, 2(1), 1–15. <https://doi.org/10.33751/jsep.v2i1.1699>
- Putri, S. R., & Syafriani. (2022). Pengembangan e-modul fisika berbasis SETS (Science, Environment, Techonogy, Society) untuk meningkatkan kemampuan berpikir kritis peserta didik SMA/MA. *Jurnal Penelitian dan Pembelajaran Fisika*, 8(2), 142–151. <https://doi.org/10.24036/jppf.v8i2.119361>
- Putriani, J. D., & Hudaidah. (2021). Penerapan pendidikan Indonesia di era revolusi insdustri 4.0. *Edukatif: Jurnal Ilmu Pendidikan*, 3(3), 831–838.
- Qistina, M., Alpusari, M., Noviana, E., & Hermita, N. (2019). Pengembangan multimedia interaktif mata pelajaran IPA kelas IVC SD Negeri 34 Taraibangun Kabupaten Kampar. *Primary: Jurnal Pendidikan Guru Sekolah Dasar*, 8(2), 160–172. <https://doi.org/10.33578/jpkip.v8i2.7649>
- Setiawan, I., Ibrahim, Isnaini, Anugrah, M., Aslamiah, M., & Nurhayati. (2021). Peran pasar digital di era pandemi pada wirausaha muda di Banyumulek. *Jurnal Pengabdian Meagister Pendidikan IPA*, 4(4), 440–447. <https://doi.org/10.29303/jpmipi.v3i2.1161>
- Simanjuntak, B. R., Desnita, & Budi, E. (2018). The development of web-based instructional media for teaching wave physics an andrid mobile. *JPPPF (Jurnal Penelitian Dan Pengembangan Pendidikan Fisika)*, 4(1), 1–10. <https://doi.org/10.21009/1.04101>
- Soeharto, Csapó, B., Sarimanah, E., Dewi, F. I., & Sabri, T. (2019). A review of students' common



- misconceptions in science and their diagnostic assessment tools. *Jurnal Pendidikan IPA Indonesia*, 8(2), 247–266. <https://doi.org/10.15294/jpii.v8i2.18649>
- Suanrti, T., Amiruddin, M. Z. B., Wasis, Setyarsih, W., Jauhariyah, M. N. R., & Zainuddin, A. (2023). Discussion of learning: Implementation and effect on critical thinking skill of students in general physics courses. *Studies in Learning and Teaching (SiLet)*, 4(2), 260–272.
- Widyatmojo, G., & Muhtadi, A. (2017). Pengembangan multimedia pembelajaran interaktif berbentuk game untuk menstimulasi aspek kognitif dan bahasa anak TK. *Jurnal Inovasi Teknologi Pendidikan*, 4(1), 38–49. <https://doi.org/10.21831/jitp.v4i1.10194>
- Wilson, M. C., & Wilson, M. C. (2018). Crowdsourcing and self-instruction: Turning the production of teaching materials into a learning objective of teaching materials into a learning objective. *Journal of Political Science Education*, 0(0), 1–9. <https://doi.org/10.1080/15512169.2017.1415813>
- Yulianti, Y., Lestari, H., & Rahmawanti, I. (2022). Penerapan model pembelajaran radec terhadap peningkatan kemampuan berfikir kritis siswa. *Jurnal Cakrawala Pendas*, 8(1), 47–56. <https://doi.org/10.31949/jcp.v8i1.1915>
- Yulkifli, Risma, M., Festiyed, F., & Azis, H. (2023). Validity of e-module integrated scientific literacy using the smartphone-assisted IBL model to improve student competence Validity of e-module integrated scientific literacy using the smartphone-assisted IBL model to improve student competence. *5th International Conference on Research and Learning of Physics (ICRLP 2022)*, 1–7. <https://doi.org/10.1088/1742-6596/2582/1/012051>
- Yusliani, E., & Desnita. (2022). Validity and reliability of critical thinking instruments to measure the effectiveness of context-based physics e- module on wave materials. *JPPPF (Jurnal Penelitian dan Pengembangan Pendidikan Fisika)*, 8(1), 57–64. <https://doi.org/10.21009/1.08106>
-

Author (s):

Wandika

Magister of Physics Education, Faculty of Mathematics and Natural Science,
Universitas Negeri Padang, Indonesia

Email: wandika.jambi0707@gmail.com

*Yulkifli (Corresponding Author)

Magister of Physics Education, Faculty of Mathematics and Natural Science,
Universitas Negeri Padang, Indonesia

Email: yulkifliamir@fmipa.unp.ac.id

Desnita

Magister of Physics Education, Faculty of Mathematics and Natural Science,
Universitas Negeri Padang, Indonesia

Email: desnita@fmipa.unp.ac.id

Yohandri

Magister of Physics Education, Faculty of Mathematics and Natural Science,
Universitas Negeri Padang, Indonesia

Email: yohandri@fmipa.unp.ac.id

Siti Aisyah

Master of Development Studies, Faculty of Business and Economic,
University of Malaya, Malaysia

Email: sitiyah12@gmail.com

