

Development of Socioscientific-Issue-Based Electronic Modules on Virus Material to Increase Interest and Argumentation Skills

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Abstract: This study aims to produce an electronic module based on socioscientific issues that is feasible to improve students' interest and argumentation skills. This research is development research with the ADDIE method (Analysis, Design, Development, Implementation, and Evaluation). The product to be developed is an electronic module based on Socioscientific Issues on virus material. Data collection techniques used are interviews, observations, learning interest questionnaires. The resulting product is then validated by material experts and media experts, and a limited trial is carried out. Based on the results of the development of an electronic module based on socioscientific issues, it is concluded that the electronic module is feasible to be used for biology learning in terms of the assessment of material experts with an average value of 3.11 (very feasible) and the assessment of media experts with an average value of 3.77 (very feasible). And it is effective for increasing students' interest in learning as seen from the n-gains value of 0.55 with a moderate category and to improve students' argumentation skills with an n-gains value of 0.4 with a moderate category.

Keywords: Argumentation skill; Electronic module; Socioscientific issue; Virus

Introduction

The world of education has an important role in dealing with the development of science and technology (Laksono & Wibowo, 2022). There are various skills that need to be mastered by students in the 21st century, namely critical thinking skills, creative thinking skills, communication skills and collaboration skills (Prihadi, 2017). Argumentation skills have relevance to the demands of the 21st century, because it is at the intersection of creative and critical thinking skills, and these two skills can be developed through argumentation skills argumentation skills (Glassner & Schwarz, 2007). Thus, argumentation skills are an important bridge between creative thinking and critical thinking (Azizah et al., 2022).

Argumentation skills are important for students to master (Roviati & Widodo, 2019). This is because argumentation skills are active to convey opinions from

various points of view before solving problems and making decisions (Afgani et al., 2020). Therefore, there is a need for learning that involves the practice of argumentation in students at school. However, in reality there are still many students who have low argumentation skills. Pitorini et al. (2020) argued that one factor in not optimizing the ability of students' argumentation is because students do not have a place to practice argument skills.

Based on observations made at SMA Negeri 1 Ngemplak, the argumentation ability of students is still relatively low, as evidenced by the results of the need assessment of 75% so that students are still classified as less able to express their opinions during the learning process. This can also be seen through the biology learning process carried out at school which is still teacher-centered. The teacher-centered learning process causes students to be less active in the learning process (Risanatul & Junaidi, 2022). It is necessary for teachers

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that in the learning process the teacher is not the only source of learning so that there is a need to develop the learning process (Rahayu, 2019). The same thing is expressed by Karlina et al. (2021) learning that is dominated by the teacher can result in students becoming passive and only duplicate the teacher's knowledge without actively seeking or exploring their own knowledge. Therefore, students need learning facilities that can support activeness to explore their own knowledge.

One of them is through teaching materials by utilizing electronic devices owned by students in the form of electronic modules that can be used as learning support. The selection of electronic modules as teaching materials is one of the right strategies because it adapts to the development of information and technology in the current digital era (Trilestari & Almunawaroh, 2020). The presence of electronic modules will facilitate students in accessing teaching materials easily and optimally (Pachler et al., 2010). Teaching materials that are integrated and combined with technology so that students and teachers can learn flexibly and independently, and can increase student motivation (Laili et al., 2019). In accordance with the opinion Syahrial et al. (2020) that the existence of active and interesting learning in learning helps learners to increase student learning motivation. Therefore, it is possible to modify or change traditional educational materials to electronic teaching materials to be able to adapt to the times, science, and technology (Respati & Atun, 2023).

Based on the results of interviews with biology teachers at SMA Negeri 1 Ngemplak, the teaching materials used in learning biology in the classroom are only printed books and learning activities are limited to delivering material through textbooks that focus on memorization without development towards deep understanding for students in everyday life. This is in line with the results of interviews with students at SMA Negeri 1 Ngemplak that there are difficulties in connecting material with problems in everyday life. The situation has resulted in their view of learning being changed from a happy learning into a boring learning, which then impacts on students' motivation and interest in learning.

There is one material that is considered difficult by the students in class X, that is virus material, which is a broad and complex material. Because viruses are very small microorganisms and cannot be seen with the naked eye, it is difficult for students to imagine something that cannot be seen or touched directly. Therefore, the teaching materials needed are also contextual in scope that can be correlated with the daily life of students to be able to support students' understanding of the material through a relevant study of the daily life for students.

Based on the problems faced at SMA Negeri 1 Ngemplak, it is possible to develop teaching materials to solve the problems that occurred. One of the developments that will be carried out by researchers is by developing electronic modules combined with the Socioscientific Issue approach on virus material. Socioscientific Issue is a learning method that provides contextual learning situations in the form of issues in society with conflict or dilemma situations that have a connection between science and the social life of students (Hancock et al., 2019; Sadler et al., 2016). The utilization of socioscientific issues in the learning process can train students' high-level thinking skills to solve various problems that exist in everyday life (Wirawan et al., 2023).

Previous research conducted by Fadha et al. (2023) with the title "Utilization of E-Modules Based on Scientific Social Issues in Learning Efforts to Improve Argumentation and Decision Making Skills of High School Students". In the study, the issue of environmental pollution was raised. Socioscientific issues contained in the environment are contextual issues that occur in Indonesia, this important issue is raised to students with the aim of stimulating critical thinking, analysis, and argumentation (Çalık & Wiyarsi, 2021). Therefore, SSI can develop awareness that science and society are interdependent (Suryani et al., 2024).

The novelty of this research lies in the materials and issues used. Socioscientific issue learning presents controversial issues with a variety of different views so that students can develop their argumentation skills by paying attention to different aspects of science, social, economic, moral, cultural and environmental aspects. The material used in this study is viral material that raises the issue of the use of Wolbachia in discussing the reproduction of the dengue virus that causes dengue fever in PLWHA (people living with HIV/AIDS). The issue raised in this study is one of the current issues in Indonesia. This is because the process through issues that exist in the community can potentially develop the intellectual abilities and communication skills of students (Siska et al., 2020).

Through the development of electronic modules based on socioscientific issue on virus material, it is expected to be able to increase the interest and ability of argumelntasi pelselrta students Fasel E SMA, which is still relatively low.

Method

This research is a research and development using the ADDIE model with the product to be developed being an electronic module based on socioscientific issue on virus material. According to McGriff (2000) this

ADDIE model consists of stages namely analysis, design, development, implementation and evaluation which can be seen in Figure 1.

This research was conducted in State Senior High School 1 Ngemplak. The population in this study were class X students in biology subjects.

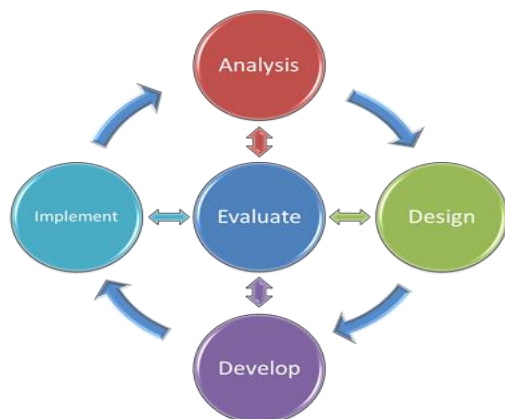


Figure 1. Stages of ADDIE model development

This research was conducted in State Senior High School 1 Ngemplak. The population in this study were class X students in biology subjects.

The first stage is analysis. In this stage, the situation and problems that occur during biology learning at SMA Negeri 1 Ngemplak are analyzed. This stage is carried out by collecting information in the school through interviews, observations and questionnaires. The second stage is the design stage of product design by making a story board design. The third stage is development which is the result of product development through the results of analysis and planning concepts that have been previously determined. The research tool was rated by materials and media experts on a 1-4 Likert scale. The formula used is

$$M = \frac{\sum fx}{N} \quad (1)$$

Description:

M : average score per aspect

$\sum fx$: number of scores per aspect

N : number of components

The obtained scores are then interpreted based on the evaluation and criteria in Table 1.

Table 1. Likert Scale Criteria and Scoring

Score	Criteria
4	Agree Strongly
3	Agree
2	Less Disagree
1	Strongly Disagree

Then the feasibility and practicality categories are interpreted products, which can be seen in Table 2.

Table 2. Criteria for Evaluating the Feasibility and Practicality of Products

Score Range	Criteria
$M_i + 1.5 S_{bi} < X \leq M_i + 3.0 S_{bi}$	Very feasible
$M_i + 0 S_{bi} < X \leq M_i + 1.5 S_{bi}$	Feasible
$M_i - 1.5 S_{bi} < X \leq M_i + 0 S_{bi}$	Less feasible
$M_i - 3.0 S_{bi} < X \leq M_i - 1.5 S_{bi}$	Not feasible

The fourth stage is the implementation of the developed product to the students. The next stage is the implementation stage. In this stage, the developed product is implemented through a trial that aims to see the effectiveness of the product on students' interest and argumentation skills. The results of the trial are then analyzed to determine the increase in students' interest and argumentation skills. The analysis will be done based on the average N-gain score using the equation 2.

$$< g > = \frac{Sf - Si}{S_{max} - Si} \quad (2)$$

Which is then interpreted based on the criteria in Table 3.

Table 3. Criteria for E-module Effectiveness

Interval Score	Criteria
$g > 0.70$	High
$0.30 < g \leq 0.70$	Medium
$g \leq 0.30$	Low

And the final stage, the evaluation stage, is conducted to ensure that the learning objectives are met and that the media and learning models used are appropriate.

Result and Discussion

The first stage of this research is an analysis conducted by collecting various information through interviews with biology teachers and questionnaires (needs assessment) to students. Then the results obtained that in learning biology at SMAN 1 Ngemplak using the teacher-centered lecture method that causes students to be less active and less involved in the learning process. As many as 73% of the students stated that they were less actively involved in biology learning activities and as many as 75% of the students stated that they were not able to express their opinions during the learning process.

Teaching materials used in the biology learning process are printed books, which results in lack of interest in learning biology. As many as 76% of students stated that the teaching materials used in the biology

learning process were interesting, and as many as 70% of students stated that learning using printed books did not foster interest in learning biology, where the contents of the printed book used by students in learning tend to contain a collection of theories with limited images, so it lacks visualization of biological objects to generate student interest, as well as learning activities that are telrkandung in printed books are dominated by memorizing concepts and practice questions, so that students feel jelnulh in the learning process.

Based on the results of observing the students' infrastructure at SMAN 1 Ngemplak, it is known that 100% of the students have smartphones and are supported by the school to support the learning process. The characteristics of students who are the subject of this study are students who are in the adolescent age group with an age range of 15-17 years. All the students have mobile devices and 88% of them like e-learning. In terms of competency analysis, the design of learning competencies in electronic modules is compiled according to the competencies contained in the Merdeka Curriculum with activities that refer to the learning outcomes. The learning outcomes used in Biology subjects are that at the end of Phase E, students have the ability to create solutions to problems based on local, national or global issues related to understanding viruses and their roles. The content presented in the electronic module is in line with the learning outcomes in phase E, namely virus material with a social science problem-based learning approach. The first topic is related to Wolbachia bacteria, which is the latest innovation in suppressing the reproduction of dengue virus, the cause of dengue fever. And the second issue is discrimination against PLWHA (people living with HIV/AIDS). The selection of the two issues was based on the fact that the topic was a hot topic of discussion among the community with various pros and cons that facilitated the students in providing arguments and strengthening their opinions based on analysis related to the given issues.

In this planning stage, the module content is organized and structured in such a way that the designed module product is more interesting and easier for students to understand. The results of module product design are shown in Figure 2.

The next phase is the development phase. In this stage, the planning results are realized by using the Canva and Issue applications, and then the product link is shared with the students. In this development stage, the results of data validation of material feasibility and media feasibility conducted by material experts and media experts are presented in Table 4.



Figure 2. Example of e-module design based on social science issues

Table 4. Results of E-Module Validation

Expert	Average Score	Criteria
Material	3.11	Very feasible
Media	3.77	Very feasible

Based on the results of the feasibility assessment by materials and media experts, the category is very feasible. This is consistent with research Humairah (2022) that e-modules are easier for students to use because they are easily accessible through smartphones and have clear instructions.

The aspect of material feasibility is used to measure the quality of the presentation of material in e-modules in terms of the suitability of the material with learning outcomes, learning objectives and indicators of learning achievement. This is because the learning activities in the social science-based e-module have been aligned with learning objectives that help students to better understand the material. In line with the opinion Cheva et al. (2019) that learning activities based on socio-scientific issues help students to understand the material presented more easily. This is supported by the opinion (Putriana, 2020) that the use of the socio-scientific approach in the learning process and in the framework of the teaching materials makes it easier for students to understand the teaching materials.

In the Media Feasibility aspect, the category is Very Feasible. This feasibility includes aspects of display quality, ease of use, and aspects of illustration quality with a very feasible category. Through interesting illustrations in the module can be an attraction for students, so as to increase student motivation in the learning process. In accordance with the opinion Laksmi et al. (2021) that an attractive and simple design according to the characteristics of students has an attraction that can arouse students' interest in independent learning. This is reinforced by the results of

research Lafifa et al. (2023) that the use of electronic modules can increase student motivation in the learning process. Student motivation plays an important role in the learning process (Samsi & Djukri, 2024). Learner motivation is very important to encourage students both internally and externally to achieve learning goals (Djarwo, 2020).

The product evaluation phase is carried out with the aim of revising the product based on the suggestions and input from media expert validators, and the material is then followed up for product improvements. After the product has been declared feasible by experts and practitioners, the implementation stage is carried out, which is the stage of testing the product in real conditions in biology learning activities on virus material. This stage aims to determine the effectiveness of the product in increasing students' interest in learning and argumentation skills. Based on the results of the trial implementation, it is known that the use of e-modules based on social science topics on virus material is effective in increasing students' argumentation skills and interest.

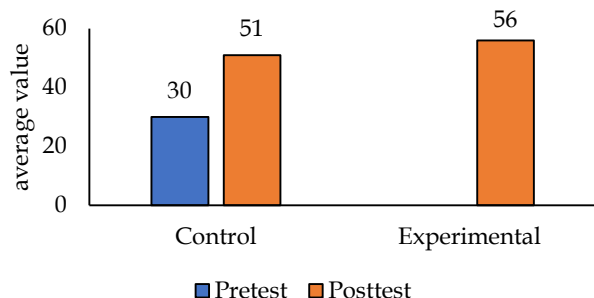


Figure 3. Comparison chart of pre-test and post-test averages learner interest

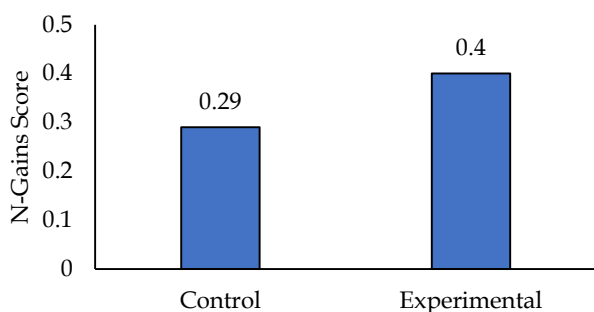


Figure 4. Comparison chart of N-gain averages students' interest in learning

Based on the results of Figure 3, it can be seen that there is an increase in students' motivation in the experimental class as seen by the pretest and posttest scores. While in Figure 4, it is known that the n-gains score of students' interest in learning is higher in the

experimental class than in the control class. The difference in pretest-posttest scores and also n-gain scores in control and experimental classes shows that the use of e-modules is effective in increasing students' interest in learning biology subjects.

This is because e-modules require students to be able to learn actively and independently. This is in accordance with the opinion Liana et al. (2022) that electronic modules are one of the innovative media that can increase students' active learning ability and independence. The use of electronic modules in the learning process can also increase students' interest in learning (Habibah & Fauzi, 2023). This is consistent with the research conducted by Haspen et al. (2021) that e-modules have an attractive design so that they can increase students' interest in learning. Interactive and student-centered learning can be created because the student's learning process using e-modules no longer depends on the teacher as a learning resource (Permatasari et al., 2023).

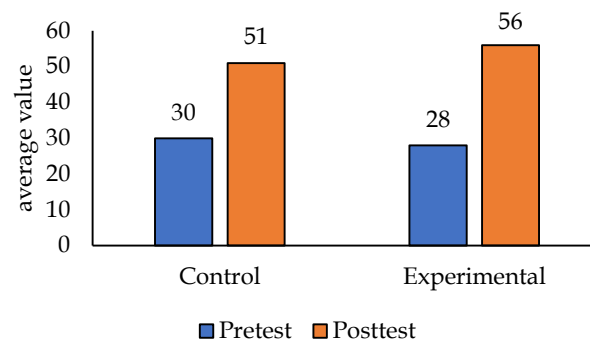


Figure 5. Comparison chart of average pretest and posttest values argumentation ability of students

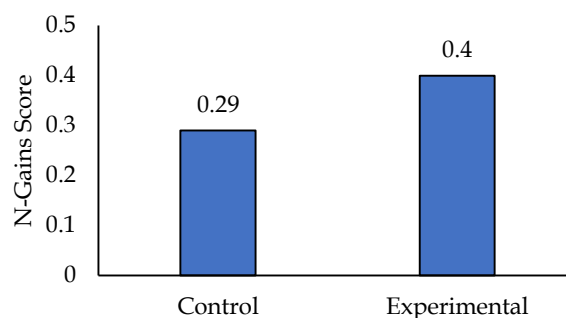


Figure 6. Comparison chart of average N-gains scores Students' Argumentation Ability

Based on the results of Figure 5, it can be seen that there is an increase in the argumentation skills of students in the experimental class as seen by the pretest and posttest scores. While in Figure 6, it is known that the n-gains score of students' argumentation ability in

the experimental class is higher than the control class. The difference between the pretest-posttest scores and also the n-gains scores in the control and experimental classes shows that the use of e-modules is effective in improving students' argumentation skills. This is in line with the research conducted by Prabasari et al. (2021) that the use of e-modules can support learning by 92%. Reinforced by the results of research Kamaruddin et al. (2021) that the use of e-modules based on socio-scientific issues obtained a 92% student response with a very interesting category, so it was concluded that it was feasible to use in the learning process. The results of this study are also according with research conducted by Ubaidillah (2019) that there is a difference in the increase in students' scientific argumentation abilities between those who use the Socio Scientific Issues learning strategy and students who do not use the Socio Scientific Issues learning strategy in the learning process.

The use of the socio-scientific issues approach as a learning stage and a framework for teaching materials makes it easier for students to understand teaching materials, can improve students' argumentation skills and ability to think critically in dealing with related issues (Pratiwi et al., 2021; Rostikawati & Permanasari, 2016). In line with the results of research that the use of social science problem-based learning can improve students' communication and decision-making skills in dealing with problems (Dalaila et al., 2022). Therefore, the application of social science issues can provide a more meaningful learning experience (Selamat, 2023).

Based on the motivation questionnaire, it is also known that students experience an increase in interest in learning biology. This is consistent with research Kusumawati et al., (2022) that the application of a socio-scientific learning process can increase students' interest in the learning process, which is characterized by students' enthusiasm during the learning process.

Conclusion

Based on the results of the research conducted on the development of electronic modules based on social science issues, it can be concluded that the development of electronic modules based on social science issues on virus material is feasible and effective to use in learning biology. The feasibility of the product is confirmed by the material expert assessment with an average value of 3.11 (very feasible) and the media expert assessment with an average value of 3.77 (very feasible). As well as effectiveness in increasing students' interest in learning seen from the n-gains value of 0.55 with a moderate category and improving students' argumentation skills with an n-gains value of 0.4 with a moderate category.

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Author Contributions

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Conflicts of Interest

The author declares that he has no conflicts of interest.

References

- Afgani, T., Hasnunidah, N., & Surbakti, A. (2020). Pengaruh Model Pembelajaran Argument-Driven Inquiry (ADI) Dan Gender Terhadap Keterampilan Argumentasi Siswa. *Jurnal Bioterdidik: Wahana Ekspresi Ilmiah*, 8(1), 1-10. <https://doi.org/doi:10.23960/jbt.v8.i1.01>
- Azizah, H. P., Ilhami, A., & Hafiza, N. (2022). Pengembangan E-Modul IPA SMP Berbasis Socio Scientific Issues (SSI): Systematic Review. *Jurnal Pendidikan Indonesia: Teori, Penelitian, dan Inovasi*, 2(4). <https://doi.org/10.59818/jpi.v2i4.206>
- Çalık, M., & Wiyarsi, A. (2021). A Systematic Review Of The Research Papers On Chemistry-Focused Socio-Scientific Issues. *Journal of Baltic Science Education*, 20(3), 360-372. <https://doi.org/10.33225/jbse/21.20.360>
- Cheva, V. K., & Zainul, R. (2019). Pengembangan E-Modul Berbasis Inkuiri Terbimbing Pada Materi Sifat Keperiodikan Unsur Untuk SMA/MA Kelas X. *EduKimia*, 1(1). <https://doi.org/10.24036/ekj.v1i1.104077>
- Dalaila, I., Widiyaningrum, P., & Saptono, S. (2022). Developing E-Module Based on Socio-Scientific Issues to Improve Students Scientific Literacy. *Journal of Innovative Science Education*, 11(3), 285-294. <https://doi.org/10.15294/jise.v10i1.54500>
- Djarwo, C. F. (2020). Analisis Faktor Internal Dan Eksternal Terhadap Motivasi Belajar Kimia Siswa Sma Kota Jayapura. *Jurnal Ilmiah IKIP Mataram*, 7(1), 1-7. Retrieved from <https://e-journal.undikma.ac.id/index.php/jiim/article/view/2790>
- Fadha, G. S., Purwianingsih, W., & Solihat, R. (2023). Use of E-Modules Based on Socio-Scientific Issues in Efforts to Improve Argumentation and Decision-Making Skills of High School Students. *Jurnal*

- Penelitian Pendidikan IPA*, 9(9), 7591-7598. <https://doi.org/10.29303/jppipa.v9i9.3507>
- Glassner, A., & Schwarz, B. B. (2007). What stands and develops between creative and critical thinking? Argumentation? *Thinking Skills and Creativity*, 2(1), 10-18. <https://doi.org/10.1016/j.tsc.2006.10.001>
- Habibah, R., & Fauzi, A. (2023). Preliminary Study: Analysis of the Need for Physics E-Modules as Guided Inquiry-Based Teaching Materials at MAN 1 Mandailing Natal. *Jurnal Penelitian Pendidikan IPA*, 9(12), 10886-10891. <https://doi.org/10.29303/jppipa.v9i12.5912>
- Hancock, T. S., Friedrichsen, P. J., Kinslow, A. T., & Sadler, T. D. (2019). Selecting Socio-scientific Issues for Teaching: A Grounded Theory Study of How Science Teachers Collaboratively Design SSI-Based Curricula. *Science & Education*, 28(6-7), 639-667. <https://doi.org/10.1007/s11191-019-00065-x>
- Haspen, C. D. T., Syafriani, S., & Ramli, R. (2021). Validitas E-Modul Fisika SMA Berbasis Inkuiri Terbimbing Terintegrasi Etnosains untuk Meningkatkan Kemampuan Berpikir Kreatif Peserta Didik. *Jurnal Eksakta Pendidikan (JEP)*, 5(1), 95-101. <https://doi.org/10.24036/jep/vol5-iss1/548>
- Humairah, E. (2022). Penggunaan Buku Ajar Elektronik (E-Book) Berbasis Flipbook Guna Mendukung Pembelajaran Daring Di Era Digital. *Prosiding Seminar Nasional Batch 1*, 66-71. Retrieved from <https://prosiding.amalinsani.org/index.php/se mnas>
- Kamaruddin, A. N., Azis, A. A., & Taiyeb, A. M. (2021). *Pengembangan Elektronik Modul (E-Modul) Berbasis Socio Scientific Issue (SSI) Terintegrasi Flip PDF Corporate Edition pada Materi Biologi Kelas XI Sekolah Menengah Atas*. Retrieved from <http://eprints.unm.ac.id/id/eprint/20998>
- Karlina, G., & Alberida, H. (2021). Kemampuan Argumentasi Pada Pembelajaran Biologi. *Jurnal Ilmiah Pendidikan dan Pembelajaran*, 5(1). <https://dx.doi.org/10.23887/jipp.v5i2>
- Kusumawati, L., Rochintaniawati, D., & Riandi, R. (2022). Effectiveness of Learning using Web-Based Inquiry Based on Socioscientific Issues to improve students' understanding of Socioscientific Issues. *Jurnal Penelitian Pendidikan IPA*, 8(3), 1569-1574. <https://doi.org/10.29303/jppipa.v8i3.1734>
- Lafifa, F., Rosana, D., Jumadi, J., Suyanta, S., Nurohman, S., & Astuti, S. R. D. (2023). Effect of Using Interactive Electronic Module with Contextual Approach on Students Learning Motivation on Conductor and Insulator Materials. *Jurnal Penelitian Pendidikan IPA*, 9(9), 6734-6741. <https://doi.org/10.29303/jppipa.v9i9.3354>
- Laili, I., Ganefri, & Usmeldi. (2019). Efektivitas Pengembangan E-Modul Project Based Learning Pada Mata Pelajaran Instalasi Motor Listrik. *Jurnal Ilmiah Pendidikan dan Pembelajaran*, 3(3), 306-315. <https://doi.org/10.23887/jipp.v3i3.21840>
- Laksmi, N. L. P. A., & Suniasih, N. W. (2021). Pengembangan Media Pembelajaran E-Comic Berbasis Problem Based Learning Materi Siklus Air pada Muatan IPA. *Jurnal Ilmiah Pendidikan dan Pembelajaran*, 5(1), 56-64. <http://dx.doi.org/10.23887/jipp.v5i2>
- Laksono, R. K. S., & Wibowo, Y. (2022). Pengembangan Bahan Ajar berbasis Socio-Scientific Issues untuk Meningkatkan Higher Order Thinking Skill. *Jurnal Pendidikan Sains Indonesia*, 10(4), 752-765. <https://doi.org/10.24815/jpsi.v10i4.25719>
- Liana, D. E., Muzzazinah, M., & Indrowati, M. (2022). Development of Science E-Modules Based of Guided Inquiry to Improve Students' Critical Thinking Ability. *Jurnal Penelitian Pendidikan IPA*, 8(3), 1368-1375. <https://doi.org/10.29303/jppipa.v8i3.1668>
- McGriff, S. J. (2000). *Instructional System Design (ISD): Using the ADDE Model*. College of Education.
- Pachler, N., Bachmair, B., & Cook, J. (2010). *Mobile Learning*. Springer US. <https://doi.org/10.1007/978-1-4419-0585-7>
- Permatasari, H. H. N., Suharno, & Suryana, R. (2023). Effectiveness of the Predict-Observe-Explain (POE) Model in The Physics Electronic Modules to Improve Critical Thinking Skills. *Jurnal Penelitian Pendidikan IPA*, 9(12), 10679-10688. <https://doi.org/10.29303/jppipa.v9i12.4681>
- Pitorini, D. E., Suciati, S., & Ariyanto, J. (2020). Kemampuan argumentasi siswa: Perbandingan model pembelajaran inkuiri terbimbing dan inkuiri terbimbing dipadu dialog Socrates. *Jurnal Inovasi Pendidikan IPA*, 6(1). <https://doi.org/10.21831/jipi.v6i1.27761>
- Prabasari, J. S., M., & Wahyuningsih, D. (2021). Pengembangan Elektronik Modul Berbasis Problem Based Learning Pada Materi Zat Aditif Dan Zat Adiktif Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa. *Jurnal Penelitian Pendidikan IPA*, 7(SpecialIssue), 312-319. <https://doi.org/10.29303/jppipa.v7iSpecialIssue.1233>
- Pratiwi, E., Suryanti, & Sudibyo, E. (2021). Pengembangan Bahan Ajar Berbasis Socio Scientific Issues Dengan Menggunakan Multimedia Interaktif Untuk Melatih Keterampilan Berpikir Kritis Siswa Kelas V Sekolah Dasar. *Jurnal Education and development*, 9(1). Retrieved from

- <https://journal.ipts.ac.id/index.php/ED/article/view/2374>
- Prihadi, S. (2017). *Penguatan Ketrampilan Abad 21 Melalui Pembelajaran Mitigasi Bencana Banjir*.
- Putriana, A. R. (2020). Pengembangan Lkpd Berbasis Socio Scientific Issue (Ssi) Pada Pembelajaran Ipa Smp Kelas Vii. *Jurnal Pajar (Pendidikan dan Pengajaran)*, 4(1). <https://doi.org/10.33578/pjr.v4i1.7919>
- Rahayu, S. (2019). Socioscientific issues: manfaatnya dalam meningkatkan pemahaman konsep sains, Nature of Science (NOS) dan Higher Order Thinking Skills (HOTS). In *Seminar Nasional Pendidikan IPA UNESA (Vol. 10)*. <https://doi.org/10.13140/RG.2.2.16332.16004>
- Respati, A. A., & Atun, S. (2023). Effect of Electronic Modules on Self-regulated Learning and Cognitive Learning Outcomes on Chemical Bonding Material. *Jurnal Penelitian Pendidikan IPA*, 9(5), 2489–2496. <https://doi.org/10.29303/jppipa.v9i5.2430>
- Risanatul, R., & Junaidi, J. (2022). Penyebab Peserta Didik Tidak Berpartisipasi Aktif dalam Pembelajaran Sosiologi di Kelas XI IPS 1 SMAN 4 Merangin Jambi. *Naradidik: Journal of Education and Pedagogy*, 1(3), 327–335. <https://doi.org/10.24036/nara.v1i3.74>
- Rostikawati, D. A., & Permanasari, A. (2016). Rekonstruksi bahan ajar dengan konteks socio-scientific issues pada materi zat aditif makanan untuk meningkatkan literasi sains siswa. *Jurnal Inovasi Pendidikan IPA*, 2(2), 156. <https://doi.org/10.21831/jipi.v2i2.8814>
- Roviati, E., & Widodo, A. (2019). Kontribusi Argumentasi Ilmiah dalam Pengembangan Keterampilan Berpikir Kritis. *Titian Ilmu: Jurnal Ilmiah Multi Sciences*, 11(2), 56–66. <https://doi.org/10.30599/jti.v11i2.454>
- Sadler, T. D., Romine, W. L., & Topçu, M. S. (2016). Learning science content through socio-scientific issues-based instruction: A multi-level assessment study. *International Journal of Science Education*, 38(10), 1622–1635. <https://doi.org/10.1080/09500693.2016.1204481>
- Samsi, I. F. & Djukri. (2024). A Development of Flipped Classroom Based an Electronic Module on Circulation System Material to Increase Student' Learning Motivation. *Jurnal Penelitian Pendidikan IPA*, 10(7), 4319–4326. <https://doi.org/10.29303/jppipa.v10i7.7411>
- Selamat, I. N. (2023). Pengembangan Bahan Ajar Pencemaran Tanah Dan Sampah Berbasis Socio-Scientific Issue. *Jurnal Pendidikan dan Pembelajaran IPA Indonesia*, 11(1), 1–9. <https://doi.org/10.23887/jppii.v11i1.60843>
- Siska, S., Triani, W., Yunita, Y., Maryuningsih, Y., & Ubaidillah, M. (2020). Penerapan Pembelajaran Berbasis Socio Scientific Issues Untuk Meningkatkan Kemampuan Argumentasi Ilmiah. *Edu Sains Jurnal Pendidikan Sains & Matematika*, 8(1), 22–32. <https://doi.org/10.23971/eds.v8i1.1490>
- Suryani, Y., Asyhari, A., & Amelya, P. (2024). E-MODUL Fisika Berbasis Socio-Scientific Issues Menggunakan Perangkat Lunak Flip Pdf Professional: Pengembangan E- Modul Pada Materi Momentum Dan Impuls. *Journal of Science Education*, 4(1), 366–372. <https://doi.org/10.52562/biochephy.v4i1.1158>
- Syahrial, Asrial, Melinda, L. G., Fajar, M. R., Jannah, N., Puspitasari, T. O., & Putri, Y. E. (2020). Impact E-Modul Ethnoconstructivism: Attitude & Motivation. *International Journal Of Scientific & Technology Research*, 9(4), 3752–3757. Retrieved from <https://www.ijstr.org/final-print/apr2020/Impact-E-modul-Ethnoconstructivism-Attitude-Motivation.pdf>
- Trilestari, K., & Almunawaroh, N. F. (2020). E-Module as a Solution for Young Learners to Study at Home. In *4th Sriwijaya University Learning and Education International Conference (SULE-IC 2020)* (pp. 364–369). Atlantis Press. <https://doi.org/10.2991/assehr.k.201230.132>
- Ubaidillah, M. (2019). Strategi Socio Scientific Issues untuk Meningkatkan Kemampuan Argumentasi Ilmiah Siswa pada Konsep Sistem Respirasi Di Kelas XI MIPA SMAN 1 Suranenggala. *JIA: Jurnal Ilmu Alam Indonesia*, 2(1), 50–59. Retrieved from <https://www.syekhnurjati.ac.id/jurnal/index.php/jia/article/view/6274>
- Wirawan, I. K. A., Arnyana, I. B. P., & Subagia, I. W. (2023). Pengaruh Model Pembelajaran Berbasis Proyek Berorientasi Isu Sosiosaintifik Terhadap Hasil Belajar Peserta Didik Ditinjau dari Efikasi Diri. *Jurnal Penelitian Pendidikan IPA*, 9(10), 9056–9066. <https://doi.org/10.29303/jppipa.v9i10.4831>