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DEVELOPMENT OF E-MODULES ASSISTED BY QR CODE THROUGH PBL LEARNING BASED ON SOCIO SCIENTIFIC ISSUES (SSI) TO IMPROVE CRITICAL THINKING SKILLS: REVIEW ARTICLE

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Abstract. *Problem-Based Learning (PBL) based on Socio-Scientific Issues (SSI) is a learning approach that engages students in solving real-world problems that are socially and scientifically relevant. This review article analyses 20 journal articles published between 2018 and 2023, selected from national and international sources, focusing on the development and implementation of e-module teaching materials through PBL based on SSI. The qualitative literature review method was employed. Findings indicate that integrating PBL with SSI in chemistry education effectively enhances students' critical thinking skills. The contextual nature of SSI makes learning more meaningful and relevant. However, while e-modules offer advantages such as accessibility and interactivity, challenges remain in ensuring equal understanding among students with diverse backgrounds..*

Keywords: problem based learning, sioscio scientific issues, critical thinking, literature review

INTRODUCTION

Learning is known as an aspect of education that has a major role in determining the quality of education in accordance with the times (Suryaningsih *et al*., 2021). The development of science and technology is in line with improving the quality of education in schools, especially in adopting technology. The application of technology in teaching facilitates the teaching process of teachers to students and expands access to unlimited information (Muzana et al., 2021) which can be done in various ways, especially the teaching materials used cannot be separated from the existence of the industrial revolution era 4.0 (Nuraeni *et al*., 2019). This is necessary because learning is not only oriented towards the current learning needs of students but must be oriented towards future life patterns so that students can become lifelong learners. Therefore, teachers need to design and manage learning by involving students in encouraging learning by understanding and utilising technology that can be used as teaching materials in the learning process.

Teaching materials are an important learning tool as a tool for the smooth learning process. However, in reality, in accordance with the times of technological development and previous research that has been conducted, the delivery of material is less effective when using simulations in the form of printed modules because the delivery of material becomes less interactive and monotonous, and cannot convey implied messages through images, animations, and videos (Kurniawan & Suyatna, 2015). Therefore, the use of teaching materials that can be integrated electronically is one of the characteristics of learning for today's digital young

generation. An example is the use of teaching materials in the form of electronic modules or E-modules.

However, the form of innovation that can be done by educators in the current era of information technology is not only by using teaching materials in the learning process and utilising existing information technology, especially in the field of chemistry. But also improving the quality of learning because teaching materials itself is actually only as tools or tools and not everything as said by the Indonesian Minister of Education, Nadiem Makarim. Chemistry is one of the branches of Natural Sciences which is the basis of science because it studies a material that is reviewed in terms of its structure, properties to changes accompanied by changes in energy (Jespersen *et al*., 2012). One of the common chemical materials in everyday life is electrochemistry. Electrochemistry itself is a branch of chemistry that connects electrical energy with chemical reactions. Therefore, this electrochemical material contains a wide range of phenomena and even problems in society related to the concept of science learning or science to train students' skills directly (Azizah *et al*., 2022). The skills that can be raised are critical thinking skills.

Contrary to the condition of students in Indonesia, they are not accustomed to solving problems by requiring aspects of critical thinking and even creative thinking such as reasoning, analysis, application, and evaluation. In fact, critical thinking skills are included in skills that require high-level thinking patterns that can optimise learning objectives (Fihani et al., 2021), especially in effective problem solving. Thus, the need for changes in the chemistry learning process to improve critical thinking skills, with the application of Problem Based Learning (PBL) as the effectiveness of the learning process is based on learner-centred activities with the potential for educators or teachers to remain involved. Problem Based Learning (PBL) is a learning model that involves students in the process of solving a problem by conducting an investigation through the stages of the scientific method.

Besides students being able to solve a problem, it is necessary to deliver learning materials that are related to real world life, especially in raising issues or problems (Karakoç, 2016) in the community and the environment around students, which is known as the Socio Scientific Issues (SSI) approach (Winarni, *et al*., 2022). Socio Scientific Issues are problems or issues that exist in the social life of society that are closely related to science in a contextual manner so that they can stimulate students to think critically, be able to analyse and reason to voice their arguments (Azizah et al., 2022). In improving this thinking ability, students will indirectly process their scientific thinking skills by finding theories or facts so that students can determine and even make a decision (Zeidler *et al*., 2019).

This article aims to analyse the research trend of e-module teaching materials through problem-based learning based on Socio Scientific Issues (SSI) in terms of its essence, advantages and disadvantages for students in related learning in chemistry subjects in the classroom.

METHOD

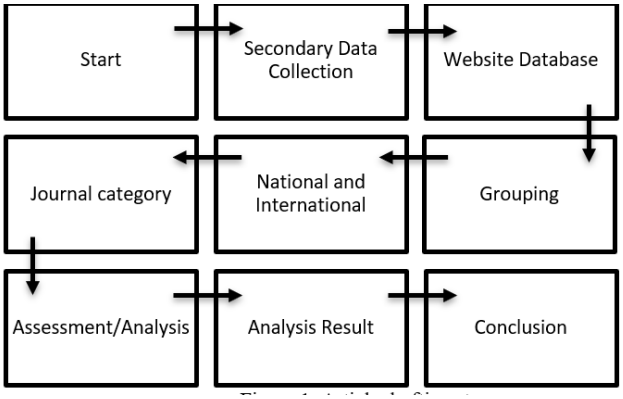
The method used in the preparation of this article is a qualitative method of literature review study approach, which is a collection of information through international and national literature conducted using the Erick research database, Google Scholar, Garuda, ProQuest, Taylor & Francis Group, Cambridge Journals, Researchgate, Springer.com, and Wiley Online Library. From the literature data selected from several sources so that it becomes a conclusion and becomes a new idea that can provide insight into the problem-based learning model and Socio Scientific Issues (SSI) in accordance with chemistry.

Journal articles used as literature are articles that discuss "E-modules" and "problem-based learning models based on Socio Scientific Issues (SSI) in Chemistry". The number of journals obtained is 20 journals taken from 2018 to 2023 using the keywords "e-module"

"chemistry education in problem based learning", "problem based learning of chemistry", "chemistry education in socio scientific issues", "socio scientific issues of chemistry", and "learning model in chemistry education". The 20 journals were identified and explored for relevance, as well as a compilation that will be outlined in the form of a review article. In obtaining the category, the journals are divided or grouped into 2 types of research results, namely national and international journals.

From the division of these categories, then the journals are reviewed from the results and discussions that have been carried out to find out the results obtained as a reference to the research trend of e-module teaching materials through problem-based learning based on Socio Scientific Issues (SSI) in chemistry learning. The stages in the preparation of this article are more clearly shown in the figure

Figure 1. Stages in compiling an article



RESULTS AND DISCUSSION

Results

This study was conducted to determine the research trend of e-module teaching materials through problem-based learning based on Socio Scientific Issues (SSI) applied in the classroom in chemistry subjects both as reference material for educators in handling learning with today's learning demands. The results of the literature review of secondary data related to problem-based learning models and socio scientific issues approaches in chemistry subjects with several journals consisting of national and international journals can be seen in Table 1.

Table 1. National and International Journal Literature Review Data

No	Author and Year	Journal Index	Research Results
1	(Wiyarsi & Çalik, 2019)	International Q-1	The implementation of problem-based learning challenges learners to think like scientists or scientific thinking habits.
2	(Koulougliotis et al., 2021)	International Q-1	The application of SSI can help students understand and solve problems around them, especially more familiar with Green Chemistry.
3	(Hernández-Ramos et al., 2021)	International Q-1	The context of PBL and SSI is the integration of versatile technologies in explaining complex phenomena.

No	Author and Year	Journal Index	Research Results
4	(Sofiana & Wibowo, 2019)	International Q-2	SSI-based modules can be used as a variety of teaching materials that can be used by teachers and students in learning independently.
5	(Rubini et al., 2019)	International Q-4	Problem-based learning with socio-scientific issues can improve students' science literacy in fostering critical thinking skills.
6	(Hamdalia Herzon & Hari Utomo, 2017)	National Sinta 2	The syntax of the problem-based learning model is able to train students to undergo the learning process by thinking at a higher level so that this learning model can improve critical thinking skills with significant results in students.
7	Enawaty, E. (2023). (Enawaty, 2023)	National Sinta 2	The Problem Based Learning (PBL) based Basic Chemistry e-module helps improve thinking skills in Chemistry learning.
8	Putro Utomo, A., Narulita, E., Nur, R., & Billah, I. (2020). (Putro Utomo et al., 2020)	National Sinta 3	SSI learning can improve students' critical thinking skills through learning activities that utilise modules and worksheets.
9	Siska, Yunita, & Ubaidillah, M. (2019). (Siska et al., 2019)	National Sinta 3	The use of a problem-based learning model with problems based on socio-scientific issues (SSI) makes learning more real and meaningful so that students can easily solve a problem.
10	Rosana, D & Hestian. (2020). (Rosana, 2020)	National Sinta 3	The application of learning with the SSI approach can improve students' critical thinking skills.
11	Maula Noer, I., Cahyani, D., & Ekanara, B. (2022). [20]	National Sinta 4	Students' critical thinking skills need to be trained by educators by providing more varied learning models.
12	Ataji, H. (2019). [21]	National Sinta 3	The use of socio scientific based problem based learning model increases students' critical thinking so that students can solve a problem.
13	Pratiwi, M. K. (2022).	National Sinta 4	E-module QR Code is one of the practical and efficient teaching materials to be accessed anywhere and anytime.
14	Rohiat, S.,	National	E-Module QR Code module will be a teaching

No	Author and Year	Journal Index	Research Results
	Amir, H., & Yunita, S. (2018). Click or tap here to enter text.	Sinta 4	material for students in a communicative alternative way.
15	Widarti, H., R.; Wonorahardjo, S.; Asmi, S., O. (2019). Click or tap here to enter text.	International Q-4	The application of problem-based learning by utilising technology can improve students' learning outcomes by providing learning resources in the form of textbooks and media in the form of animated videos.
16	Khasanah, S. U., & Setiawan, B. (2022). Click or tap here to enter text.	National Sinta 2	Learning with the SSI approach can improve learners' literacy by utilising electronic learning media.
17	Kamaruddin, A. N., Azis, A. A., Taiyeb, A. M., & Biologi, M. J. (2021).	National -	The existence of Socio Scientific Issue-based e-modules as teaching materials will make it easier for students to learn the subject matter by presenting issues related to the context in the real life of students.
18	Purwati, R.; Suranto; *et al*. (2019). Click or tap here to enter text.	International -	Problem-Based Learning (PBL) module with the topic of socio-science problems can improve argumentation skills that encourage students to empower critical thinking processes.
19	Setyaningrum Winarni, D., Susilo, S., Saptono, S., & Widiyatmoko, A. (2021).	National Sinta 3	The application of socio-scientific issue (SSI) learning is able to increase efforts in solving problems that become obstacles..
20	Lestari & Annizar. (2020). Click or tap here to enter text.	National Sinta 3	The use of socio-scientific issues (SSI) in learning can develop students' logic skills to stimulate critical thinking skills in addressing the country's problems for the Indonesian generation.

The literature reviewed from 20 journals between 2018–2023 shows a growing interest in integrating problem-based learning with the Socio Scientific Issues (SSI) approach to enhance critical thinking skills in chemistry education. A comparison of national (13 journals) and international (7 journals) studies reveals that while both support the effectiveness of this integrated approach, international journals tend to emphasize technology integration, global scientific literacy, and the development of students' scientific thinking habits. In contrast,

national studies more often focus on practical classroom implementation, the use of e-modules (especially those enhanced with QR Codes), and contextual relevance to local issues. Both domains agree that SSI-based PBL enhances students' ability to reason, argue, and engage critically with real-world problems. Notably, national studies are rich in implementation insights, while international research contributes broader theoretical perspectives and methodological diversity.

Discussion

Journals obtained from search results on Erick research, Google Scholar, Garuda, ProQuest, Taylor & Francis Group, Cambridge Journals, Researchgate, Springer.com, and Wiley Online Library. which focuses on the topic to be studied, namely the problem-based learning model and the socio scientific issues approach in chemistry subjects as information media in chemistry learning so that several journals are obtained including national journals and international journals. The number of each journal used as review material for 13 national journals consisting of Sinta 2 to Sinta 4 along with 7 international journals. The results of the literature review of 20 journals obtained based on Table 1, show that the average results say that problem-based learning based on Socio Scientific Issues (SSI) has many advantages in learning chemistry.

In problem-based learning, there are several stages of identification, definition, problem representation and exploration of strategies or solutions related to the problem as knowledge with different perspectives (Purwati & Murti Prasetyanti, 2019). This provides an opportunity for students to question related phenomena that occur.

Based on research (Putro Utomo *et al*., 2020) the use of this problem-based learning model requires the delivery of learning materials that are related to real-world life, especially in raising issues or problems (Karakoç, 2016). With this, it not only stimulates students to solve a problem but also to solve a problem with debates related to controversial social issues, especially those in the environment or around students critically, which occurs according to their intellectual development (Rahayu, 2015).

Based on research (Hernández-Ramos et al., 2021) that Problem-based learning is constructive and contextual learning so that it fosters an independent attitude in learning, intellectual skills, critical thinking, creative and collaborative learners. With the integration of the Socio Scientific Issues (SSI) approach in Problem-based learning, it can make learning centred on students to have a direct impact on society. There are many approaches used in the problem-based learning model besides Socio Scientific Issues (SSI), including STEM, ethnoscience, TPACK, etc. This indicates that the problem-based learning model is a good choice. This indicates that the problem-based learning model does not make the learning process of students only focused in one field, but can be integrated as a whole with various approaches.

According to (Sholehah et al., 2022), that the Socio Scientific Issues (SSI) approach helps students to provide open answers from various points of view by developing the logical abilities of students in discussions related to problem solving. The learning process leads or centers on students, the teacher is only a facilitator. Therefore, the critical thinking skills of these students will be honed in the process of discussion and debate.

Based on research (Lestari & Annizar, 2020), Socio Scientific Issues (SSI) based learning can also foster logical abilities and even basic reasoning in higher-level thinking. Students can be said to be reasoning if these students can implement the knowledge that has been obtained into new conditions that become the problems they encounter.

Based on research (Enawaty, 2023), if in learning the more problems students face, the more the students' critical thinking skills will increase. Then the more contextual the issue or problem presented, the more effective the learning that takes place and the more active the

students are motivated. This is supported by expert opinion, according to (Nurul Khotim et al., 2015) that such learning can build students' conceptual understanding of learning material and help students in applying it in the real world according to scientific concepts (Devi Imaningtyas et al., 2016).

Based on research (Rosana, 2020), the integration of the application of problem-based learning based on Socio Scientific Issues (SSI) can improve problem solving, communication, collaboration and critical thinking skills. Problem solving skills are one of the important skills for students who need creativity and critical thinking in finding solutions. This ability is able to link something with others accurately (Andryani *et al*., 2016).

Based on research (Rubini *et al*., 2019) In Indonesia, students' critical thinking skills are still very lacking. This is evidenced by the 2018 PISA results that Indonesia is ranked 7th from the bottom (Lestari & Annizar, 2020). The application of a problem-based learning model based on Socio Scientific Issues (SSI) involves students to encourage the ability to discuss to openly share ideas. Optimizing the learner-centered learning process but still paying attention to the formation of competent learners. This can be used as the basis for a combination of theories between problem-based learning and Socio Scientific Issues (SSI), proof that both support each other in improving students' critical thinking skills so as to create a dynamic and meaningful learning environment.

(1)Learning Syntax *Problem Based Learning*

Based on research (Herzon et al, 2018), the problem-based learning model can improve students' critical thinking skills with syntax that can train these abilities, among others, with the following steps:

- **3.1.1 Orienting students to the problem**

At this stage, the teacher as an educator provides information related to learning objectives, logistical needs, and directs students to observe the problem.

- **3.1.2 Organizing students in learning activities**

At this stage, the teacher as an educator provides assistance to students in determining and organizing tasks so that they are able to convey various questions related to the problems that have been studied.

- **Guiding and assisting independent and group investigations**

At this stage, the teacher as an educator helps students in carrying out their duties, namely gathering information, conducting experiments or experiments and tracking solution strategies related to the problems studied.

- **Developing and presenting work**

At this stage, the teacher as an educator assists students in planning and preparing a work product by associating some data that has been obtained from various sources.

- **Analyzing and evaluating the problem-solving process**

At this stage, the teacher as an educator helps students analyze and evaluate the answers that have been obtained in solving the problems being studied (Kemendikbud, 2017).

(2)Disadvantages of Problem Based Learning based on Socio Scientific Issues (SSI)

Based on research (Sofiana & Wibowo, 2019) with many advantages of applying Socio Scientific Issues (SSI) based problem-based learning, it certainly has disadvantages where the learning is included in learning with a contextual approach. What can be a drawback is that it allows students to have difficulty or even not be able to participate in learning because they do not get the same knowledge and experience among other students. However, this deficiency can be bridged by developing teaching materials or independent teaching materials for students in the form of modules. This is because e-modules are teaching materials that can provide

opportunities for students to learn at their own pace and help students improve weaknesses in knowledge through repetition of material (Erifal, 2010).

The selection of teaching materials or independent teaching materials for students also needs to pay attention to current technological advances in the digital era. An era that is always continuous with digital assistance called digital native. One of them is teaching material in the form of E-modules or electronic modules based on QR Code. E-Modules are practical, efficient teaching materials that can be accessed in various spaces and are easily understood according to the ability of students (indana & Kurnia, 2022). Regarding the use of QR Code in the E-module, it is able to present and manage knowledge information related to learning in a limited place and make e-modules as alternative and communicative teaching materials.

CONCLUSION

The results of the literature study show that during the period 2018–2023, problem-based learning based on Socio Scientific Issues (SSI), which integrates social issues or problems in real life, can help students develop critical thinking skills. The more contextualized the issues or problems presented, the more effective the learning process becomes, and students are motivated to be more active in thinking critically. However, it is necessary to select teaching materials or independent teaching resources that align with current technological developments in the digital era—one of which is electronic modules (E-modules).

The implication of this study indicates that integrating SSI into problem-based learning can serve as a pedagogical strategy to enhance student engagement and critical thinking in chemistry education. However, a key limitation lies in the variability of students' prior knowledge and access to digital tools, which may affect their ability to benefit equally from SSI-based E-modules. Future research is recommended to explore the development and implementation of SSI-based E-modules in diverse classroom settings, including comparative studies on their effectiveness across different educational levels and socioeconomic backgrounds. Additionally, further investigation is needed on how to scaffold students' digital literacy and argumentation skills to maximize the benefits of this approach.

DAFTAR PUSTAKA

Andryani, F., Djafar, H., Jurusan, M. Q., Fisika, P., Tarbiyah, F., & Keguruan, D. (2016). Penerapan Pendekatan SSI (Socio-Scientifict Issues) dengan Menggunakan Media Power Point terhadap Kemampuan Berpikir Kritis pada Mahasiswa Baru Angkatan 2015 Jurusan Pendidikan Fisika Fakultas Tarbiyah dan Keguruan Universitas Islam Negeri Alauddin Makassar. Jurnal Pendidikan Fisika, 4(2). http://journal.uin-alauddin.ac.id/indeks.php/PendidikanFisika

Asmi, S. O., Wonorahardjo, S., & Widarti, H. R. (n.d.). The Application of Problem Based Learning Assisted by Blended Learning In Atomic Spectroscopy Material on Cognitive Learning Outcomes and Students' Self System Based on Marzano Taxonomy The Application of Problem Based Learning Assisted by Blended Learning In Atomic Spectroscopy Material on Cognitive Learning Outcomes and Students' Self System Based on Marzano Taxonomy. European Journal of Open Education and E-Learning Studies , 2019. https://doi.org/10.5281/zenodo.3236775

Ataji, H. (2019). Pengembangan Modul Berbasis Qr Code Technology pada Materi Sistem Reproduksi Manusia dengan Terintegrasi Kepada Al-quran dan Hadits sebagai Sumber Belajar Biologi Kelas XI Sman 1 Punggur. Bioedusiana, 4(2), 17–24. https://doi.org/10.34289/285231

Azizah, H. P., Hafiza, N., & Ilhami, A. (2022). Pengembangan E-Modul IPA SMP Berbasis Socio Scientific Issues (SSI) : Systematic Review Riwayat Artikel. Jurnal Pendiidkan Indonesia: Teori, Penelitian Dan Inovasi, 2(4), 2807–3878.

Devi Imaningtyas, C., Karyanto, P., & Asriani, L. (2016). Penerapan E-Module Berbasis Problem Based Learning untuk Meningkatkan Literasi Sains dan Mengurangi Miskonsepsi pada Materi Ekologi Siswa Kelas X MIA 6 SMAN 1 Karanganom Tahun Pelajaran 2014/2015. Jurnal Pendidikan Biologi.

Enawaty, E. (2023). Development of Basic Chemistry E-Module Based on Problem-Based Learning for Chemistry Education Students. Jurnal Penelitian Pendidikan IPA, 9(2), 568–573. https://doi.org/10.29303/jppipa.v9i2.2677

Erifal. (2010). Pengembangan Modul Pemecahan Masalah pada Pembelajaran Geometri Di SMA. FKIP UNSRI.

Fihani, N., Yaumul Hikmawati, V., & Mu'minah, I. H. (2021). Pendekatan Socio-Scientific Issue (SSI) untuk Meningkatkan Keterampilan Berpikir Kritis Siswa SMA pada Konsep Virus.

Hamdalia Herzon, H., & Hari Utomo, D. (2017). Pengaruh Problem-Based Learning (PBL) terhadap Keterampilan Berpikir Kritis. Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan . http://journal.um.ac.id/index.php/jptpp/

Hernández-Ramos, J., Pernaa, J., Cáceres-Jensen, L., & Rodríguez-Becerra, J. (2021). The effects of using socio-scientific issues and technology in problem-based learning: A systematic review. In Education Sciences (Vol. 11, Issue 10). MDPI. https://doi.org/10.3390/educsci1110064

Indana, P. S., & Kurnia, M. (2022). Development Of A Qr-Code-Based E-Module to Train Students' Digital Literature Ability on Environmental Change Materials. In Tahun (Vol. 11, Issue 2). https://ejournal.unesa.ac.id/index.php/bioedu

Jespersen, N. D., Brady, J. E., & Hyslop, A. (2012). Chemistry: The Molecular Nature of Matter, Sixth Edition (6th ed.). Wiley.

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.

Karakoç, M. (2016). The Significance of Critical Thinking Ability in terms of Education. International Journal of Humanities and Social Science, 6(7). www.ijhssnet.co

Kemendikbud. (2017). Naskah-Naskah Model Pembelajaran.

Khasanah, S. U., & Setiawan, B. (2022). Penerapan Pendekatan Socio Scientific Issues Berbantuan E-LKPD pada Materi Zat Adiktif untuk Meningkatkan Literasi Sains Siswa. PENSA E-JURNAL : PENDIDIKAN SAINS. www.liveworksheet.com

Koulougliotis, D., Antonoglou, L., & Salta, K. (2021). Probing Greek secondary school students' awareness of green chemistry principles infused in context-based projects related to socio-scientific issues. International Journal of Science Education, 43(2), 298–

313. https://doi.org/10.1080/09500693.2020.1867327

Kurniawan, D., & Suyatna, A. (2015). Pengembangan Modul Interaktif Menggunakan Learning Content Development System pada Materi Listrik Dinamis. Jurnal Pembelajaran Fisika.

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

Maula Noer, I., Cahyani, D., & Ekanara, B. (2022). Pengaruh Pendekatan Socio Scientific Issues-Based Instruction Terhadap Kemampuan Berpikir Kritis Siswa Pada Materi Virus Kelas X Di MAN 1 Kota Cirebon. 1(2), 1–5.

Muzana, S. R., Jumadi, Wilujeng, I., Yanto, B. E., & Mustamin, A. A. (2021). E-STEM project-based learning in teaching science to increase ICT literacy and problem solving. International Journal of Evaluation and Research in Education, 10(4), 1386–1394. https://doi.org/10.11591/IJERE.V10I4.21942

Nuraeni, S., Feronika, T., & Yunita, D. L. (2019). Implementasi Self-Efficacy dan Keterampilan Berpikir Kritis Siswa Pada Pembelajaran Kimia di Abad 21. Jambura Journal of Educational Chemistry, 1(2).

Nurul Khotim, H., Nurhayati, S., & Hadisaputro, S. (2015). Pengembangan Modul Kimia Berbasis Masalah pada Materi Asam Basa. Chemistry in Education. http://journal.unnes.ac.id/sju/index.php/chemined

Purwati, R., & Murti Prasetyanti, N. (2019). Problem-Based Learning Modules with Socio-Scientific Issues Topics to Closing the Gap in Argumentation Skills. TOJET: The Turkish Online Journal of Educational Technology, 18(4).

Putro Utomo, A., Narulita, E., Nur, R., & Billah, I. (2020). Penerapan model pembelajaran problem based learning berbasis socio-scientific issue (SSI) terhadap kemampuan berpikir kritis siswa SMP. JURNAL PENDIDIKAN IPA VETERAN, 4(2), 2020. https://doi.org/10.31331/jipva.v4i2.1259

Rahayu, S. (2015). Meningkatkan profesionalisme dalam mewujukan literasi sains siswa melalui pembelajaran kimia/IPA berkonteks isu-isu sosiosaintifik (socioscientific issues). Semnas Pendidikan Kimia Dan Sains Kimia, 1–16.

Rohiat, S., Amir, H., & Yunita, S. (2018). Analisis Kemampuan Berpikir Kritis Mata Pelajaran Kimia pada Siswakelas XI IPA SMAN 1 Kepahiang. 2, 33–38

Rosana, D. (2020). The Effect of Problem Based Learning Based Sosio-Scientific Issues on Scientific Literacy and Problem-Solving Skills of Junior High School Students. Journal of Science Education Research Journal, 1, 15–21. www.journal.uny.ac.id/jser

Rubini, B., Ardianto, D., Setyaningsih, S., & Sariningrum, A. (2019). Using Socio-scientific Issues in Problem Based Learning to Enhance Science Literacy. Journal of Physics: Conference Series, 1233(1). https://doi.org/10.1088/1742-6596/1233/1/012073

Setyaningrum Winarni, D., Susilo, S., Saptono, S., & Widiyatmoko, A. (2021). Prosiding Seminar Nasional Pascasarjana ISSN 26866404 Pascasarjana Universitas Negeri Semarang Penerapan pendekatan Socio-Sicentific Issue (SSI) Menggunakan Desain Project untuk Meningkatkan Penguasaan Technopreneurship Mahasiswa. In Prosiding Seminar Nasional Pascasarjana. http://pps.unnes.ac.id/prodi/prosiding-pascasarjana-unnes/

Sholehah, A., Pertiwi, A. D., & Yudianti, F. (2022). Studi literatur penggunaan pendekatan socio scientific issue untuk membentuk generasi indonesia yang kritis. In Sholehah @Studi Literatur Penggunaan… ScienceEdu (Issue 2).

Siska, Yunita, & Ubaidillah, M. (2019). Strategi Socio Scientific Issues untuk Meningkatkan Kemampuan Argumentasi Ilmiah Siswa pada Konsep Sistem Respirasi Di Kelas XI MIPA SMAN 1 Suranenggala. Jurnal Ilmu Alam Indonesia . www.syekhnurjati.ac.id/jurnal/index.php/jia

Sofiana, S., & Wibowo, T. (2019). Pengembangan Modul Kimia Socio-Scientific Issues (SSI) Materi Reaksi Reduksi Oksidasi. Journal of Educational Chemistry (JEC), 1(2), 92. https://doi.org/10.21580/jec.2019.1.2.4382

Suryaningsih, S., Fakhira, D., & Nisa, A. (2021). Kontribusi Steam Project Based Learning Dalam Mengukur Keterampilan Proses Sains dan Berpikir Kreatif Siswa. Jurnal Pendidikan Indonesia, 2(6)

Wiyarsi, A., & Çalik, M. (2019). Revisiting the scientific habits of mind scale for socio-scientific issues in the Indonesian context. International Journal of Science Education, 41(17), 2430–2447. https://doi.org/10.1080/09500693.2019.16839

Zeidler, D. L., Herman, B. C., & Sadler, T. D. (2019). New directions in socioscientific issues research. Disciplinary and Interdisciplinary Science Education Research, 1(1). https://doi.org/10.1186/s43031-019-0008-7