



Effectiveness of Implementing PBL-SSI-Based Electronic Modules on Reflective Judgment and Communication Skills of Muhammadiyah High School Students

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Abstract

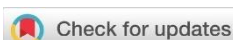
Background: The PBL-SSI model approach can develop students' reflective judgment and communication skills at school because learning with this model is based on scientific concepts that impact people's lives. This research aims to determine the effectiveness of implementing SSI-based electronic modules in improving the reflective judgment and communication skills of class X Muhammadiyah High School students in Palembang City. **Methods:** The research method uses a quantitative descriptive method, with the research subjects being biology teachers and class X students at SMA Muhammadiyah 1 and SMA Muhammadiyah 5, Palembang City. This research is quasi-experimental, with a pretest-posttest non-equivalent control group design. **Results:** The research results show that the effectiveness value of the PBL-SSI electronic module can increase reflective judgment, as seen from the N-gain value results. Muhammadiyah 1 High School in the control class has 40% less effective criteria, and the experimental class has 71% sufficient criteria that are effective. Muhammadiyah High School 5 in the control class was 25% ineffective criteria, and the experimental class was 61% quite effective criteria. Meanwhile, the results of communication skills were obtained by SMA Muhammadiyah 1 in the control class with a score of 76 good criteria, the experimental class with a score of 83 perfect criteria, SMA Muhammadiyah 5 in the control class with a score of 79 good criteria, the experimental class with a score of 88 perfect criteria. **Conclusions:** Applying PBL-SSI-based electronic modules on environmental change material effectively improves students' reflective judgment and communication skills.

Keywords: Communication; Effectiveness; Electronic module; PBL-SSI; Reflective Judgement

Introduction

Students in 21st-century education must increase their knowledge and skills but not abandon moral education that aligns with national education goals (Rafikov et al., 2021). Moral education instilled in students includes ethics expected to provide knowledge in distinguishing between good and evil (Froushani et al., 2012). The ability to have good and bad attitudes in learning is self-regulation in deciding (judging) and suitable communication methods, resulting in interpretation, analysis, evaluation, inference, and exposure to using evidence, concepts, methodology, criteria, or contextual considerations, which is the basis for making decisions and is categorized by experts as critical thinking skills (Siti, 2018).

Reflective judgment is the ability to think reflectively in making decisions and solving problems based on specific considerations (Karişan et al., 2018). This shows the literacy level



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of students in analyzing information or data from various sources and using it as a basis for making responsible decisions (Subiantoro et al., 2013). The ability to make decisions reflectively and communicate with students in solving a social problem is still experiencing difficulties due to students' lack of understanding of concepts and literacy skills, which creates doubts in determining attitudes towards biological issues that can be found daily.

The SSI approach is a scientific approach to problems in community activities, which is theoretically and closely related to scientific subject matter (Kim & Lee, 2017). Issues regarding the environment often have uncertain and complicated responses for students. The SSI approach found in the environment is a relevant problem that occurs where students live (Shuaib et al., 2022), and discussing this problem is essential to stimulate communication and decision-making skills in students' actions (Karakaya, 2022). Using this approach in learning is expected to facilitate students in developing arguments related to scientific concepts and societal problems related to science.

Using the problem-based learning (PBL) model based on socioscient issues (SSI), two teaching and learning approaches emphasize applying knowledge to solve relevant problems. The incorporation of SSI-based PBL specifically integrates relevant social and scientific issues in teaching and learning. This teaching and learning model focuses more on contemporary issues involving social, ethical, environmental, and scientific aspects. Students are not only asked to be able to solve problems but also to explore the social, moral, and scientific impacts of the issues under consideration. So far, these two approaches have been used to improve written argumentation (Balgopal, 2017), technology simulations in learning (Chang, 2016), and evaluation of school curricula (El Arbid, 2020). Increasing student communication and decision-making in responding to attitudes toward caring for the environment using the PBL-SSI combination has never been done, and it is essential to apply to students. The combination of PBL-SSI can stimulate students to be more concerned about the surrounding environment, especially with environmental changes that occur significantly around where students live.

Learning that only focuses on teaching materials often creates difficulties in understanding lessons (Gusman, 2023), especially environmental material. Therefore, teachers consider environmental change material integrated with social problems to increase students' references to understand ecological change material and increase sensitivity values in protecting the environment. According to (Ule et al., 2021), students can integrate the use of various potentials that exist in the surrounding environment with environmental change material, as well as different factors that cause changes in the surrounding environment, such as pollution (water, soil, air, and sound pollution), landslides and floods.

The advantage of the product offered is that it raises local environmental issues regarding controversial environmental changes in Palembang City by displaying pictures and videos to make learning more attractive. Students can be helped to understand social problems conceptually linked to science, which will later involve morals or ethics in solving issues (Zeidler & Nichols, 2009). Implementing SSI in learning in various countries can improve students' abilities, especially in supporting the 21st Century (Genisa et al., 2020), including using SSI-based teaching materials. Electronic modules can support students' 21st-century skills, especially reflective judgment skills, which are part of critical thinking. Apart from that, if the content of the electronic module is linked to SSI, which is a conceptual representation of social issues or problems in social life, then this is very appropriate for the development of reflective decision-making. Therefore, this research aims to determine the effectiveness of SSI-based electronic modules in improving students' reflective judgment and communication skills at SMA Muhammadiyah Palembang City. The research results hope to make students more concerned about protecting the environment.

Methods

This research was conducted using quantitative descriptive methods. Samples were taken at Muhammadiyah High School accredited A, namely SMA Muhammadiyah 1 and SMA Muhammadiyah 5 Palembang in class X with two biology teachers, 55 students in the experimental class, and 62 in the control class. This research is quasi-experimental, with a pretest-posttest non-equivalent control group design. The instruments used include 1) observation sheets to observe the implementation of semester learning plans in the learning process and 2) tests to obtain data on the effectiveness of reflective judgment skills. The dependent variable instrument in this research is the reflective judgment understanding test instrument. Data on understanding these skills is collected using test instruments. Quantitative data was analyzed using inferential analysis to determine the significance of the differences between the control and treatment classes. The value of applying the SSI electronic module in improving reflective judgment skills refers to the calculation of the N-Gain percentage analysis by Hake (1998) with four groupings of criteria: effective, quite effective, less effective, and ineffective. Meanwhile, the value of increasing student communication refers to the communication assessment by Fitriyani et al. (2019), which has five assessment categories: inferior, poor, sufficient, reasonable, and very good.

Result

The effectiveness of implementing SSI-based electronic modules was obtained from the pretest and posttest results of the control and experimental classes by obtaining the N-gain value (Table 1).

Table 1. Results of N-gain Analysis for Control Class and Experimental Class Muhammadiyah 1 High School Palembang.

Class	Pretest	Posttest	N-gain %	Criteria
X IPA 4 (Control)	44,2	68	40	Less effective
X Tahfiz (Experimental)	36	82	71	Quite effective

Table 2. Results of N-gain Analysis for Control Class and Experimental Class Muhammadiyah 5 High School Palembang

Class	Pretest	Posttest	N-gain %	Criteria
X 2 (Control)	32	50	25	Ineffective
X 3 (Experimental)	39,4	77	61	Quite effective

Table 3. Results of N-gain Analysis for Control Class and Experimental Class in both school

Class	Pretest	Posttest	N-gain%	Criteria
Control Class	39	60	34	Ineffective
Experimental	37	79	67	Quite effective

Based on the results of the N-gain analysis obtained at SMA Muhammadiyah 1 Palembang in the control class, it was 40% (less effective criteria). In contrast, in the experimental class, the N-gain value was 71% (quite effective criteria). This is different at SMA Muhammadiyah 5 Palembang, where the control class obtained an N-gain value of 25% (ineffective criteria), while the N-gain analysis results for the experimental class were 61% (quite effective criteria). In the control class, the N-gain value was obtained at 34% (ineffective criteria); in the experimental class, the N-gain value was obtained at 67% (quite effective criteria). This shows that using SSI-based electronic modules improves reflective judgment skills. These results were also obtained because the e-module developed used excellent and correct Indonesian Spelling rules (EBI), the terms were appropriate to the subject matter, and the language used was communicative,

simple, straightforward, and easy to understand. The breadth of material in the e-module is relevant based on learning outcomes and objectives, and the material's suitability can support learning. The e-module developed is attractive in design visual communication and easy to use with the proper software selection, so it is considered adequate and efficient.

The results of students' communication skills were obtained through observations by the class teacher as the observer. Communication skills are valued during the learning process through observation, especially when presenting results and work (Table 4). They have achieved perfect criteria based on the analysis of communication skills at SMA Muhammadiyah 1 Palembang and SMA Muhammadiyah 5 Palembang.

Table 4. Analysis of Communication Skills

School	Control		Experimental	
	Value	Criteria	Value	Criteria
SMA Muhammadiyah 1 Palembang	76	Good	83	Very good
SMA Muhammadiyah 5 Palembang	79	Good	88	Very good

Discussion

The PBL learning model collaborated with SSI to enable students to relate their scientific concepts to phenomena on earth and train in scientific literacy. The PBL learning model can be applied to deal directly with phenomena and demonstrations. In this learning model, students must be independent in finding the latest knowledge and relate it to the problems found (Alatas & Fauziah, 2020) so that students' conceptual understanding of this knowledge can increase (Kusumawati et al., 2022). Learning objectives and indicators of competency achievement can be achieved optimally by choosing a suitable learning model (Arifah & Widiyanti, 2023).

Reflective judgment skills, one of the students' target abilities that can be developed through PBL-SSI-based learning, are the reflective ability to make decisions and solve problems based on specific considerations through good communication. This skill can enable students to evaluate opinion claims, analyze the basis of arguments, and measure their perspective regarding the socioscientific issues presented (Zeidler et al., 2009). The difference in categories of reflective judgment skills obtained in the two schools is due to less focused students during the learning process. These facilities are less supportive of providing school wifi and the condition of students accepting the application of PBL-SSI-based electronic modules. Quality education services can be supported by adequate learning facilities (Manuputty et al., 2023), thus requiring schools to provide good facilities to support a more effective teaching and learning process (Azizah & Agatha, 2021). Impacts: these learning facilities (wifi and projector) can be used as a tool for students to absorb the information and knowledge conveyed by the teacher so that students can take part and be active in the learning process (Conlin & Thompson, 2017; Mahmud et al., 2019). The advantage of classes that use the PBL-SSI electronic module is that it facilitates students to participate in problem-based learning around them. In the first stage of reflective judgment skills, namely the pre-reflective ability of students, they will respond to a problem. In PBL-SSI learning, they will become sensitive to scientific concepts that impact social life (Fihani et al., 2021).

Students' communication skills are obtained from observations during learning. Based on data analysis, the communication skills of experimental and control class students have increased. Initially, students need to understand and adapt to the PBL-SSI model. This can be seen from the results of initial observations, which are included in the relatively good category. However, when exchanging opinions between groups, students showed their adaptation process to the learning patterns carried out. Hence, the observation results in students' communication skills increased to the perfect category. The combination of the PBL-SSI model provides opportunities for students to conduct

investigations and inquiries about a problem in group discussions (Rubini et al., 2019). Discussions and skillful asking of questions related to various scientific and socioscientific issues allow for exploring the nature of science more deeply (Wiyanto et al., 2017; Hancock et al., 2019). This causes students' opinions to actively discuss socioscientific issues describing scientific knowledge, ethics, and values (Utomo et al., 2020). PBL-SSI model learning activities, students' communication skills develop well. This looks different from using conventional learning models (lectures) carried out by teachers in monologues (Afisha, 2015), thus making students passive in the learning process. Learning using the lecture method is only teacher-centered. It does not provide opportunities for students to develop communication skills because students only listen to and accept the material presented by the teacher (Wilsa et al., 2017).

The existence of the learning model in the e-module can attract students to take part in learning because the steps in PBL, starting from orientation, can stimulate students to optimize their mindset in reflecting on a problem presented based on ESSI. So, in this first stage, students' pre-reflective abilities will respond to a problem, and in SSI learning, they will become sensitive to scientific concepts that impact social life (Fihani et al., 2021). The next step, which applies organization and investigation, can encourage students to discuss and look for references related to the problems raised. Of course, at this stage, students have begun to activate quasi-reflective abilities, which are carried out simultaneously by linking Islamic values by looking for verses from the Koran and their contents as religious values in solving a problem. Implementing the quasi-reflective stage certainly requires the elaboration of evidence as a basis for knowledge so that decisions can be made (Aisya et al. 2016). The last two steps of the PBL model can improve students' reflective abilities because, at this stage, students have presented the results of their work to be used as new information to be discussed, and finally, the conclusion is delivered. This agrees with Fitriani & Beni (2017), who state that learning model-based modules can make students responsible and increase learning activities with the progress and abilities obtained during the learning process.

Model PBL-SSI is a learning strategy that presents science material in the context of social issues involving moral or ethical components. The involvement of social aspects in SSI provides opportunities for the emergence of conflict between 3 scientific reasoning (Alvita, 2017) and social perspectives, which in learning has great potential for developing moral reasoning and the ability to reflect judgment and express opinions through good communication in problem-solving. Related issues (Azizah et al., 2021). The use of electronic modules in collaboration with the PBL-SSI model for learning can increase students' capacity to observe and solve social problems given by the class teacher (Selviani, 2019) so that the learning model used can build the enthusiasm of students in the classroom to become more active when in class during learning activities (Alviaturrohmah et al., 2021).

Conclusions

The PBL-SSI-based electronic module improved reflective judgment abilities with the N-gain analysis results obtained at SMA Muhammadiyah 1 Palembang in the control class at 40% (less effective criteria). In contrast, in the experimental class, the N-gain value was 71% (sufficient criteria effective). This is different at SMA Muhammadiyah 5 Palembang, where the control class obtained an N-gain value of 25% (ineffective criteria), while the N-gain analysis results for the experimental class were 61% (quite effective criteria). In the control class, the N-gain value was obtained at 34% (ineffective criteria); in the experimental class, the N-gain value was obtained at 67% (quite effective criteria). Then, the student's communication skills scores were received as very good criteria in the experimental class, with details of a score of 76 suitable for the control class and a score of 83 excellent criteria for the experimental class at SMA Muhammadiyah 1 Palembang. Meanwhile, a score of 79 is a good criterion for the control class, and a score of 88 is an excellent criterion for the experimental class at SMA Muhammadiyah 5 Palembang. In

other words, applying PBL-SSI-based electronic modules to environmental change material effectively improves students' reflective judgment and communication skills. Suggestions for electronic modules based on the PBL-SSI model will be more optimal if the teacher implements it according to the stages of learning activities. Then, the PBL-SSI electronic module can become a new alternative teaching material for teachers, an independent learning resource for students, and a valuable reference for schools in increasing active and innovative learning.

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Declaration statement

The authors reported no potential conflict of interest.

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