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Development of PBL-Based Module to Facilitate Students' Science Literacy and Independence Skills

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Abstract

The purpose of this study is to develop a respiratory system module, test its feasibility and practicality, and analyze the module potential to train students' scientific literacy skills and independence. The feasibility test is carried out through expert-judgment by experts and the module's readability test. The module practicality is measured by the responses of students and biology teachers. The potential of the module in practicing scientific literacy and student independence was obtained from the results of posttest and observations. The results showed that the feasibility level of the module according to material and media experts was 71,67% and 78,12% (feasible). The readability of the module according to students is 79% (feasible). The level of practicality of the module according to students and teachers are 82,27% and 96,15% (very practical). The results of the posttest and observation showed that the scientific literacy level of the experimental class reached 61.46% and for the control class was only 52,53%. The average independence of the experimental and control class are 61,84% and 53,14%. Conclusion: The respiratory system material module is feasible and practical to be applied in learning, and has the potential to train students' scientific literacy skills and independence.

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INTRODUCTION

The 21st century is an era full of challenges and competition. Rapid technological developments have made significant changes in improving the quality of life of the world's people. However, these technological advances are also accompanied by new problems that will make life difficult. As a global society, we must be answer and solve these problems. To solve these problems, we need people who understand scientific ideas, have intellectual abilities, creativity and a sense of care for these problems so that they are able to overcome them. This hope can be achieved if the community has good scientific literacy skills. Therefore, scientific literacy skills are increasingly needed now so that we can live in the midst of modern society.(Zuriyani, 2011).

Based on the results of an interview with one of the biology teachers of SMA Negeri 2 Rembang (04-12-2020) students' scientific literacy skills have not developed well and still need to be improved, especially in the respiratory system material. This material is contained in KD 3.8 which is formulated "Analyzing the relationship between the structure of tissues making up organs in the respiratory system in relation to bioprocesses and functional disorders that can occur in the human respiratory system" and contained in KD 4.8 which is formulated "Presenting the results of the analysis of the effect air pollution on abnormalities on the structure and function of the human respiratory organs. The level of students' understanding of the material is still low because students tend to memorize the material more often than understand it. Students cannot use their knowledge in overcoming problems related to the material. Based on this statement, it can be seen that students' scientific literacy skills only be fulfilled in the knowledge aspect, even though scientific literacy consists of three aspects, there are knowledge, competence and the context of science.(OECD, 2015). So according to the biology teacher at SMA Negeri 2 Rembang, students' scientific literacy skills still need to be developed. Students' scientific literacy skills can be developed with use of socioscientific issues as topics in learning. Socio-scientific issue-based learning is a learning that presents issues in everyday life related to science material. If students are accustomed to using everyday problems in the learning process, it will be easier to facilitate the achievement of scientific literacy skills (Imaningtyas *et al.*, 2016). Learning socioscientific issues leads to discussion and higher-order thinking activities because in this learning students are required to connect various components in analyzing a problem topic (Zeidler & Nichols, 2009)this article reviews the theory underlying the use of socioscientific issues (SSI.

Based on the results of the literature study, it is known that socio-scientific issue-based learning is very suitable to be combined with the PBL (Problem Based Learning) model. PBL-based learning strategy with socio-scientific issues is a problem-based learning, where by raising socioscience issues related to learning materials, students will actively conduct observations, analyzes and experiments on the science concepts being studied. Where using the SSI (Socio Scientific Issues)-based PBL model in the learning process can stimulate students' problem solving abilities more than when students are taught by direct learning methods (Masfuah & Motherland, 2018).

Problem Based Learning is a learning approach that uses life problems as a context for students to learn about how to think critically and have problem solving skills and acquire knowledge, the essential concepts of the material being studied (Lidinillah, 2013). Problem Based learning model is very influential on students' scientific literacy skills, because in the delivery of learning concepts, contexts related to daily life are displayed so that they can stimulate students' curiosity about the material being studied (Bahriah, 2015). In addition, the PBL model is one of the constructive learning models so that it can help students in solving a problem, where this activity is to stimulate students to use their thinking skills and collect data through discussion activities, literature studies and experiments (Jolly & Jacob, 2012). Also supported by research results (Holbrook & Rannikmae, 2009) that the application of the PBL model based on socioscience issues in learning can support students' creativity, critical thinking skills and problem solving abilities. Where these skills are components of scientific literacy skills. The PBL model can also facilitate students in constructing the knowledge gained so as to make learning more meaningful (Çelik, 2011). Therefore, the application of PBL based on ISS (Socio Scientific Issues) in this study is expected to facilitate students' scientific literacy skills.

In addition to the application of suitable learning models, learning facilities are an important component in achieving learning objectives. The implementation of learning needs support from various factors, one of which is learning facilities to achieve optimal learning outcomes (Fauziah *et al.*, 2017)**.**The availability of adequate

learning facilities both in quality can assist students in developing their knowledge, skills and attitudes. Learning resources are one of the learning facilities that can support the implementation of learning activities. Based on the analysis of textbooks, it was found that the competencies needed in the 21st century, one of which was scientific literacy skills, had not been fully developed, so that they did not support the achievement of 21st century competencies, especially scientific literacy skills.

One of the recommended learning resources at this time is the module. In general, the modules used by students today still emphasize the delivery of material that is considered quite solid. The module used does not present real-life cases in the context of learning topics. This is an opportunity to develop a module that is able to present problems related to everyday life so that it can develop students' abilities, especially scientific literacy. By presenting examples of issues or problems with the context of the learning topic, it is hoped that students can be more motivated to learn the material and be able to apply it to solving problems in everyday life. Modules are an integral part of planned learning designed to help students learn independently (Sukirman, 2011). The function of modules in general can be said to facilitate student learning independence. By using a module that has a unique design, even students who have low learning motivation can have an interest in learning it. This can be the initial capital for a teacher to train students' independent learning (Novalia & Noer, 2019).

Learning by using modules can increase students' independence in doing their tasks. When a teacher uses modules in the learning process, students will be encouraged to learn on their own and enrich their learning resources (Wena, 2009). However, in SMA Negeri 2 Rembang, this is not the case, based on the results of observations, the online learning process does not use a module so that the learning process is less to train students' independence. Based on the results of the interview, it was found that the learning independence of SMA Negeri 2 Rembang students was still low. The low independence of students' learning can be seen from the dependence of students on teachers. Students will only argue or express responses when ordered by the teacher. The lack of preparation of students before participating in learning resulted in the learning process students tended to be inactive. The tendency of students who do not have the initiative to learn before the learning process also depends on the teaching materials used as learning components (Nasir, 2017). Based on the above statement proves that the level of student independence is still low. So that the function of the module is expected to facilitate student learning independence.

Based on the description of the problems above, the purpose of this study is develop a PBL module, determine the feasibility and practicality of the module and the potential of the module to facilitate science literacy skills and learning independence for senior high school students.

METHOD

Module development is carried out using a modified ADDIE model through the Analysis, Design, Development, Implementation and Evaluation stages (Branch, 2009). At the analysis stage, activities are carried out to analyze the need for the development of teaching materials such as modules. At the design stage, activities are carried out to design modules and develop instruments needed in carrying out research. At the development stage, an expert assessment of the feasibility of the module is carried out to determine the feasibility level of the module. The next stage is product implementation, testing the practicality of the module and implementing the module in learning to determine the potential of the module to facilitate scientific literacy and student independence. In the practicality test of the module, a questionnaire sheet used to accompant by a comment and suggestion column, this aims to gain views in improving the module. It aims to fix the parts that are not right in order to produce good teaching materials (Nurhidayah et al., 2014). At the evaluation stage, the module is refined as the final product.

Data was collected using two types of instruments, there are test and non-test instruments. The non-test instrument used consisted of a module feasibility sheet according to experts, a module readability questionnaire sheet, a module practicality questionnaire sheet and an observation sheet for student learning independence. While the test instrument in the form of multiple choice posttest questions used to analyze the potential of the module in practicing scientific literacy skills. Data collection techniques and instruments are presented in Table 1.

Table 1. Data Collection Techniques and Research Instruments

Data collection technique	Research instrument	Data source
Interview	Interview sheet	Biology teacher, student
Media expert validation questionnaire	Media expert validation sheet	Media expert
Material expert validation questionnaire	Material expert validation sheet	Material expert
Readability Questionnaire	Module Readability Questionnaire Sheet	Student
Practicality Questionnaire	Module practicality questionnaire	Biology teacher, student
Science literacy test	Posttest questions	Student
Independent observation	Independent obser. sheet	Student

The feasibility of the module is assessed by material and media experts. The assessment of the feasibility of the module by material and media experts is carried out using a questionnaire sheet. The module readability test was assessed using a module readability questionnaire. The practicality of the module was assessed using a module practicality questionnaire according to students and teachers. The facilitation of scientific literacy skills and student learning independence was assessed using posttest questions and independence observation sheets during the learning process.

The data obtained were analyzed descriptive quantitatively. Data from teacher interviews were analyzed descriptively. The data obtained from the results of the feasibility questionnaire according to the experts, the readability questionnaire and the practicality questionnaire in the form of scores were converted into percentages in the following way:

$$N = \frac{\text{Score obtained}}{\sum \text{Max Score}} \times 100\%$$

Information:
N = Percentage score
$\sum$ = Quantity

The results of the feasibility, readability and practicality assessment of the modules obtained are matched with the criteria for feasibility, legibility and practicality as shown in Table 2.

Table 2. Respiratory System Module Criteria

Range (%)	Criteria		
	Feasibility	Readibility	Practicality
81 < P 100	Very worth it	Very good	Very practical
62 < P 81	worthy	Good	Practical
43 < P 62	Not worth it	Not good	Less practical
25 < P 43	Not feasible	Not good	Not practical

Modules can be said to be feasible and practical, if they get an assessment of each with a percentage 63%.

Result data *posttest* and independent observations are processed to obtain scores in the following way:

$$N = \frac{\text{Score obtained}}{\sum \text{Max Score}} \times 100\%$$

Information:
N = Percentage score
$\sum$ = Quantity

The results of that, then matched with the assessment criteria according to (Purwanto, 2009) in Table 3.

Table 3. Criteria for Assessment of Students' Science Literacy Ability and Independence

Range (%)	Criteria
86% < P 100%	Very good
75% < P 86%	Good
60% < P 75%	Pretty good
54% < P 60%	Not good
P < 54%	Not much

Source: (Purwanto 2009)

RESULT AND DISCUSSION

Respiratory System Module Feasibility

The module feasibility test process aims to determine whether the material in the module has been presented in accordance with aspects of basic competence, language, presentation, graphics and the effect of using the module in learning. The results of the module feasibility assessment

according to material and media experts are presented in Table 4.

Table 4. Results of the feasibility of the respiratory system module

Rated aspect	Score	Max score	%
Material			
Contents	29	40	72.5
Language	14	20	70
Σ Score	42		
Σ Maximum score	60		
%	71.67		
Criteria	worthy		
Media			
Presentation	9	12	75
Graphics	19	24	79
Effect on learning	22	28	78.5
Σ Score	50		
Σ Maximum score	64		
%	78.12		
Criteria	worthy		

Based on the results of the module feasibility assessment (Table 4), it can be seen that the developed module is feasible to be used in trials but with some improvements. The assessment of the module with the lowest score is in the linguistic aspect with a percentage of 70%. For this reason, the researcher made improvements by reviewing the words and sentences in the module. The use of unfamiliar vocabulary will be difficult to understand than when using familiar vocabulary. The arrangement of long and complex sentences also greatly affects the level of understanding of the readers (Sugianto, 2017). Therefore, the researcher then made improvements to the aspects of word selection and sentence arrangement so that the linguistic components of the module were much better to make it easier for readers to understand the content. The assessment of the feasibility module with the highest score is in the graphic aspect with a value of 79%. This shows that from the graphic feasibility component, the respiratory system module is considered feasible because the module is arranged in an adapted format. The module format is an important thing to consider. There are two components that must be considered in determining the module format, namely frequency and consistency in compiling the module design. In the preparation of the module, it is not allowed to use variations of writing or design too often (Ramadhani & Mahardika, 2015). This module uses an attractive typeface with the right size for reading. This module has presented an image on the cover which is based on the message of the respiratory system material, especially about respiratory system issues. The choice of color on the cover is quite contrasting with the image presented, this function to increase students' interest in reading. This is in accordance with the statement (Mustafa & Efendi, 2016) that the teaching materials used in the learning process must to attract students to study it so as to stimulate curiosity and increase student knowledge.

After the module was said to be feasible and revised, to determine the readability level of the module, a module readability test was carried out by 31 students of class XI MIPA using a questionnaire instrument. The results of the module readability test are presented in table 5.

Table 5. Results of Module Readability Assessment

Criteria	Average (%)	Total Respondents
Very good	88.63	11
Good	73.75	20
%	79.03	worthy

Based on the results of the readability test (Table 5), an average percentage of 79.03% was obtained in the "decent" category with some improvements based on suggestions and comments from students. The development of teaching materials really needs to be improved after a small-scale trial is carried out before being tested widely. This improvement aims to fix the parts that are not right so that good teaching materials are produced (Nurhidayah et al., 2014).

Respiratory System Module Practicality

Modules that have been tested for readability are then implemented in learning to determine the level of practicality of the modules. The practicality level of the module is determined based on the results of the practicality test by XI MIPA students and biology teachers. The results of the practicality assessment by students can be seen in Table 6.

Table 6. Assessment of the Practical Results by Students

Rating	Average (%)
The attractiveness of the module view	82.50
Clarity of module content (benefits)	90
Sentences easy to understand	82.50
The clarity of the images and videos presented	83.33
Easy to understand language style bahasa	84.16
The display of real cases in the module is clear	85.83
The suitability of the material with the level of student development	80.83
Module ability in facilitating scientific literacy	82.25
The module's ability to facilitate independent learning	79.67
%	82.27%
Category	Very practical

Based on the assessment of the practical by students (Table 6), the results show that the module is very practical to use in learning with a percentage of 82.27%. The assessment of the practical with the lowest score is found in the indicator "The module's ability to facilitate independent learning" with a score of 79.67% in the good category. The highest score is on the "Module content kelejasan" indicator with a score of 90% in the very good category. The indicator states that the module used can be useful for students. The assessment of the module practicality according to the teacher was obtained with a percentage of 96.15% which stated that the module was very practical to use in learning.

Potential of Modules in Practicing Students' Scientific Literacy and Independence Skills

The module developed in this study is one source of learning material for the respiratory system that students can use independently. This module is structured based on KI and KD in the 2013 curriculum which consists of three parts, the introduction, content and closing. The introductory part consists of cover, preface, table of contents, instructions for use, concept map, basic competencies and learning objectives. The content section consists of problems regarding sub-chapters related to daily life, LKPD, materials and a summary of material per sub-chapter. While the closing section consists of multiple choice questions to measure the improvement of students' scientific literacy skills, answer keys, glossary, bibliography and author's profile.

The preparation of PBL-based modules with socio-scientific issues on respiratory system material aims to facilitate students' scientific literacy and independence. Therefore, each component of the presentation in the module is inserted with aspects of scientific literacy and learning independence.

Problem Based *Learning* is a learning approach that uses everyday life problems as a context for students to learn about how to be able to think critically and have skills in solving problems and acquiring knowledge, essential concepts from learning materials (Lidinillah, 2013). PBL facilitates students to solve problems related to real life. The basic concept of a problem-based learning approach has similarities with the understanding and purpose of scientific literacy skills. Referring to his definition that scientific literacy is a capacity of students to apply knowledge and skills and to analyze, reason and communicate effectively when solving a problem (Zuriyani, 2011).

This fact shows that PBL is the right learning approach to solve problems related to the low scientific literacy ability of students, because both have the same characteristics, using issues or problems as learning topics. The use of the PBL approach causes the habit of using problems in learning. If students are accustomed to using everyday problems, it will be easier to facilitate the achievement of scientific literacy skills(Imaningtyas *et al.*, 2016). This is evidenced by the opinion (Bahriah, 2015) that based on the results of her research, the Problem Based learning model is very influential on the level of students' scientific literacy skills, because in the delivery of learning concepts, many contexts related to daily life are displayed so that they can stimulate students' curiosity about the material being studied. So that the application of PBL-based modules as an effort to create student-centered learning is expected to contribute in facilitating students' scientific literacy.

The measurement of students' scientific literacy level is carried out by holding a posttest based on scientific literacy indicators according to (OECD, 2015) there are knowledge, competence and context. Measurement of learning independence using observation sheets based on four aspects of independence; responsibility, confidence, discipline and initiative. This respiratory system module is said to have the potential to train scien-

tific literacy skills and learning independence if the learning outcomes and the percentage of independence of the experimental class students are higher than the control class. Based on the results of the analysis, the level of scientific literacy and independence of students is obtained which is presented in Table 7.

Table 7. Recapitulation of Students' Scientific Literacy and Independence

Criteria	Control Class	Experiment Class
Students' Scientific Literacy		
Highest score	22	23
Lowest score	5	10
Average	52.53%	61.46%
Criteria	Not much	Enough
Independence		
Highest score	26	35
Lowest score	14	16
Average	53.14%	61.85%
Criteria	Not much	Enough

Based on Table 7, it can be seen that there are differences in scientific literacy skills between the control and experimental classes. The results of the scientific literacy posttest of the control class students showed the highest score of 22, while the lowest score reached a score of 5. After averaging the scientific literacy ability of the control class, the score was 52.53%. The highest score of the experimental class students reached a score of 23, while the lowest score was obtained by a score of 10. After the average scientific literacy ability of the experimental class reached a score of 61.46%. Based on these data, it can be seen that there are differences in the level of scientific literacy ability in the two classes. The science literacy scores of experimental class were better than the control class students. By using PBL-based modules, students become more independent and active in the learning process (Imaningtyas *et al.*, 2016). In addition, the PBL learning model is one of the constructive models so that it can help students in solving a problem, where this activity can stimulate students to use thinking skills and collect data through discussions, literature studies and experiments .(Jolly & Jacob, 2012).

Based on the recapitulation of the learning independence results (Table 7), the control class students got the highest score of 26, while the lowest score only reached a score of 14. After averaging the learning independence of the control class, the score was 53.14%. The learning independence results of the experimental class students got the highest score of 35, while the lowest score reached a score of 16. After averaging the learning independence of the control class, the score was 61.85%. Based on these data, it can be seen that there are differences in the level of learning independence in the two classes. The independence score of the experimental class students was better than the control class students. Learning by using modules can increase independence. When a teacher uses a module in the learning process, then students will be encouraged to learn on their own and enrich their learning resources (Wena, 2009). In addition, by using new teaching materials (modules) that provide students the freedom to determine their own way of learning, the module provides students with broad knowledge about how efforts can be made to achieve learning targets and provides new strategies for understanding the material even with difficult reading. though. With the new module that has a unique design, even students who have low learning motivation can have an interest in learning it. This can be a capital to train students' learning independence (Novalia & Noer, 2019).

CONCLUSION

The respiratory system module developed is proven to be feasible to use, the respiratory system module developed is proven to be very practical to use in facilitating scientific literacy skills and student independence, the module has the potential to train students' scientific literacy skills and independence.

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