Designing an integrated learning strategy to develop students' awareness of river environment and science process skills

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Abstract. The river plays a vital role in the daily life of the Banjarese people, Indonesia. Unfortunately, the awareness of the people to keep the rivers clean is still lacking. Hence, the number of rivers in Banjarmasin is decreasing, and the water quality is getting poorer. The study aimed to improve students’ awareness of river environment and science process skills by designing learning strategies integrating four subjects, namely: Science, Indonesian language, English, and Civics education. This research employed Research and Development with the 4-D model. The pilot study of the learning design was administered for 100 junior high school students. The data were collected by questionnaires and a science process skill test and were analyzed using descriptive analysis. The results showed that the integrated learning strategy developed in this research was valid, practical, and effective to develop students’ awareness of river environment and science process skills. Four weeks after the learning was completed, students’ awareness of river environment remains high. Students’ process skills of observing, collecting data, and concluding developed higher compared to other skills. Further research is needed to provide more evidence by implementing the strategy involving other subjects.

1. Introduction
Banjarmasin is known for its wetlands as it is surrounded by many rivers required everyone’s attention and care. In fact, some Banjarese houses are located on the river. Garbage is the current problem of the river. Garbage is the current problem of the river. According to the data, among 117 existing rivers in Banjarmasin, there are now only 60 rivers left [1]. The number will surely continue decreasing if the government does not take this problem into account. Nowadays, these rivers are not only facing the threat of sitting up and narrowing but also the threat of pollution hence the water quality is not worth consuming. According to the pick test results conducted by the Regional Environment Agency (BLHD) of South Kalimantan, the general condition of river water in Banjarmasin has many heavy metals and E. Coli bacteria.

The results of the preliminary study carried out by Winarti, Sarbaini and Yamin [2] showed that in general junior high school students do not fully understand the importance of environmental awareness yet. Besides, the habit of littering is still prevalent. Teacher responses in some schools also reinforce that students still look down on the spirit of environmental care. Research by Manase [3] found that environmental education methods are not satisfactory enough to increase environmental conditions. Different environmental education methods need to be developed to create sustainable learning outcomes within environmental education.

Treatment implemented in an environmental education course can be effective to change student perception toward the environment and increased students’ environmental attitudes [4,5]. Based on these findings, this study designed a learning strategy that can build students’ environmental awareness. Different from the previous studies, the learning strategy developed in this study is presented in the thematic form in which the material is supported by science subjects, Indonesia language, English, and Civics. Environmental awareness will be improved through listening and science process activities. The main purpose of listening is to get facts, analyze, evaluate, get inspired, and to improve the ability to speak. In the context of
this study, listening is not only hearing, but also giving attention and care. Therefore, through listening habituation, students' awareness of the environment will be developed.

Science process skills are the things done by scientists in learning and investigating [6]. The science process skills are the skills underlying a person in scientific thinking and making decisions. Concerning environmental awareness, practicing process skills will enable students to discover, develop facts and concepts, and cultivate and develop positive attitudes and values for the environment. By training both listening and science process skills, it is expected to develop a positive attitude towards the environment and raise awareness as well as students' critical attitude in decision-making related to the environment.

To be implemented, the developed learning strategy must meet the valid, practical, and effective criteria [7]. What is meant by valid is fulfilling the validator judgment, the practical criterion is practical according to experimental results of learning device implementation, and the effectiveness criterion is effective in building environmental awareness and science process skills. Generally, this study aims to develop webbed integrated learning strategy which is valid, practical, and effective to build students' environmental awareness in wetland areas.

2. Method

This study employed a Research and Development with 4-D design. The research stages were Define, Design, Develop, and Disseminate. The pilot product applied the Tessmer formative test [7]. The study was conducted in schools located near the rivers in Banjarmasin. Through purposive sampling technique, three junior public schools in Banjarmasin, Indonesia were selected for the pilot test. This study involved 100 Year 7 students.

This research data was in the form of worksheets readability test results, the validity of learning tools, science process skills, and environmental awareness of students. The worksheet readability, the learning tools validity, and the students' environmental awareness data were obtained through a questionnaire technique. The learning implementation data was obtained through observation, while the science process skill data were obtained through the test. Analyze of the readability student worksheet data, the learning devices validity, learning effectiveness, and students' environmental awareness were conducted by using percentage technique, while the validity of instructional learning was analyzed using the category of validity. There are four categories of validity, namely highly valid, valid, invalid, and highly invalid [7]. This criterion states the learning device has a good degree of validity if the minimum validity reaches a valid level. Practical data on instructional devices are viewed based on the results of the observer's assessment.

The practicality test of learning strategy was conducted three times in each school. Revisions are made to each one-time lesson based on iterative principles. Practical data on instructional devices are viewed based on the results of the assessment observer.

The environmental awareness was measured four times. The first measurement was done before the learning, and the second measurement was done immediately after the learning, the third and fourth measurements were each conducted on the second and the fourth week after the learning was completed. The aim was to see whether the expected environmental awareness has been internalized on the students, even though the learning has been completed. Meanwhile, the science process skills were trained three times. Then, at the end of the learning, the science process skills test was given to the students.

3. Results and discussion

Validation results on learning devices that include the lesson plan, student worksheet, and textbook showed that the developed learning devices are valid, with a mean score of 4.2. The lesson plan reached the score of 4.4, the student worksheet score was 4.1, and 4.1 was in the textbook. Even though this result was declared valid, some small revisions on learning devices related to writing and goal formulation according to the advice of the validator were done.

Based on the results of the student worksheet legality test, it is concluded that the worksheet material is useful, the presentation of the drawing is impressive, and the question and the writing are clear and interesting. Revision of student worksheet only changes the type of letters, from times new romance to arial because it is considered preferable to students. The low score of the practicality of lesson plan 1 on aspects of student activity listening to the text in the cause of the text used is too long, so students do not focus and find it difficult. In the second study, the text was revised so that it did not happen again.

Based on worksheet readability test, several revisions were conducted namely (1) simplifying working procedures; (2) replacing some images with other relevant images; (3) adding some new questions and
eliminating irrelevant questions; (4) adding color variation. The sample of the student worksheet can be viewed in Figure 1.

Figure 1. Sample pages of the student worksheet

Figure 1 shows the cover of student worksheet and part of student worksheet containing students’ activities of checking the sample of river water. Different from other learning strategies in science which focus on laboratory activities only, the laboratory activities in this worksheet are combined with environmental observation and reading analysis. By doing these activities, students’ awareness of the environment will be built.

Table 1. The implementation of learning devices

| No. | The observed activity                                      | Learning | Average |
|-----|-----------------------------------------------------------|----------|---------|
|     |                                                           | 1        | 2       | 3       |         |
| 1   | The teacher motivates students by showing pictures, etc.  | 3.9      | 4.4     | 4.4     | 4.2     |
| 2   | The teacher explains the English reading passage         | 3.8      | 4.1     | 4.3     | 4.1     |
| 3   | The teacher guides students to listen to the content of   | 3.9      | 4.0     | 4.3     | 4.1     |
|     | the passage                                              |          |         |         |         |
| 4   | The teacher provides guidance on the environmental       |          |         |         |         |
|     | observation/practicum activities                          | 4.2      | 4.4     | 4.5     | 4.4     |
| 5   | The teacher guides the discussion of the preparation of  | 4.0      | 4.2     | 4.4     | 4.2     |
|     | the observation report                                   |          |         |         |         |
| 6   | The teacher guides the discussion of the presentation of | 4.0      | 4.2     | 4.4     | 4.2     |
|     | the observation report                                   |          |         |         |         |
| 7   | The teacher guides students to conclude the lesson.      | 4.0      | 4.2     | 4.4     | 4.2     |
| Average |                                                  | 4.0      | 4.2     | 4.4     | 4.2     |
The practical test results of the developed learning strategy are viewed from the implementation of the learning devices and student activities presented in Table 1 and 2.

| No | The observed activity                              | Material learning | Average (%) |
|----|--------------------------------------------------|------------------|-------------|
|    |                                                  | 1 (%)            | 2 (%)       | 3 (%)       |     |
| 1  | Listen to the teacher's explanation.             | 91.3             | 92.5        | 96.7        | 93.5 |
| 2  | Listen to the English reading passage.           | 74.3             | 79.2        | 81.7        | 78.4 |
| 3  | Actively search for the data on the environmental/practicum observation. | 90.0 | 90.2            | 92.0        | 90.7 |
| 4  | Actively inquire about the environmental/practicum observation. | 76.7 | 82.5            | 90.7        | 83.3 |
| 5  | Be active in discussion activity preparation of the report. | 85.0 | 85.2            | 86.7        | 85.6 |
| 6  | Be active in the presentation and discussion of the report. | 80.0 | 80.0            | 83.3        | 81.1 |
| 7  | Actively conclude the lesson.                    | 85.0             | 85.0        | 85.0        | 85.0 |
|    | Average                                          | 83.2             | 84.9        | 88.0        | 85.4 |

The data in Table 1 and Table 2 show the high mean score of the used learning devices by 4.2 with the good category, and students activities were done well with the average percentage of 85.4%. The teacher's teaching activities also went well. It means that the teacher did not have difficulty in understanding the instructions in the lesson plan and student worksheet or in other words, the learning strategy is easy to implement. The most challenging activity for the students was listening to the passage, and the students' most preferred activity was finding data on the current activities of the observation and lab work.

The students’ prior ability in listening was still low. They were not very interested in discussing the English discourse as it is a bit too long. The teacher solved this problem by increasing the interaction at the listening time so that students understand the purpose of the activity. This teacher’s effort seemed successful as can be seen in the following excerpt of the conversation.

*Teacher:* ... use one short sentence to express the meaning of this discourse.

*Student:* The plastic waste contaminates the river.

*Teacher:* Exactly. What do you think about this condition?

*Student:* If the water is used for bathing, it would be itchy, ma’am.

It is seen in this excerpt that the teacher’s effort to divert the students’ boredom when listening to the passage was successful. One of the students responded in line with the habits of the population around the area that is using the river for bathing and washing purposes.

This situation continued with the observation of the river and sampling activities, in which students appeared to be enthusiastic. This outdoor learning activity attracted the students' attention; therefore, they were very active. This relates to the good teacher's ability when guiding the observation (Table 1 point 4). Good teacher guidance keeps students motivated to do the activity. Another reason for the students' interest in observation activity was because this activity is outdoor. Frequent outdoor learning experiences implemented by a trained teacher in a familiar setting can result in greater engagement for students [9,10,12]. In this research, outdoor learning also gives students the opportunity to contact with the environment directly. Therefore, it provides a balance between the application of knowledge and attitude formation, thus making learning feels effective for students. However, while feeling happy with the observational activity, the students rarely asked the teacher questions during observation. In the second lesson, this concern was improved by the teacher by asking more questions to provoke the students' curiosity.

The developed learning strategy effectiveness is seen from the development of the environmental awareness up to 4 weeks after the learning as well as the increase in the students' science process skills. The environmental awareness was built on how to practice listening and science process skills. The listening abilities were developed by introducing environment-related vocabulary, analyzing poems about nature's destruction, and discussing efforts to overcome the natural damage. The skills of the science process were carried out in the student worksheet activities, including observing activities, formulating hypotheses, collecting data, analyzing data, and summarizing integrated into river observation activities, comparing
polluted and uncontaminated river conditions, cleaning up plastic waste around the rivers, taking samples of the river water, and conducting physical and chemical tests on water samples. The results of the effectiveness test of the developed learning strategy are presented in Table 3.

Table 3. Percentage of the students' ecological awareness level

| Indicator                                                                 | Level of ecological awareness before learning (%) | Level of consciousness Ecological after learning (%) |
|---------------------------------------------------------------------------|--------------------------------------------------|---------------------------------------------------|
| Concern for the condition of the river.                                  | High (1) Moderate (1) Low (1)                     | High (2) Moderate (3) Low (4)                     |
| Awareness of the importance of maintaining the environment.              | 20 40 40                                          | 100 90 90 0 10 10 0                               |
| Awareness of the importance of education to build the environmental care.| 20 35 45                                          | 100 100 0 0 0 0 0                                |
| Average                                                                   | 31.7 36.7 31.7 100                                | 96.7 93.3 3.3 6.7 0 0                            |

= the first test; = the second test; = the third test; = the fourth test

It can be seen in Table 3 that before the learning, the percentage of students with a high level of awareness is still lacking (mean of 31.7%). After learning, the environmental awareness was on the third indicator, reached 100% or increased by 56.7%. After two to four weeks of learning was completed, the percentage of the students with high environmental awareness slightly decreased (3.3% to 6.7%) however, this reduction is minimal. During this period of 1 to 4 weeks, the teacher also continued to monitor and reminded students not to throw garbage into the rivers.

The results showed that the awareness of the waking student environment appears to be internalized. This increased awareness is related to the high interest of students in outdoor learning activities, as well as the involvement of the four subjects that make learning more interesting. This corresponds to the findings stating that the use of nature-based outdoor activities is effective in increasing the students' environmental awareness and sensitivity to the environment. In contrast to the previous studies [4,5] which involving one subject only, the student perception toward the environment in this study involving four subjects, thus the student activities were more varied.

The students' rising environmental awareness after using this strategy was recognized by the students on the student worksheet readability test. The students were very enthusiastic about the second student worksheet material. As much as 68.18 % of students stated strongly agree and 22.73% agreed that the student worksheet material raises their environmental awareness. Thus, the students were convinced that the student worksheet material has a good impact on the development of their environmental awareness. In addition to the environmental awareness, the science process skills after learning also developed to the height category (the mean 3.4 to 3.7). This is possible because of the exercises of the science process skills steps performed on the three previous worksheets. The data on the students' science process skills are presented in Figure 2.

![Figure 2. Science process skills of students after learning](image-url)
As shown in Figure 2, the mean score of the science process skills across all aspects of the three schools ranged from moderate to high. On the observing, data collecting, and concluding aspects in all three schools are high, while the hypothesizing and data analyzing aspects are quite high. It shows that the exercises and laboratory activities applying the science process skills for learning can play a role in the development of these science process skills. The findings are relevant to previous research [12-14] which found that applying science process skill activities in learning will increase the science process skills of students. Even though the previous researches using different methods to train science process skills, however, all efforts provided the same results, science process skills improvement. I-diagram implemented by Karamustafaoglu [14], computer simulation applied by Siahaan, Suryani, Kaniawati, Suhendi, and Samsudin [12], and five stage learning cycle used by Safaah [13] train science process skill in different ways but have the same purposes. Same as the previous researches, applying laboratory work integrated with reading and environment observation in this research made students train their science process skill frequently, hence the skills develop well, especially observation, data collection, and conclusion. At first, the students were not accustomed to doing the science process skills. The observing skill was still low, and there was a confusion between observing and referencing as it is known through the following students' excerpt.

Student A: What are the characteristics of a polluted river?
Student B: ...the dirty river.
Student A: So, write "The river is polluted" in the observation table.
Student B: Ehmmm (pause) I don’t think that is what the teacher said. Write the results of the observation according to what we see. It means we write it there that this river has a lot of garbage.
Student A: The Polluted river is the same as the dirty river.
Student B: (Hesitant)...I don’t think it is the same. Let’s ask the teacher then.

Such confusion did not happen again in further learning. From the results of this study, it can be concluded that the developed webbed model integrative thematic learning strategy proved valid, practical to be implemented, and effective in building students’ environmental awareness and science process skills.

4. Conclusion
In general, the integrative learning strategy developed in this study has met the valid, practical and effective criteria for building environmental awareness and develop science process skills of the junior high school students in river areas. Specifically, it can be concluded that the developed integrative learning strategy is valid according to the validator's assessment result. The developed learning strategy is practically used based on the teacher’s activity and students’ activity. The developed integrative learning strategy is effective in building the students’ environmental awareness and science process skills. Students’ process skills in observing, collecting data, and concluding develop higher compared to the other skills. Two to four weeks after the learning was completed, students’ awareness of river environment remains high. Further research is needed to find out more justified evidence by implementing the strategy by involving other subjects.

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