Effects of instructional material of natural science with literacy skills of our respiratory and excretory health theme on academic achievement of students

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Abstract. Teaching process in the 21\textsuperscript{st} century should be able to develop the holistic competence of students. Integrated teaching is relevant to the principles of 21\textsuperscript{st} century learning to develop holistic competence. Besides that, the integration of literacy skills in teaching is able to strengthen the competence of students in a certain area. In the 2013 curriculum, the education policy in Indonesia has promoted the application of integrated teaching and literacy program in the school. However, the integration of learning material of natural science and literacy skills of students in schools was still low. Solution of the problem was to apply the instructional material of natural science with literacy skills on our respiratory and excretory health theme. Research method can be entered into a quasi experimental. Research design was non-equivalent group of two group samples. The research instruments to collect the data consist of a written test in multiple choices, observation sheet of attitudes, and performance assessment sheet of skills. The data were analyzed in three ways, namely descriptive statistics, comparison of two means test, and Mann-Whitney test. The results of the data analysis indicate that the application of instructional material of natural science with literacy skills in the scientific approach has a meaningful effect on students’ academic achievement in aspect of knowledge, attitudes, and science process skills.

1. Introduction

Teaching process should be able to encourage the development of students’ competence. In teaching process, teachers need to develop the competence of students so they have good and holistic competence. In the 21\textsuperscript{st} century students must have holistic competence. The competency framework in the 21\textsuperscript{st} century includes a broader understanding which emphasizes skills, attitudes, knowledge, and values which required by students in the school, in the workplace, and in their life [1,2,3,4].

Teaching in the 21\textsuperscript{st} century needs to involve the acquisition of holistic competence. Teaching needs to encourage the acquisition of new knowledge, skills, experiences, and attitudes which allow students to study, to modify, and to change their actions [5]. For this reason, teaching needs to apply essential principles in the 21\textsuperscript{st} century learning. There are four essential principles of the 21\textsuperscript{st} century learning, namely: teaching should be centered on students, implemented collaboratively, connected to real-world contexts, and linked to society life [6].
Integrated teaching of natural science is relevant to the essential principles of 21st century learning. This reason is based on the characteristics of integrated teaching. There are four characteristics of integrated teaching, namely: active, authentic, holistic, meaningful [7,8,9,10]. Active means integrated teaching emphasizes student activity in teaching. Authentic means integrated teaching allows students to understand the concepts and principles which they learned directly. Holistic means integrated teaching enables students to understand a phenomenon from various aspects. Meaningful means integrated teaching enables the formation of relationships between interconnected concepts.

The application of integrated teaching of both natural science and social science has been emphasized by Indonesian education policy in junior high school. According to the 2013 curriculum, the natural science teaching needs to be applied in concepts and principles of integrated science. In every basic competency of natural science has integrated the learning materials from the branches of natural science, such as Physics, Biology, Chemistry, and Earth Science [7,9,11]. The meaning of integrated teaching in natural science shows the connection between the various aspects and learning materials in the basic competence of natural science. Integrated teaching can integrate the learning materials in several sub-disciplines or science studies in one theme. Integration in natural science teaching is intended to create the teaching more meaningful, effective and efficient.

However, in the application of integrated science teaching still have some problems. The first problem was the generally science teaching in schools was still conducted separately by science teachers [12,13,14]. The second problem was generally science teachers still experience some difficulties in applying the integrated teaching of natural science in schools [15,16]. The third problem was the textbook of integrated science for class VIII of students was still written separately into Physics, Biology, and Chemistry [10,17,18]. The fourth problem in the schools was the combination of literacy skills in natural science teaching was still limited to reading and writing.

The gap between real conditions and expected conditions described the problem of applying integrated teaching of natural science in the schools. Based of this problem, the solution of the problem was to apply the instructional material of natural science with literacy skills. The integration of learning materials and literacy skills in instructional material on the theme of our respiratory and our excretory health was main essential characteristic of this problem solution.

The instructional materials need to be used by teachers in the teaching process to increase participation and activity of students. In this case, instructional materials can be defined as essential and meaningful tools which required to create efficient teaching for teachers from their subjects and to improve their students’ academic performance [19,20]. Another definition of instructional materials are devices to help teachers in presenting their sequential and rational teaching to their students [5,21,22]. Instructional materials can also be defined as all kinds of materials which used by teachers to implement teaching and learning activities [23]. Therefore, teaching materials can be seen as tools or devices, they can be used by teachers and students in the teaching process, and they can be used to improve student performance in the teaching process.

In the teaching process of natural science, instructional materials play an important role both for teachers and for students. They can facilitate learning by arousing students’ interests, maintaining attention, providing opportunities for students to interact with their social and physical environment, offering opportunities for independent and individual learning, creating concrete basic for conceptual thinking, and offering opportunities for students to develop abilities and skills [5]. Instructional materials can also enhance the memory level of students and improve learning achievement of students [24,25]. In teaching process, instructional materials serve as a channel between teachers and students in delivering instruction, giving motivation to students, and getting attention of students and eliminating boredom of students in learning [26].

The application of instructional materials in teaching provides benefits to both the teachers and the students. In this case, the application of instructional materials can make teaching more interesting, practical, realistic and appealing. Instructional materials also allow teachers and students to participate actively and effectively in teaching activities, to provide room to acquire knowledge and skills, to promote self-confidence and self-actualization [19,21]. The use of instructional materials can support,
influence, facilitate, and improve of knowledge, skills, and attitudes. Instructional materials can make learning simple, easy to understand, help retention, and recall things whenever it is necessary [5].

The application of instructional material of natural science with literacy skills on our respiratory and excretery health theme was expected to be used as a solution to solve the problem of this research. Based on this reason, we were interested in applying this instructional material of natural science in scientific approach in junior high school. The objective of the research was to determine the effect of instructional material of natural science with literacy skills on the academic achievement of students in aspects of knowledge, process skills, and attitudes.

2. Research Method
Research method can be classified into quasi-experimental research. The design of research was non-equivalent control group post test only design. In the initial condition, the ability of students in the experimental group and the control group was the same. In experimental group, students were given treatment, while in control group, they weren’t given it. After using the science instructional material for eight meetings, the both experimental group and the control group were given the same post test.

The population of the research was all students of grade VIII in SMP Negeri 13 Padang, which registered in the January-June semester in 2018. Students Grade VIII were distributed into eight classes and each class consisted of 32 students. The total number of students as the research population consist of 224 students. The sampling technique which used to obtain sample class was a combination of purposive sampling and cluster random sampling. From this sample technique, it was obtained class 8.1 as an experimental group and class 8.5 as a control group. The number of students in the experimental group and the control group was 32 students respectively.

The instruments in this research to collect data can be divided into three parts. The multiple choice written test to measure of knowledge aspect was given to the experimental group and the control group after giving a treatment. The observation sheet in teaching process was used to obtain of attitudes aspect in applying instructional material of natural science. The last instrument to collect data was performance assessment sheet. This instrument was useful for assessing the science process skills of students in science teaching by using instructional material of natural science.

The research data were analyzed in three ways, namely descriptive statistics, comparison of two means test, and the Mann-Whitney test. Analysis of descriptive statistics can describe of data groups on aspects of knowledge, attitudes, and science process skills of students. Comparison of two means test or t-test can determine the difference in the average value of the academic achievement of students between the experimental group and the control group for parametric statistics. Meanwhile, the Mann-Whitney test was used to determine the difference in the average value of academic achievement of students between the experimental group and the control group for non-parametric statistics. Therefore, the type of comparison test to prove the research hypothesis depends on the results of the normality test and the homogeneity test of the data groups.

3. Result and Discussion
The effect of instructional material of natural science with literacy skills in the knowledge aspect of students was the first result of the research. The instructional material of natural science was applied for eight meetings. After giving treatment, the same post test was given to both the experimental group and the control group of students. Learning material in post-test relates to the theme of our respiratory and excretion health. Data from post test were analyzed by using descriptive statistics, normality test, homogeneity test, and comparison of two means test. The results of data analysis from the knowledge aspect of both groups of sample were shown in Table 1.

| No | Types of Statistics | Values of Parameters | Experiment Group | Control Group |
|----|---------------------|----------------------|------------------|--------------|
| 1  | Descriptive statistics | Mean                | 73.67            | 69.83        |
The average value of knowledge data from experimental group students is higher than the average value of control group students. Data of both experimental group and control group have a normal distribution. On the other hand, both data of students’ knowledge aspect have the same variance. This means that the data aspect of knowledge meets the requirements of parametric statistics so that the t-test can be used. The result of the comparison of two means test indicated that the null hypothesis for the knowledge aspect data can be rejected. This means that the result of data analysis show that the use of instructional material of natural science gives a significant difference between the average value of knowledge aspect of students who use the instructional material of natural science with students who didn’t use it. In the initial condition, the average value of knowledge aspect of the two groups didn’t differ significantly. The difference in the average value of knowledge aspect of students indicates the effect of applying instructional material of natural science. Thus, the application of instructional material of natural science with literacy skills on the theme of our respiratory and excretory health has given a meaningful effect on the knowledge aspect of students.

The effect of instructional material of natural science with literacy skills on attitudes aspect of students was the second result of the research. The attitude of students in the teaching process was assessed on both the experimental group and the control group. There were six indicators of student’s attitudes which assessed, namely: curiosity, self confidence, inquiry commitment, cooperation, and communication. The attitude data of students were analyzed by using the appropriate statistics. The results of data analysis of students’ attitudes on both the experimental group and the control group can be listed in Table 2.

| No | Types of Statistics | Values of Parameters | Experimental Group | Control Group |
|----|---------------------|----------------------|--------------------|---------------|
| 1  | Descriptif statistics | Mean | 73.69 | 67.22 |
|    |                     | Mode   | 72.90 | 66.70 |
|    |                     | Median | 73.45 | 66.70 |
|    |                     | Standard deviation | 4.68 | 6.32 |
|    |                     | Variance | 21.90 | 39.98 |
|    |                     | Minimum | 63.50 | 54.20 |
|    |                     | Maximum | 84.40 | 79.20 |
| 2  | Normality test      | P-value | 0.766 | < 0.00 |
| 3  | Homogeneity test    | P-Value F Test | 0.099 |  |
| 4  | Comparison test     | t-value | -4.167 |  |

From data in the Table 2, the average value of the students’ attitudes in the experimental group is higher than the average value of the control group. The attitudes data groups of the experimental group have a normal distribution, while the data groups of the control group didn’t have a normal distribution. Both data of the experimental group and the control group of attitudes aspect have a homogeneous variance. This means that the two data groups didn’t meet parametric statistics so that the data groups can be analyzed by non-parametric statistics. The difference of the average value of attitudes aspect of students was analyzed using the Mann-Whitney test. From the comparison of the Z value which obtained from the Mann-Whitney test with the Z value in the table, it can be stated that
the null hypothesis was rejected in this case. This means that, the application of instructional material of natural science has given a meaningful difference between the average value of the experimental group and the control group in attitudes aspect. Therefore, the application of instructional material of natural science with literacy skills has a meaningful effect on the attitudes aspect of students.

The effect of instructional material of natural science with literacy skills on aspects of science process skills was the last result of the research. There are eight indicators of science process skills which were assessed in the science teaching process, namely: observing, questioning, formulating hypothesis, preparing an investigation, measuring, interpreting data, making conclusion and communicating. The average value of each indicator of science process skills is shown in Figure 1

![Figure 1. Average Value of Science Process Skills Components](image)

Series 1 in Figure 1 explains the average value of each component of the experimental group while Series 2 explains the average value for the control group. The average value of science process skills of each component of the experimental group is higher than the average value of the control group. The average value of science process skills of the experimental group and the control group is 75.02 and 71.85, respectively. Therefore, the average value of the data groups of the process scientific skills of the experimental group is higher than the average value of the control group.

The data groups of the science process skills aspect of the experimental group and the control group of students were also analyzed by using appropriate statistics. The results of data analysis of the science process skills aspect are listed in Table 3.

| No | Types of Statistics | Values of Parameters | Experiment Group | Control Group |
|----|---------------------|----------------------|------------------|--------------|
| 1  | Descriptif statistics | Mean | 75.02 | 71.85 |
|    |                     | Mode | 75.00 | 71.90 |
|    |                     | Median | 75.00 | 71.90 |
|    |                     | Standard deviation | 1.67 | 1.89 |
|    |                     | Variance | 2.77 | 3.57 |
|    |                     | Minimum | 73.30 | 65.60 |
|    |                     | Maximum | 78.10 | 75.00 |
| 2  | Normality test | P-value | 0.048 | 0.12 |
| 3  | Homogeneity test | P-Value F Test | 0.491 | |
| 4  | Mann-Whitney test | Z | -5.65 | |
The data of the science process skills aspect of the experimental group didn’t have a normal distribution, while the data of the control groups have a normal distribution. Meanwhile, both data of process science skills of the experimental group and the control group have the homogeneous variance. Based on the characteristics of these two groups, the difference in the value of science process skills aspect were analyzed by using the Mann-Whitney test. The Z value of this test was obtained -5.65. In this case, the null hypothesis can be rejected. The result of the analysis revealed that the application of instructional material of natural science with literacy skills has a meaningful effect on the average value of science process skills aspect between the experiment group and the control group. Thus, the application of instructional material of natural science with literacy skills of our respiratory and excretory health theme has given a meaningful effect on science process skills aspect of students at the 95% confidence level.

4. Conclusion
Conclusion of the research can be drawn based on data analysis. The result of the data analysis revealed that the application of instructional material of natural science with literacy skills on the theme of our respiratory and excretory health has given a meaningful effect on academic achievement of students, including knowledge aspect, attitudes aspect, and science process skills aspect of grade VIII students. The application of instructional material of natural science with literacy skills is able to promote activities, involvement, and understanding students of science teaching materials. Besides that, the combination of literacy skills in instructional material of natural science can improve and train the students in writing, calculating, describing information, explaining scientific concepts, practicing science process skills, explaining scientific contexts, interpreting visual, and using visual of natural science phenomena. Thus, the science teachers can apply the instructional material of natural science with literacy skills to promote science teaching and the students can use it in studying the science learning material in junior high school.

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