Need analysis to develop science learning material based on thematic teaching by integrating the new literacy

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Abstract. Education in the 21st century must be able to develop the competence of students in a holistic and balance form. Integrated teaching is relevant with the 21st century learning paradigm because it is able to encourage active, authentic, holistic, and meaningful learning. The 4.0 industrial revolution in the 21st century has demanded teaching to develop a variety of student literacy skills so that they can succeed both in learning and in everyday life. But the application of integrated teaching and the integration of literacy skills in natural science teaching is still limited. Real condition shows that science literacy of Indonesian students is still low. The solution to this problem is to develop the science learning material based on thematic teaching by integrating the new literacy. The purpose of the research was to describe the initial conditions before developing the science learning material based on thematic teaching. This type of research was descriptive research. The research data were analyzed by descriptive statistics. The results of the data analysis stated that: generally the application of thematic learning components is still low, the integration of new literacy components in science teaching and science textbooks can be entered into low category, generally the characteristics of students are good for receiving thematic science learning material, and generally the early literacy of students can be classified into low category. The results of this research provide a good opportunity to develop science learning material based on thematic teaching by integrating new literacy.

1. Introduction

Education should be able to foster and develop 21st century skills for students. They need to have good skills to solve problems and face challenges in the 21st century. There are at least three 21st century skills that students need to have to succeed in learning and living, namely learning skills, literacy skills, and life skills [1, 2, 3]. Learning skills are required by students to get success in learning such as critical thinking, creative thinking, and collaboration, communication. Literacy skills include information literacy, media literacy, and digital literacy. On the other hand, life skills consist of flexibility, leadership, initiative, productivity, and social. Therefore, 21st century learning needs to develop learning skills, literacy skills, and life skills for students.

The Indonesian government has made efforts to grow and develop 21st century skills for students. First, the 2013 curriculum encourages science teaching in junior high schools in a thematic form [4, 5, 6]. The aim of thematic teaching is to create student-centered, authentic, holistic, and meaningful learning. The application of thematic teaching can develop some literacy skills of students such as critical thinking, creative, problem solving, and so on. Second, Second, the school literacy program...
has created and implemented to build literacy from school members [7, 8, 9, 10, 11]. The aim of the school literacy program is to improve literacy of students such as basic literacy, information literacy, technological literacy, and so on. Thus, the application of thematic teaching and integration of literacy in teaching is relevant to science teaching.

Recently education in Indonesia is also faced with the 4.0 industrial revolution. Education should create human resources that have the ability in cyber physical systems, the internet of things, and networks. The physical system provides the opportunity to connect a device to the internet network. In addition, this physical system also provides the opportunity to control and respond from the internet to the machine through sensors and actuators. Internet of things is an object that has the ability to transfer data through a network. On the other hand, a network is a telecommunications network that allows computers to communicate with each other by exchanging data. In this revolution, students need to be prepared to apply the five main characteristics of the industrial revolution, namely interconnection, data, integration, innovation, and transition. Therefore, literacy is needed by students to face the challenges of the industrial revolution 4.0.

Some researchers have developed or implemented thematic teaching model to improve students' abilities [12, 13, 14]. Development of learning materials based on integrative thematic is carried out for elementary school students [15, 12, 16, 17, 18]. On the other hand, some researchers have also either developed or implemented science thematic learning materials by integrating literacy for students [6, 19, 20]. However, these researches have not integrated the literacy yet that required by students to face the challenges of the industrial revolution 4.0. Generally the development of thematic teaching models and thematic learning materials are used for students in elementary school. Therefore, the main focus of this research is to develop science learning material based on thematic teaching, integrate new literacy, and apply it for students in junior high school.

Thematic teaching is an integrated teaching type that uses a theme to connect several branches of knowledge to provide meaningful experiences [21, 22]. Thematic teaching can be also defined as an integrated teaching that uses themes to connect several subjects that allow students either individually or in groups to actively discover scientific concepts and principles holistically, meaningfully, and authentically [13]. Theme can connect several variations of concepts, learning materials, and branches of knowledge to make teaching holistic and meaningful. The purpose of thematic teaching is to provide a good opportunity for active, interesting, and meaningful experiences for students [23]. Thematic teaching can improve motivation, scientific work, and learning outcomes of students [24].

New literacy is the ability needed by someone to face the challenges of the industrial revolution 4.0. New literacy includes data literacy, technological literacy and human literacy [25, 26, 27]. These three components of literacy are new terminology in answering the challenges of the industrial revolution 4.0. Data literacy is a set of abilities to find, read, analyze, and use information in the digital world [28, 29]. Technology literacy is a set of abilities to understand, access, use and manage technology [27, 30, 31]. On the other hand, human literacy is directed to improve communication skills and understanding of design science. In other words, human literacy is related to 21st century skills, namely critical thinking, creative thinking, collaboration, and communication [32, 33, 34]. New literacy is created to produce competitive graduates by perfecting old literacy program that only focuses on improving reading, writing and mathematics skills.

Development of learning material based on thematic teaching needs to be done to improve learning outcomes and new literacy of students. Thematic teaching is used as a basis for the development of natural science teaching material intended to create teaching in a real world context, active, comprehensive, meaningful. On the other hand, the integration of new literacy into science learning material is intended to practice the data literacy skills, technological literacy, and human literacy of students. In this way, they are able to solve problems and face the challenges of the industrial revolution 4.0. This preliminary research was conducted as a basis for designing and developing science learning material based on thematic teaching by integrating new literacy. Therefore, the purpose of this research is to describe the application of thematic teaching in science
teaching in schools, integration of new literacy components in science teaching, integration of new literacy components in science textbooks, student characteristics, and initial literacy of students.

2. Research Method

This research method can be categorized into descriptive research. In this research, a group of data is described to illustrate the results of the research. There are five groups of data that are described to achieve the research objectives. First, data on the application of thematic teaching in science teaching process in three junior high schools in Padang City. Second, data integration of new literacy in science teaching in Padang City junior high school. Third, data integration of new literacy components in integrated science textbooks for junior high school students. Fourth, the data of students’ characteristics in aspects of background, interests, attitudes, motivation, and learning styles. Fifth, data of learning outcomes to describe the initial literacy of students.

In general, there were three objects that were investigated in this initial research. The first object was three science teachers who apply science teaching in junior high school. In the application of science teaching was observed the thematic learning components and the new literacy components. The second object was six science textbooks for eighth grade students of junior high school. Science textbooks were analyzed in the integration aspect of the new literacy components. The third object was students of class VIII from three junior high schools in the Padang City to obtain data on student characteristics and their initial literacy abilities. The number of students from each school involved in taking data from 25 to 32 students. Thus, the total number of students involved in data collection of student characteristics and initial literacy tests was 91 students.

The instrument for collecting data in the initial research consisted of four parts, namely observation sheets, document analysis, questionnaire sheets, and initial knowledge tests of students. The science teaching observation sheet was used to observe the application of thematic teaching and the integration of new literacy in science teaching. Document analysis sheet was used to assess the integration of new literacy in science textbooks for grade VIII. Questionnaire sheet was used to analyze the characteristics of students as a basis for developing thematic learning material. The initial knowledge test sheet was used to obtain new literacy data. The new literacy test was related to the initial ability of data literacy and technology literacy.

Research data were analyzed with descriptive statistics. Data analysis includes the calculation of data focusing, data distribution, and data presentation in graphical form. Presentation of data in graphical form was used to describe data on the application of thematic teaching in the science teaching process, data integration of new literacy components in science teaching, data integration of new literacy in science textbooks for grade VIII, and data of student characteristics as a basis to develop thematic learning material. By analyzing data in graphical form, data from all four aspects of the research can be well described. On the other hand, the calculation of data focusing and data distribution was used to describe the initial knowledge of students that obtained from the literacy test.

3. Result and Discussion

3.1. Observation Results of Science Teaching in Schools

The results of observations of science teaching in schools include four indicators. The four indicators include: elements of thematic learning, elements of integration of data literacy, elements of integration of technology literacy, and elements of integration of human literacy. Thematic teaching elements consist of five indicators, namely (1) in the teaching of science using themes (TM), (2) presenting concepts from the contents of Biology, Physics, Chemistry, and Technology (SD); (3) themes used in science teaching are close to students (AS); (4) provide direct experience for students in teaching science (EP); (5) connecting learning material in the classroom with real world contexts (CN). The results of the assessment for the five sub-indicators can be seen in Figure 1.
From the data in Figure 1, it can be explained that the average value of the indicators using themes in science teaching is 33.30. The mean value of the indicator presenting the concept of the charge of Biology, Physics, Chemistry, and Technology is 58.33. The average value of the theme indicators used in science teaching close to students was 58.33. The average value of the indicator giving direct experience to students in science teaching is 83.33. The average value of the indicator linking learning material in class with real world context is 75.00. The average value of the indicators using themes in science learning, presenting concepts from the contents of Biology, Physics, Chemistry, and Technology, and themes used in science teaching close to students can be grouped into low criteria. The average value of the five thematic teaching element assessment indicators is 61.66. This grade point average is low according to the science teacher. This means that students still have not applied thematic teaching in accordance with curriculum demands.

3.2. Observation Results of New Literacy Integration in Science Teaching

The results of observations of the integration of new literacy in science learning consist of data literacy, technological literacy and human literacy. Data literacy is related to indicators of ability to read data (RD), analyze data (AD), predict the results of data analysis (PD), communicate the results of data analysis (CD), and make conclusions of thinking based on data and information obtained (MC). The result of data analysis from the integration of data literacy in science teaching can be seen in Figure 2.

The result of the data analysis of the data literacy indicators in Figure 2 can be described. Three indicators of data literacy are already in the good category, namely reading data, analyzing data, and
communicating the results of data analysis with an average value of 66.67 respectively. Making conclusion from data analysis can be classified into enough category with an average value of 58.33. Meanwhile, one indicator of data literacy is still in the low category, which is predicting the result of data analysis. The average value predict the result of data analysis of 50.00. The average value of the five indicators of assessment of data literacy elements is 61.66. This means that student abilities are still in the enough category to read data, analyze, predict, communicate, and make conclusions. From the data measurement results of this data literacy seems to be necessary to implement science teaching that encourages the data literacy of students. The result of data literacy analysis still provide a good opportunity to develop thematic science learning material to improve the ability of several indicators of student literacy in particular predicting the result of data analysis and making conclusion from the result of data analysis in junior high schools.

Technology literacy is related to the ability to understand the products of the technology. Application of technology and technology-based work of products to get maximum results. Indicators to assess the integration of technology literacy elements in natural science learning observations include: understanding the work of human technology (MP), connecting science and technology (ST), using measuring instruments (INS), using computers (COM), using virtual laboratories (VL). The result of data analysis on integration of technology literacy in science learning is displayed in Figure 3.

![Figure 3. Indicator of Technology Literacy](image)

The data in Figure 3 explains that the average value of indicators understanding the work of human technology is 50.00. The average value of the indicator connecting science with technology is 50.00. The average value of the indicator using a measuring instrument is 66.67. The average value of the indicator using a computer is 25.00. The average value of the indicator using a virtual laboratory is 25.00. The average value of all indicators of integration of technological literacy are low criteria. The average value of the five assessment indicators of the integration elements of technology literacy is 37.50. This means that students must have good technology literacy skills from all of these indicators so that students' technological literacy can follow the development of education in the 4.0 revolution era.

Furthermore, the result of the observation data analysis of the integration of human literacy is described in several indicators. Indicators of assessment of human literacy elements include: (1) facilitating students by making experimental reports (MR), (2) facilitating students communicating the results of group work (OC), (3) encouraging students to collaborate in teams (CL), (4) encouraging students to think critically (C1T), and (5) encouraging students to think creatively (C2T). The result of the data analysis of integration of human literacy in science teaching be considered in Figure 4.
The result of data analysis in Figure 4 show that the values obtained ranged from 50.00 to 75.00. Two indicators of human literacy can be included in the low category, namely facilitating students to make experimental report and encouraging the creative thinking skills of students with an average value of 50.00. On the other hand, three other indicators of human literacy can be grouped into a good category, namely facilitating students to communicate the result of group work, encouraging students to work in a team, and encouraging their critical thinking skills with an average value of 75.00; 66.67; and 66.67 respectively. From the result of data analysis, the average value of the five indicators of human literacy is 61.67 with an average value that can be categorized into sufficient category. The result of this data analysis indicates that the ability of students to make report on the result of experiment and apply creative thinking skills still needs to be improved in science teaching. Therefore, the human literacy needs to be improved in particular facilitating students to make experimental report and develop the creative thinking ability of students.

3.3. Analysis of the Integration Literacy in Science Textbook

The integration of material in integrated science textbooks can be determined by analyzing integrated science books. The textbooks analyzed consisted of five types and each of the textbooks is displayed the value of the score (SC), maximum score (MS), and average value (AV).

From Figure 5, the average value of the first textbook is 52.78. The average value of the second textbook is 35.71. The average value of the third textbook is 48.61. The average value of the fourth textbook is 42.77. The average value of the fifth textbook is 37.50. The average value of integration of
the five integrated science textbooks was 43.47. From the results of these values it can be seen that the integration of natural sciences in textbooks is in the inadequate category. In other words, the science textbook is still presented based on their respective fields of study.

3.4. Analysis of Student Characteristics
The analysis result of the characteristics of the students was obtained from three public schools in Padang City. In this case, the characteristics of students can be seen from six indicators. The six indicators are background (BG), interests (IN), attitudes (AT), learning motivation (MT), learning styles (LS), and creativity (CR). Percentage graphs from the analysis of students' characteristics can be seen in Figure 6.

Figure 6. Components of Student Characteristics

The result of the data analysis of student characteristics in Figure 6 can be described the initial conditions of students on the six indicators of student characteristics. Generally, students give responses in a goof category in the background, interest, attitudes, learning motivation, learning styles, and creativity related to science learning. Three indicators of student characteristics at high school level have a very good average value, namely the attitude, learning motivation, and learning style. One indicator of the characteristics of students at medium level school has a very good average value, namely attitude. Meanwhile, one indicator of student characteristics in low-level school has a very good average value, namely learning motivation. The average value for all indicators is 79.49. This shows that the indicators of background, interest, learning motivation, learning styles, attitudes and creativity are already in the good category and very good category.

3.5. Analysis of Literacy Test of the Initial Knowledge of Students
The last preliminary research result is the initial knowledge of students that related to data literacy, technology literacy, and critical thinking skills. In this case, the instrument for collecting data was the literacy test sheet of students. The literacy test sheet was given to eighth grade junior high school students consisting of three of state junior high school in Padang City. Every junior high school student sample is taken from one class. Descriptive statistical parameter values from the results of the initial knowledge tests of students from 3 state junior high schools can be considered in Table 1.

Table 1. Statistical Parameter Values from the Initial Knowledge of Students from Test Literacy

| No | Parameters | Sample of School |
|----|------------|-----------------|
|    |            | S25 | S15 | S28 |
| 1  | N          | 32  | 28  | 31  |
| 2  | Mean       | 80.78| 79.52| 79.79|
| 3  | Median     | 77.50| 79.52| 79.79|
| 4  | Mode       | 75.00| 40.00| 45.00|
From the data in Table 1 it can be revealed that the lowest score of the initial knowledge test for the three schools is 10.0 while the highest score is 100. A score of 10.0 means that the results of the initial knowledge test are in the very low category, while the number 100, means the results of the knowledge test the start is in the very good category. The range of initial knowledge test results is 35,00; 55.00; and 45.00. The average value of a student's initial knowledge test is 58.46. This average value indicates that the student's initial knowledge is in the poor category. Scores that often arise from the initial knowledge test results for three schools range from 40.00-70.00 while the mean scores from the initial knowledge test results are 40.00-77.50. Both of these values are in the less visible category in S15 and S28. In this case, it can be said that based on the average scores of the three schools still have low initial ability.

4. Conclusion

The results of the research can be obtained from the results of data analysis. Based on the results of data analysis, some conclusions can be stated from this research. First, generally the application of thematic teaching components is still low in science teaching such as the use of themes and integration of science materials. Second, the average value of the new literacy components in science teaching is in the low and sufficient category. Third, the integration of new literacy components in natural science textbooks is still low. Fourth, the characteristics of students are good to develop thematic learning of science. Finally, the initial literacy in knowledge form of students relating to the new literacy components is in the low and good category. Thus, the results of this research can be used as a good basis for designing and developing thematic science teaching material by integrating new literacy.

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