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Effectiveness of integrated science instructional material on pressure in daily life theme to improve digital age literacy of students

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Abstract. Integrated science learning and literacy skills are relevant issues in Indonesian’s education. However, the use of the integrated science learning and the integration of literacy in learning cannot be implemented well. An alternative solution of this problem is to develop integrated science instructional material on pressure in daily life theme by integrating digital age literacy. Purpose of research is to investigate the effectiveness of the use of integrated science instructional material on pressure in daily life theme to improve knowledge competence, attitudes competence and literacy skills of students. This research was a part of development research which has been conducted. In the product testing stage of this research and development was used before and after design of treatment for one sample group. Instruments to collect the data consist of learning outcomes test sheet, attitude observation sheet, and performance assessment sheet of students. Data analysis techniques include descriptive statistics analysis, normality test, homogeneity test, and paired comparison test. Therefore, the important result of research is the use of integrated science instructional material on pressure in daily life theme is effective in scientific approach to improve knowledge competence, attitudes competence, and digital age literacy skills of grade VIII students at 95% confidence level.

1. Introduction
Skills are important for students to achieve success in their learning, daily life and future in the 21st century. The 21st century skills are a set of abilities that students need to develop in order to succeed in the information age [1]. In general, there are three types of 21st century skills that students need to handle the future challenges, namely learning skills, literacy skills, and life skills [2, 3]. Digital age literacy is one part of 21st century skills to improve information skills of students in varying contexts [4]. Therefore, education in schools needs to produce graduates not only possesses relevant knowledge but also interpersonal relations and communication skills, ability to work in various contexts, and literacy skills in their daily life [5].

An integrated curriculum is a popular way to develop this 21st century skill [6]. As the reason is integrated curriculum is one who encourages students to see the interconnectedness and interrelationships. The objective of integrated curriculum is to develop the skills of students such as effective communication, problem solving, independent learning, and information sharing [7]. In this way students are trained to make a connection between the subject matter, connection between sub-disciplines of knowledge, and connection between learning material and real-world contexts. Thus, integrated curriculum can encourage students to learn holistically, authentically, meaningfully, and actively [8,9].

The ministry of education and culture of Indonesia has realized the importance of integration of science and literacy in education. For this reason, the 2013 curriculum requires science subjects in junior high school to be implemented with integrative science concepts. In one basic competence of science has been integrating the science concepts which found in the sub disciplines of biology,
physics, chemistry, and earth science and space. In addition, the school literacy movement program was also created to improve literacy skills of students in the school.

However, the real conditions show that the implementation of integrated science learning and integration of literacy in learning process cannot be implemented well. From the results of preliminary research and other relevant research, three real conditions were found. The first condition was science learning in school is still implemented separately in sub-disciplines of biology, physics, and chemistry [10,11,12]. The second real condition was instructional materials in integrated science books are still written separately in sub-disciplines of biology, physics, and chemistry [13,14]. The last real condition was the digital age literacy skills on component of functional literacy, scientific literacy, and visual literacy of students were still low [10].

The real conditions which found didn’t match with the ideal conditions. This indicates a research problem need to be solved. An alternative solution to this problem was to develop integrated science instructional material on the pressure in daily life to improve the knowledge competence, attitude competence, and digital age literacy skills of students.

Instructional materials are an important part of the learning process. Teachers use instructional material to facilitate student to learn a certain material. On the other hand, students use instructional to construct a competency. Instructional material is defined as essential and significant tools needed for teaching and learning of school subjects to promote teacher’s efficiency and to improve the performance of students [15]. Instructional materials are also defined as objects or devices that assist teachers to present their lessons logically and sequentially to the learners [16]. Meanwhile, instructional materials are all things that are used to support, facilitate, influence or encourage the acquisition of knowledge, competency and skills. Therefore, instructional materials are an important tool or material to assist teachers in learning process to improve the competencies of students.

In learning, there are several functions of instructional materials such as accommodating learning materials for students and teacher, being the main source of material content, being specific idea about fundamental properties of scientific learning, providing materials to develop the science, and being the main direction to arrange teacher’s strategy in science learning. Learning process which uses instructional materials can improve cognitive value, skills and affective value of students [17]. The use of instructional materials plays an important role in learning. The role of instructional materials are to make learning more interesting, practical, realistic and meaningful [15,18-20], to enable teachers and students to participate actively and effectively in learning, to provide space for acquiring skills and knowledge and to develop self-confidence and self-actualization [21,20], to help transfer information and skills to others [18] and to make abstract knowledge become more concrete [22], and to improve competencies of students including knowledge, skills and affective [23,17].

The use of integrated science instructional material on pressure in daily life is important for solving this research problem. In this case, the use of integrated science instructional material is to promote the use of integrated science learning in school, to connect the science material to real-world contexts, and to improve competencies of students in the form of knowledge, attitudes, and literacy skills. From this reason, research to use integrated science instructional material on the pressure in daily life theme by integrating digital age literacy is very important to be conducted in this research. The purpose of this research is to investigate the effectiveness of using integrated science instructional material on the pressure in daily life theme in the scientific approach to improve the knowledge competence, attitudes competence, and digital age literacy skills of grade VIII students.

2. Research Method
Type of research was research and development or R&D. R & D is a research method which used to create a certain product, and to test the effectiveness of that product. This means that product and testing of this product are important in R & D. Main product of this research is integrated science instructional material on pressure in daily theme by integrating digital age literacy. Development model which was used in this research can be divided into four parts such as preliminary research, design and test its validity, product testing in limited scale, application testing in wide scale.

The first part of the research was to do preliminary research. This first part consist of two stages were to understand the potency and problem and to collect the information. Activities on these stages
include analyzing the curriculum, analyzing integrated science textbooks, analyzing literacy skills of students, and analyzing learning outcomes of students. Thus, the important result of the preliminary research was the description of the integration in the science curriculum, integration in the science textbook, the digital age literacy of students, and the knowledge competence of students.

The second part of the research was to design of product and to test it. The stages on this part were to design the product, to test the validity of the product and to revise the product. Integrated science instructional material was designed based on guidance for the development of instructional material. Integrated science instructional material consists of learning guides, competency to be achieved, instructional content, support information, exercises, worksheet, evaluation and feedback from students. Digital age literacy which integrated into instructional material consists of functional literacy, scientific literacy and visual literacy. The product of instructional material was validated by five experts from physics, biology, and chemistry. The expected result of the activity was integrated science instructional material by digital age literacy that was valid. Therefore, the high validity value of this integrated science instructional material was important in this part.

The third part of the research was to conduct the product testing in a limited scale and to revise the product. The purpose of this product testing was to determine the practicality and the effectiveness of the use of integrated science instructional material. The research design which used in the product testing in limited scale was before and after design of treatment for one sample group. A revision of integrated science instructional material was done based on the weaknesses and the problems which found on the product testing in limited scale. The expected result of the activity was the description of the practicality and effectiveness of the use of integrated science instructional material in science learning. So, practicality and effectiveness were important point in research and development.

The instruments for collecting data consist of three parts, namely learning outcomes test sheet, attitude observation sheet and performance assessment sheet. Learning outcomes test sheet was used to assess the knowledge competence of students before and after using integrated science instructional material. This instrument consists of pre-test and post-test. Attitude observation sheet was used to assess attitudes of students in the scientific approach. Components of attitude competence of students include self-confidence, curiosity, communicative, discipline, responsibility and hard work. On the other hand, the performance assessment sheet was used to assess the digital literacy skills of students. In this case, these literacy skills include functional literacy, scientific literacy and visual literacy.

The data of research were analyzed by descriptive statistic analysis, normality test, homogeneity test, and paired comparison test. Descriptive statistics analysis was used to describe the parameters of a group of data such as pre-test, post-test, attitude of students and literacy skills of students. Normality test was used to determine the normality of a data group. Homogeneity test was used to determine the similarity of variance of the two data groups. The result of normality test and homogeneity test were used as consideration in choosing the comparison test. A paired comparison test was used to determine the difference of competence after and before using integrated science instructional material on pressure on daily life theme in scientific approach. On the other hand, Wilcoxon paired comparison is used if the data groups don’t have normal distribution.

3. Result and discussion
Main result of this research is the effectiveness of the use of integrated science instructional material by integrating the digital age literacy in scientific approach. In this case, the result of this research can be grouped into three groups, namely the effectiveness of the use of integrated science instructional material on knowledge, attitudes and digital age literacy skills aspects of students. The component of digital age literacy which discussed in this research consists of three components; those are functional literacy, scientific literacy and visual literacy.

The effectiveness of the use of integrated science instructional material on knowledge competence was determined from pre-test and post-test data. On the other hand, the effectiveness of the attitudes competence was determined from the attitude value after using the integrated science instructional material before using it. Data on knowledge competence and attitudes competence were analyzed with descriptive statistics and paired comparison test. The result of data analysis of knowledge competence and attitudes competence of students can be seen in Table 1.
In knowledge competence, the average value of post-test is higher than pre-test. From the normality test, it is known that the data groups of both pre-test and post-test don’t have normal distribution. In addition, from the homogeneity test, it is found that both data pre-test and post-test also don’t have the same variance. For this reason, the Wilcoxon paired comparison test was used to analyze the data. The Wilcoxon test was used to analyze the differences from the observed results of two paired data. This test can be included into non-parametric testing. The calculated Z for 28 students is -4.63. At significant level $\alpha = 0.05$, a half value of significant level is 0.025, then area under the curve $F(z) = 0.475$ obtained the Z value in table is 1.9. The value of calculated Z is outside the acceptance area of the null hypothesis. The result of this hypothesis test indicates that there is a significant difference between knowledge competence of students after using the integrated science instructional material on pressure in daily life theme in scientific approach and before using it. In other words, from the result of this hypothesis test can also be stated that the use of integrated science instructional material is able to improve the knowledge competence of students. Thus, the use of integrated science instructional material on pressure in daily life is effective in scientific approach to improve the knowledge competence of grade VIII students at 95% confidence level.

In the attitudes competence of the students, the average value of student attitudes after using integrated science instructional material is higher than before using it. Based on the normality test, the both data group of attitudes of students after using integrated science instructional material and before using it have normal distribution. On the other hand, homogeneity test result indicates that both data groups of attitudes competence of students have the same variance. Attitudes data groups of students before and after using integrated science instructional material satisfy the parametric statistics. For this reason, paired comparison test was used to determine the difference attitudes competence of students. From paired comparison test was obtained the calculated value of t is -13.13. On the other hand, the value of $t$ in table for the number of 28 students, degree of freedom was 27 and the significant level $\alpha =0.05$ is 2.05. The value of calculated $t$ is outside the acceptance area of the null hypothesis. The result of paired comparison test indicates that there is a significant difference of attitudes competency between after using integrated science instructional of pressure in daily life and before using it. The result of this hypothesis test indicates that the use of integrated science instructional material can improve the attitudes competence of students. Therefore, the use of integrated science instructional material on pressure in daily life by integrating digital age literacy is effective in scientific approach to improve the attitudes competence of students.

The effectiveness of the use of integrated science instructional material is also determined on digital age literacy skills of students. In this case, the digital age literacy which integrated into instructional material consists of three components, namely functional literacy, scientific literacy and visual literacy. Functional literacy includes writing and describing information. The scientific literacy includes scientific concepts, scientific processes and scientific contexts. On the other hand, visual literacy consists of visual interpreting and visual use. The statistics parameter values of functional

| Statistics Parameters | Knowledge | Attitudes |
|-----------------------|-----------|-----------|
|                       | Pre-test  | Post-test | Before | After |
| Mean                  | 47.57     | 81.07     | 61.24  | 74.26 |
| Median                | 52.00     | 80.00     | 59.38  | 71.88 |
| Mode                  | 52.00     | 76.00     | 54.17  | 62.50 |
| Standard deviation    | 11.99     | 6.41      | 8.49   | 10.99 |
| Variance              | 143.81    | 41.03     | 72.13  | 120.95|
| Minimum               | 16.00     | 72.00     | 50.00  | 60.42 |
| Maximum               | 64.00     | 96.00     | 75.00  | 93.75 |
| P-value of normality test | 0.038   | 0.013     | 0.086  | 0.080 |
| P-value of F test     | 0.002     |          | 0.186  | -13.13|
| Paired comparison test|          |          | -13.13 | -4.63 |
literacy, scientific literacy, and visual literacy before and after using integrated science instructional material on the pressure in daily life are displayed in Table 2.

| Statistics Parameters | Functional Literacy | Scientific Literacy | Visual Literacy |
|-----------------------|---------------------|---------------------|-----------------|
|                       | Before  | After  | Before  | After  | Before  | After  |
| Mean                  | 54.58   | 68.59  | 49.27   | 68.39  | 47.44   | 62.95  |
| Median                | 56.25   | 68.75  | 49.32   | 68.77  | 46.88   | 61.73  |
| Mode                  | 56.25   | 59.38  | 44.32   | 64.16  | 50.00   | 68.76  |
| Standard deviation    | 8.48    | 8.25   | 5.37    | 4.28   | 7.61    | 8.72   |
| Variance              | 71.96   | 68.05  | 28.80   | 18.30  | 57.90   | 76.12  |
| Minimum               | 40.63   | 54.69  | 38.47   | 59.59  | 34.38   | 48.44  |
| Maximum               | 68.75   | 85.94  | 59.45   | 78.13  | 62.50   | 78.13  |
| P-value of normality test | 0.126  | 0.254  | 0.660   | 0.594  | 0.649   | 0.503  |
| P-value of F test     | 0.886   | 0.245  | 0.482   | 0.482  | 0.886   | 0.482  |
| Paired comparison test| -18.43  | -26.37 | -16.94  | -16.94 | -18.43  | -26.37 |

From the data in Table 2, it can be described that the average value of functional literacy, scientific literacy and visual literacy of students after using integrated science instructional material are higher than before using it. On the normality test, the group data of literacy skills before and after using integrated science instructional material have normal distribution. In addition, the group data of literacy skills of student before and after using integrated science instructional material on the F test have the same variance. On the other word, the group data of literacy skills is called as homogenous.

The characteristics of data group of functional literacy, scientific literacy and visual literacy satisfy the parametric statistics. For this reason, the paired comparison test can be used to determine the difference the literacy skills of students after and before using integrated science instructional material on pressure in daily life. From paired comparison test, t values are obtained for functional literacy, scientific literacy, and visual literacy are -18.43, -26.37 and -16.94 respectively. On the other side of the two-tailed test with a significant level of 0.05 and degree of freedom 27 the value of t in the table is 2.05. The value of calculated t of three literacy skills of students is outside the acceptance area of the null hypothesis. The results of this hypothesis test show that there are significant differences in functional literacy, scientific literacy and visual literacy between after and before using the integrated science instructional material on the pressure in daily life in scientific approach. This means that the use of integrated science instructional material in scientific approach can improve functional literacy, scientific literacy and visual literacy of students. Therefore, the use of integrated science instructional material on the pressure in daily life by integrating digital age literacy is effective in scientific approach to improve functional literacy, scientific literacy and visual literacy skills of grade VIII students at 95% confidence level.

The result of the research which has been achieved is the use of integrated science instructional material on the pressure theme in life was effective in scientific approach of grade VIII students. This result is indicated by the improvement of competence of students on competences of knowledge, attitudes and literacy skills between after and before the use of integrated science instructional material in scientific approach. This means that learning objective can be achieved with the use of integrated science instructional material. From results of other researches, the effectiveness of instructional material can be indicated by the significant effect of the use it on some aspects such as: academic achievement and retention [24], attitudes, knowledge achievement, and skills achievement [25], critical thinking skills [14], and science literacy skills [26]. This means that the result of this research is relevant to the results of other researchers. From this result can be recommended to science teachers and students of grade VIII can use the integrated science instructional material by integrating digital age literacy as an alternative learning resource to construct the competencies in science subjects.
4. Conclusion
Based on the data analysis can be presented the results of this research. As result of the research is the use of integrated science instructional material on pressure in daily life by integrating digital age literacy is effective in scientific approach to improve knowledge competence, attitudes competence and digital age literacy skills on grade VIII students at 95% confidence level. In this case, the digital age literacy of students includes functional literacy, scientific literacy and visual literacy. The integration of learning material in science instructional material can encourage students to connect learning material to real world contexts, to encourage the activity of students in learning, to develop holistic thinking of students, and to make learning more meaningful. In addition, the integration of digital age literacy in integrated science instructional material can practice the functional literacy, scientific literacy and visual literacy skills of students. Literacy skills play an important role in helping students to get success in their learning and daily life. For this reason, science teachers and students in junior high school can use this integrated science instructional material on pressure in daily life as an alternative learning resource. This instructional science instructional also has some limitations such as basic competence of science which developed and integrated learning model which used in instructional material. Therefore, other researchers can develop integrated science instructional material for other science basic competencies and integrated learning models.

Acknowledgement

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