THE DEVELOPMENT OF WORKSHEETS WITH A CONTEXTUAL APPROACH TO IMPROVE STUDENTS’ SCIENTIFIC LITERACY SKILLS

Dwi Agnes Setianingrum*, Sabar Nurohman

Study Program of Science Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta

Corresponding Author. Email: dwiagnes.2017@student.uny.ac.id

ABSTRACT

The aims of this study were to i) analyze the feasibility of worksheets with a contextual approach, ii) analyze the practicality of the worksheets with a contextual approach, and iii) analyze the effectiveness of the worksheets with a contextual approach to improve students’ scientific literacy skills. This study used the Thiagarajan Four-D (4D) development model, consisting of four stages, namely the definition, design, development, and disseminate stages. The dissemination stage was not carried out. This research was only limited to testing the feasibility and effectiveness of the product. The results showed that i) the worksheets with a contextual approach were feasible judging from the results of the material, media, and teacher validators with scores of 3.54 (very good), 3.89 (very good), and 3.00 (very good), respectively, ii) the analysis of the students' responses was 3.12 (very good), and iii) the worksheets with a contextual approach was effective in improving students' scientific literacy skills with N-Gain of 0.56 (moderate) and effect size of 1.22 (high). Based on the analysis of the paired sample t-test, there is a significant difference between the pretest and posttest scores.

INTRODUCTION

The development of the 21st century occurs very rapidly following the era of globalization, which is marked by the increasingly intertwined science and technology. The rapid development of science and technology can affect various fields of life, one of which is the field of education. Especially in science education today, students are directed to be able to prepare for life in order to be successful in the 21st century. One of the skills needed by students in the 21st century is scientific literacy (Liu et al., 2009).

The results of the evaluation of Trends in Mathematics and Science Study (TIMSS) in 2011 for the field of science of grade VIII, Indonesia was ranked in the top 5 from the bottom along with Macedonia, Lebanon, Morocco, and Ghana. Indonesia's ranking of 39 from 42 with a score of 406 is below Palestine, Malaysia, and Thailand. The rank obtained by Indonesia actually went down compared to the results in 2007, which was ranked 36 out of 49 countries that participated with a score of 427 (Hariapsari & Astriani, 2015).

The 2009 PISA data shows that Indonesia's ranking has only been able to occupy the bottom 10 of the top 10 of 65 countries. There are three aspects studied by the Program for International Student Assessment (PISA), namely reading skills, mathematics, and science. The results of the 2009 PISA survey showed reading skills at 57, mathematics at 61, and science at 60. This shows that Indonesian children are still low in scientific literacy skills, including identifying scientific problems, using scientific facts, understanding living systems, and understand the use of science equipment (Hayat, 2011).

Based on PISA data, the scientific literacy ability of students in Indonesia is still very low, as quoted from the Organization for Economic Cooperation and Development [OECD] (2010)
Indonesia's ranking in 2009 was ranked 57 out of 65 countries with a score of 383. In 2012 Indonesia's ranking was 64 out of 65 countries with a score of 382 as quoted from the OECD (2013). Furthermore, in 2015 Indonesia's ranking was 64 out of 72 countries with a score of 403 as quoted from the OECD (2018). The acquisition of the scientific literacy score experienced an improvement but still below the average set by the OECD. Based on these data, it can be concluded that the scientific literacy of students in Indonesia is still low. This is reinforced by the results of Pantiwati's (2014) study, which states that students in Indonesia have not been able to apply science concepts in everyday life.

Scientific literacy according to Choi et al. (2011) is about the depiction of individuals who have an integrated understanding of ideas from science, can appreciate cultural diversity and values, participate in the development of social values through cooperation and communication with others, take responsibility for taking action on global issues related to science, and ultimately develop characters and values as members of the world’s community. Some domains of the scientific literacy according to OECD (2013) are the context of knowledge, competence, and attitudes. The competency domain contains three main aspects that can represent other domains, namely explaining phenomena scientifically, evaluating and designing scientific investigations, and interpreting scientific data and evidence. Scientific literacy according to Gultepe & Kilic (2015) is a skill that is used at a time when scientific knowledge is used as a basis in everyday life.

It turned out that in the aspect of explaining the phenomenon scientifically, class VIII A students of SMP Negeri 1 Yogyakarta had difficulties in identifying the kinds of joints and their direction of motion based on a simple model or picture. In addition, students also have difficulty identifying the names of bones from a skeletal model. In the aspect of interpreting data and evidence scientifically, students also experienced difficulties in interpreting straight motion data into a graph. Based on the acquisition of the average learning outcomes of class VIII A students at SMP Negeri 1 Yogyakarta for science subjects on motion and movement systems is 75. This value is below the school's minimum completeness criteria (MCC) score. This shows that students' scientific literacy is still low in learning science.

According to Holbrook & Rannikmae (2009), the factors that can affect the low scientific literacy ability of students are the lack of science learning that is associated with the context of problems in everyday life so that they cannot handle simple problems because they are unable to relate the concepts of knowledge they have acquired in school with problems in everyday life.

Regulation of the Ministry of Education and Culture No. 22 of 2016 concerning the learning principles used in the 2013 Curriculum states that learning by active students is further strengthened by a science approach learning model. So, good learning is that students can build and find their own concepts. The teacher only plays a role in directing and guiding students. In addition to finding their own concepts, science learning must be meaningful for students, where in the learning process the teacher connects the material with everyday life.

Contextual learning is learning that is based on the ability of students to understand the meaning of the material received and understand the meaning of school assignments in forming new information with the knowledge and experience that students already have before (Johnson, 2002). Absorbing and understanding academic material is not difficult, but how students are able to understand the meaning of the material received and relate it to the tasks given by the teacher is what is difficult. Teachers are required to be able to create learning that encourages students to link the information received on scientific material with problems that occur in real life. Presenting the problems of everyday life in science learning is one way to quickly achieve this goal. Problems of daily life can be presented through discussion activities, practicum, project assignments, or questions by students.

According to Muslich (2007), awareness of the need for contextual learning is based on the fact that currently most students are not able to connect what they learn with how they are used in real life. Shamsid-Deen & Smith (2006), state that contextual learning can be used as an initiative by a science teacher to increase knowledge and familiarize children with learning according to daily activities. This can be used as encouragement by science teachers to apply contextual learning to optimize students' scientific literacy skills.

To improve students' scientific literacy skills, it is necessary to improve the learning process through the learning materials used, so that students are expected to achieve optimal competence. According to the National Center for Vocational Education Research Ltd in Nugraha & Binadja (2013), teaching materials are all forms of materials used to assist teachers or instructors in carrying out learning activities in the classroom.

The learning materials are used as a teacher's tool in teaching. For example, printed teaching materials consist of textbooks, modules, pictures, brochures, leaflets, and worksheets. The use of teaching materials in the learning process can also generate new desires and interests of students and arouse students' learning motivation. In order for the
learning activities to take place properly, it is necessary to have a learning device that supports the creation of a conducive atmosphere. The learning tools are in accordance with the 2013 Curriculum.

One of the efforts to create learning tools that are in accordance with the standard process, it is necessary to use a student worksheet that optimizes the learning activities. A worksheet is a form of learning material that contains instructions, a list of tasks, and guidance on carrying out activities. A good worksheet must be able to encourage active participation of students and develop a culture of reading and writing. In addition, the worksheet is also prepared to take into account the relationship and integration between core competency, basic competency, learning materials, and learning activities. The use of the worksheet is expected to increase the independence of students in learning, confident, discipline, responsible, and able to make decisions. The worksheet can also be used at the concept planting stage or at an advanced stage of concept planting.

The student worksheets of science subjects used at SMP N 1 Yogyakarta are contained in textbooks, so teachers only rely on textbooks in the learning process. These textbooks have not been able to achieve scientific literacy and emphasize scientific knowledge (Chiappetta & Koballa, 2010). The worksheets contained in the textbook only contain guidelines for carrying out experiments and questions that are reminiscent of the concepts that have been learned. According to the Ministry of National Education, a good worksheet structure consists of titles, learning or student instructions, competencies to be achieved, supporting information, tasks and work steps, and assessments.

In this study student worksheets are developed with a contextual approach to improve students' scientific literacy skills. One of the relevant lessons to optimize students' scientific literacy skills is contextual learning. The learning process which is carried out is expected to improve students' scientific literacy skills, so that students can have sensitivity in solving the problems they face. The worksheets developed are expected to include scientific literacy indicators so that it can facilitate teachers and schools to add teaching materials used.

Based on the background of the problem above, development of worksheets is carried out with a contextual approach. The main aim of this study is improving students' scientific literacy skills. Hence, the worksheets are developed with a contextual approach.

METHOD
This was a research and development (R&D) study. The development model used was the R&D model according to Thiagarajan et al. (1974). This research was conducted from 2 to 23 March in the 2020/2021 academic year. The worksheets resulted from this R&D research were tested at SMP N 1 Yogyakarta, which is located at Jl. Cik Di Tiro No. 29, Terban, Gondokusuman, Yogyakarta, 55223.

The subjects in this study were 25 students of grade VIIIa of SMP N 1 Yogyakarta who participated in the learning process using the science worksheets. In this case, the effectiveness of the science worksheets was determined. Moreover, the worksheets were developed to improve students' scientific literacy skills.

The research procedure consisted of four stages, namely define, design, develop, and disseminate. The define stage included the initial stage, students, assignments, concepts and formulation of learning objectives. The design stage included the preparation of instruments, media selection, format selection, and initial product design. The develop stage included the expert assessment and development trials. The disseminate stage was only done in a limited way. The research design is the one group pretest-posttest design. This design was a pretest and posttest design which was carried out in one group without comparison (Tanireja & Mustafidah, 2012).

Validation data included expert validation questionnaire data (material and media experts, and also teachers), as well as worksheets practicality questionnaire data with a contextual approach. Data on the results of the implementation of learning with a contextual approach were in terms of the activities of teachers and students. Data on students' scientific literacy skills included pretest and posttest data. Research instruments included questionnaire sheets, observation sheets, and written test questions. Data collection techniques included questionnaires, observations, and written tests.

The feasibility and practicality of the worksheets with a contextual approach were analyzed by converting scores using a scale of 4 (Mardapi, 2008). The implementation of learning with a contextual approach was analyzed using the Interjudge Agreement (IJA) equation (Pee, 2002). The effectiveness of the worksheets with a contextual approach was analyzed using the paired sample t-test (Troia & Graham, 2002), gain score (Hake, 1999), and effect size (Cohen, 1992).

RESULTS AND DISCUSSION
The results of this study are the worksheets with a contextual approach to improve students' scientific literacy skills. The development of the student worksheets with a contextual approach aims to produce products that help the learning process. The worksheets developed must have a level of validity, practicality, and effectiveness that meets the criteria.
The worksheets are composed of 4 meetings, each meeting consists of the title of the material, basic competencies, indicators of competency achievement, learning objectives, instructions for use, worksheet activities, learning materials, and evaluation. Activity 1 contains learning activities based on contextual stages on kidney organ as an excretory organ, activity 2 contains learning activities based on contextual stages on liver and skin as excretory organs, activity 3 contains learning activities based on contextual stages on lung organ as an excretory organ, and activity 4 contains learning activities based on contextual stages on excretory organ disorders and how to maintain the health of human excretory organs.

The format for the preparation of the worksheet follows the Ministry of National Education (2008) and Prastowo (2013), which consists of titles, instructions for use or learning instructions, basic competencies and indicators of achievement of learning outcomes, concept maps, supporting information, tools and materials used, work steps, assignments, and assessments.

In addition to the format of preparing the worksheet, the researcher also emphasizes a contextual approach which includes 7 components, namely constructivism, inquiry (finding), questioning (asking), learning community, modeling, evaluation, and authentic assessment. The worksheet also contains material related to the excretory system in humans.

The design of the worksheet’s cover uses an image of the kidney as an illustration of the contents in the worksheet. The cover on the worksheet consists of two parts, namely the front and back covers. The cover is designed with a light blue base color for the front cover and pink for the back cover. The supporting characteristics of the cover consist of several components such as the title of the material, the approach of the worksheets, worksheet users, and the identity of the worksheets compiler.

The worksheet’s content design with a contextual approach uses a general font size of 12 pt with Arial Rounded MT Bold and Times New Roman font types, and margin arrangement of 2.45 cm for the top, right, left, and bottom margins. In the worksheets with a contextual approach there are several pictures of the kidneys and their constituent structures, internal anatomy of the kidney, malpighian body structure, kidney nephrons, stages of the urine formation process, sweating people, skin anatomical structure, lung structure in humans, liver anatomic structure, the process of breaking red blood cells chart, crystals (stones) in the kidneys, and viral hepatitis. In addition, there are also some motivational pictures. The worksheet’s content design in the content section consists of 4 meetings, where each meeting consists of user identity, learning objectives, instructions for use, and learning based on the stages of the contextual approach.

The feasibility of the worksheet with a contextual approach is known from the assessments of material and media experts, and teachers. The effectiveness of the worksheet with a contextual approach to improve students' scientific literacy skills is determined through the limited trials.

Table 1. Interpretation of Ideal Assessment with a 4 Scale Criteria

<table>
<thead>
<tr>
<th>No.</th>
<th>Quantitative Score Range</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>( X \geq 3 )</td>
<td>Very Good</td>
</tr>
<tr>
<td>2.</td>
<td>( 2.5 \leq X &lt; X + 0.5 )</td>
<td>Good</td>
</tr>
<tr>
<td>3.</td>
<td>( 2 \leq X &lt; 2.5 )</td>
<td>Not Good</td>
</tr>
<tr>
<td>4.</td>
<td>( X &lt; 2 )</td>
<td>Very Not Good</td>
</tr>
</tbody>
</table>

(Mardapi, 2008)

Table 2. Average Material Validator Assessment Results

<table>
<thead>
<tr>
<th>Assessment Aspect</th>
<th>Rating Result</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content Eligibility</td>
<td>3.78</td>
<td>Very Good</td>
</tr>
<tr>
<td>Language</td>
<td>3.61</td>
<td>Very Good</td>
</tr>
<tr>
<td>Contextual Reality</td>
<td>3.22</td>
<td>Very Good</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>3.54</strong></td>
<td><strong>Very Good</strong></td>
</tr>
</tbody>
</table>

Based on Table 2, the average result of the material expert’s assessment of the worksheet developed is 3.54 with a very good category. The results conclude that the worksheets with a contextual approach can be used with a minor revision.

Overall, the average value of all aspects that have been assessed by material expert is 3.54 with a feasibility percentage of 88.5%. This percentage indicates that the worksheets with a contextual approach is very feasible with aspects of contextual reality, language, and content feasibility of 80.50%, 90.25%, and 94.50%, respectively. This may be seen in Figure 1.

The contextual reality aspect gets a lower score compared to the language and content feasibility.
aspects. This is because the contextual reality aspect in the worksheets before revision, especially for the constructivism component has not appeared yet. Constructivism arises because of the experiences that students’ gain from discovering by themselves. However, in the worksheets which are previously revised, the concept of the material has been presented, so that constructivism does not appear.

For the first meeting in the worksheets, the constructivism section displays an article on the kidney function. Then, after the revision, the article is changed to an article discussing bad habits such as eating petai too often without being balanced with drinking enough water can cause impaired kidney function. In the inquiry section, students are asked to conduct a simple experiment in analyzing the blood filtration process in the kidneys. From this experiment, the water that has been mixed with a handful of rice is initially cloudy (not clear), after the water is filtered using a gauze it becomes clear. This simple experiment describes the mechanism of the kidneys in the filtration process. Rice and water represent a model of blood in the renal artery, funnel and gauze represent a model of the malpighian body and glomerulus. In accordance with the mechanism of the kidney, the process that first occurs in the kidney is the blood enters the kidney through the renal artery, then the blood enters the glomerulus and Bowman’s capsule (malpighian body), and undergoes a filtering process called the filtration. Furthermore, the filtered fluid is referred to as the primary urine.

For the second meeting in the worksheets, the constructivism section consists of an article on the function of the skin to excrete sweat. Then, after revision, the article is changed to an article that discusses the habit of wiping sweat which can cause acne. When the condition of the body is sweating, one should avoid wiping using the back of the hand. This allows dirt and bacteria to mix with the sweat, which can clog the pores. In addition, the worksheets also display articles discussing the liver as an excretory organ. Then, after revision the article is changed to an article discussing smoking, which is one of the strongest triggers for liver cancer (a disorder that occurs in the liver).

For the third meeting of the worksheets, the constructivism section shows an article about the appearance of puffs like smoke from the mouth when breathing in cold weather. This indicates that there is gas being released by the lungs. Then, after revision the article is changed to an article discussing the dangers of smoking for the lungs’ health. In the inquiry section, students are asked to conduct an experiment using chalks. This experiment is conducted to prove that the excretion products released from the human respiratory system are water vapor and carbon dioxide gas. Lime water contains calcium hydroxide, which is a chemical compound that is produced when you mix water with lime. When we blow air into lime water, the carbon dioxide contained in the air we blow reacts with calcium hydroxide in lime water and produces calcium carbonate, a compound that causes lime water to become cloudy. Based on the results of this experiment, it can be concluded that the air we breathe contains carbon dioxide. This proves that carbon dioxide is the result of excretion from the human’s respiratory system.

<table>
<thead>
<tr>
<th>Assessment Aspect</th>
<th>Rating Result</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>4.00</td>
<td>Very Good</td>
</tr>
<tr>
<td>Cover Design</td>
<td>4.00</td>
<td>Very Good</td>
</tr>
<tr>
<td>Content Design</td>
<td>3.83</td>
<td>Very Good</td>
</tr>
<tr>
<td>Average</td>
<td>3.89</td>
<td>Very Good</td>
</tr>
</tbody>
</table>

Table 3. Media Expert Assessment Results

Based on Table 3, the average result of the media expert assessment of the worksheets with the contextual approach developed is 3.89 with a very good category. The result concludes that the worksheets with a contextual approach can be used with a minor revision.
accordance with the general guidelines for Indonesian spelling.

Based on Table 4, the average result of the teacher's assessment of the worksheets with the contextual approach developed is 3.00 with a very good category. The results conclude that the worksheets with a contextual approach can be used. The overall average of all aspects is 3.00 with an eligibility percentage of 75%. This percentage indicates that the worksheets with a contextual approach are feasible.

The product is said to be valid if it includes several components, namely (1) the content feasibility component, which includes the suitability of the competency standard with basic competency, needs, substance truth, benefits, moral values, and social values; (2) the presentation component, which includes the clarity of the objectives to be achieved, the order of presentation, the provision of motivation, attraction, interaction (providing stimulus and response), and completeness of information; and (3) the linguistic component, which includes limitations, clarity of information, conformity with Indonesian language rules, and effective and efficient use of language. All of these components are assessed by the validators on the validation sheets to determine the level of product validity based on the validity criteria (Desmiwati et al., 2017). The results show that all aspects of the assessments are in the valid category, so that the student worksheet with a contextual approach can be used in the field trials in the classroom learning to measure its effectiveness.

Based on Figure 4, the overall score of all aspects is 77.89%. This percentage shows that students are interested in the worksheets with a contextual approach. The percentages of the content material, interest in the worksheets, and language aspects are 73.75%, 75.75%, and 84.35%, respectively.
The effectiveness of the worksheets with a contextual approach can be seen from the results of the scientific literacy test after the worksheets have been tested. The test given is in the form of multiple choice questions totaling 20 items. The scientific literacy tests are given to students to determine the level of students' scientific literacy skills on the material provided by using the worksheets.

![Figure 5. Pretest Results of the Science Literacy Questions](image)

![Figure 6. Posttest Results of the Science Literacy Questions](image)

Based on Figure 6, the posttest percentages of the aspects of explaining phenomena scientifically, evaluating and designing scientific investigations, and interpreting data and evidence scientifically are 91.43%, 80.00%, and 84.00%, respectively. From the results of the pretest and posttest, there is an increase in the aspects of explaining phenomena scientifically and evaluating and designing scientific investigations. This shows that the worksheets with a contextual approach is able to help students to improve their scientific literacy skills.

In order to determine whether there is an influence of the worksheets on the students' scientific literacy skills, the data on the pretest and posttest scores of students are tested using the paired sample t-test using the SPSS version 22 software. The paired sample t-test is part of the comparative hypothesis test or comparison test. The paired sample t-test aims to determine whether there is a difference in the average of two samples (two groups) that are paired or related.

The results of the pretest show an average value of 73.00 from 25 data. The data distribution (std. deviation) obtained is 14.58 with a standard error of 2.92. The posttest results have an average value of 88.40 from 25 data. The data distribution (std. deviation) obtained is 10.77 with a standard error of 2.15. This shows that the posttest is higher than the pretest. However, the posttest data distribution range is wider with a higher standard error.

The coefficient value of the correlation is 0.543 with a significance value (sig.) of 0.005. Because the value of sig. 0.005 < 0.05, it can be said that there is a relationship between the pretest and posttest variables. The significant value (2-tailed) obtained is 0.000 (p < 0.05). So that the results of the pretest and posttest experienced a significant difference. Based on descriptive statistics, the posttest is proven to be higher than the pretest. Hence, it can be concluded that the student worksheet with a contextual approach can improve students' scientific literacy skills.

<table>
<thead>
<tr>
<th>No.</th>
<th>Coefficient Interval</th>
<th>Relationship Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>0.00 – 0.199</td>
<td>Very low</td>
</tr>
<tr>
<td>2.</td>
<td>0.20 – 0.399</td>
<td>Low</td>
</tr>
<tr>
<td>3.</td>
<td>0.40 – 0.599</td>
<td>Moderate</td>
</tr>
<tr>
<td>4.</td>
<td>0.60 – 0.799</td>
<td>Strong</td>
</tr>
<tr>
<td>5.</td>
<td>0.80 – 1.000</td>
<td>Very Strong</td>
</tr>
</tbody>
</table>

(Cohen, 1992)

The influence of the worksheets on students' scientific literacy skills is determined with an effect size test. The effect size test is a statistical test follow-up with the aim of knowing the effect of the treatment. Based on the calculations, the effect size obtained is 1.22. Based on Table 6, the effect size value obtained shows that the worksheets have a very strong influence on students' scientific literacy skills. The result of the effect size with a sample of 25 students shows that the worksheets belong to the scientific literacy ability of students in the high category of influence. This shows that the worksheets with a contextual approach have a high influence on students' scientific literacy skills.

To find out the increase in the mastery of students' concepts after learning is carried out by the N-gain test. The N-gain is the difference between the students' posttest and pretest scores. The results of the N-gain value produce an averages pretest and posttest of 73.0 and 88.4, respectively, hence the N-gain is 0.56. This means that students experience an increase...
in scientific literacy skills in the medium category because the N-gain is in the interval of 0.7 > g > 0.3. Based on these data, it can be said that there is an increase in students' scientific literacy skills on excretory system in humans using the worksheets with a contextual approach. From the discussion above, it can be concluded that the worksheets with a contextual approach is effective in improving the scientific literacy skills of students in science subjects with the material of excretory system in humans.

CONCLUSION
The worksheets with a contextual approach developed in this study is valid and feasible to be used in science learning. The worksheet is also effective for improving students' scientific literacy skills. A good student worksheet is one that suits the needs of students. So that the learning process, the level of activity, and student learning outcomes continue to increase. Further study can be conducted to understand more deeply about learning with a contextual approach used so that the resulting products are better of higher quality, and can help the learning process. The product developed can be tested not only in one class so that it can involve large numbers of students. Furthermore, determining the science material, which is suitable for learning with a contextual approach is also an interesting study that can be conducted. This is because not all science materials are suitable to be delivered using a contextual approach.

REFERENCES
Shamsid-Deen, I., Smith, B.P. 2006. Contextual Teaching and Learning Practices in the Family
and Consumer Sciences Curriculum. *Journal of Family and Consumer Education.*

