Designing Simple Technology as a Science Teaching Aids from Used Materials

Arif Widiyatmoko¹, Sita Nurmasitah²

¹Science Education Study Program, Mathematics and Natural Science Faculty, Semarang State University
²Engineering Faculty, Semarang State University, Indonesia

Corresponding Author Email: arif.gnpt@gmail.com

Abstract:

The purpose of this research is to design simple technology for Science teaching aids that utilized the used materials. Based on the research result, there were three products of simple technology tools that can be used for Science teaching aids, they are: electrolyte test device, earthquake detector and flood detector. The advantages of the utilization of used materials are reducing production cost and reducing environmental pollution. The result of trial showed that those simple technology tools for teaching Science got a positive response from students and teachers.

Keyword: simple technology, science, teaching aids

1. Introduction

The quality of science teaching and learning continues to be an area of concern. When it is inadequate, it is often the lack of a sufficient number of highly-qualified and dedicated science teachers that is cited as the problem. A central component of science education is the learning of scientific inquiry. The term scientific inquiry describes particular practices such as generating questions about the world, constructing explanations, assessing available sources of information to inform one’s observations, testing hypotheses, and interpreting data or results (National Research Council, 2000). In recent years science education reform movements have emphasized the need for integrating technology into teaching, learning and assessment processes as technological advancements revolutionize all facets of human life. Accompanying the pace of the technological advancements in the twenty-first century has been the proliferation of scientific information, rapid transformations in society (e.g., growth of cities with their increased pollution, transportation need) and emergent problems in our physical environment (global warming, species elimination). These changes have coalesced to increase the complexity of the science curriculum and science itself as an area of study and instruction. They are also suggestive of the need for better methods of instruction and assessment as well as ways of improving and facilitating the knowledge and process of learning of students (Kumar, 2009).

In science education, simulations, animations, and other interactive graphics can be an effective way to represent complicated relationship (Bravo, 2005; Furberg 2009; Holzinger et al., 2009;
Lowe, 2003), and equally important, can active and motivate students (Merrick & Maher, 2007; Yaman et al., 2008). Technologies can be used as media for learning through inquiry. The inquiry-based learning framework focuses on this particular set of uses. Innovative learning approaches in science, mathematics, and engineering have concentrated on this set of uses (Bruce & Levin, 1997).

Science education in Indonesia is still using a traditional method. The teacher rarely use learning media and teaching aids because of the lack of it. At present, in Indonesia, many science teachers are still using conventional methods (explaining) in the learning process. It is not in accordance with the Curriculum Education Unit in 2013 that in learning science need to use a variety of learning methods. One of the methods is to use learning media and science teaching aids.

Science is a knowledge gained through the data collection by conducting experiment, observation, and deduction to produce an explanation of a phenomenon that can be trusted. One of the goals of science education in junior high is to make learners have the ability to, (1) develop an understanding of a variety of natural phenomena, concepts and principles of science that are useful and can be applied in everyday life, (2) develop a curiosity, a positive attitude, and awareness of the interplay relationship among science, environment, technology, and society, and (3) increase the awareness to participate in preserving, maintaining and conserving the environment and natural resources (Ministry of Education, 2006).

In Curriculum 2013, science education will have several changes such as the concept of learning which is developed as an integrative science educations will be no more as educational disciplines. The concept of this integration is shown in the Core Competence and the Basic Competence in science education in which one Basic Competence has integrated science concepts derived from physics, biology, chemistry and earth and space science. The orientation of science education are applicative skills, the development of thinking skill, learning skill, curiosity, and the development of caring and responsible attitude towards the social and natural environment (Munegumi, 2013).

Criteria for good science education in accordance with the curriculum 2013 are not enough to stem from a book, but the teaching processes must be equipped with practical tools which are in line with the surrounding environment. Students will be encouraged to develop the skills and attitudes that are useful to attend the higher level of education or to live in the community. Through the use of instructional media, the instillation of concepts, principles, and laws of science education will result in effective learning. At first, the students will face a difficulty when learning the science education; and it will be much easier for them to understand when the teaching-learning processes take advantages of learning media and interesting teaching aids. The teaching aids can be used to help learners have the exploitation in the form of observation (observing), associate the phenomena (associating), ask or formulate the problems (questioning), and conduct the experiment (experimenting) or advanced observation.

Teaching aid is defined a helping tool to educate or teach in order to make the concepts taught are easy for students to understand. The teaching aids used in the teaching-learning processes can be made by the teachers or students by using simple materials that are easily obtainable from the surrounding environment. These teaching aids will help learners understand and achieve the learning competences. Scientific teaching aids can be created in accordance with the concepts.
taught at reasonable costs; these can be made from the simple materials that are easily obtained from the used materials. Science teaching-learning using the teaching aids is more effective in achieving the learning objectives that have been set before when compared to the lack of teaching aids in teaching-learning processes. Teaching aids are the intermediary or messenger of learning contents. The teaching-learning processes using the teaching aids means that the teacher optimize the whole function of students’ senses to increase the effectiveness of students learning in the way of hearing, seeing, feeling, and using the mind logically and realistically.

2. Method
The objective of this study is to design the science teaching aids using simple technology from the used materials. The steps taken to develop these science teaching aids are:
1. Assigning one material/theme of integrated science in junior high school that needs teaching aids in its teaching-learning processes.
2. Designing the model of science teaching aids using used materials and then being tested for feasibility.
3. Revising the draft model of science teaching aids to be in accordance with the aspects and indicators of its feasibility.
4. Producing the science teaching aids using simple technology from the used materials.
5. Trying out the science teaching aid in order to provide feedbacks and suggestions for improvement.
6. Enhance the science teaching aids based on the feedbacks and suggestions received while having trial.

3. Result and Discussion
To finally understand the teaching aids, firstly it is better to understand the media; since the teaching aids are included in media. Pujiati (2004) explained that the medium of instruction can be defined as all the objects that mediate the learning processes; they can be as software or hardware. Meanwhile, teaching aids are media of teaching that contain and carry out the characteristics of the concepts learned. Additionally Sudjana (2002) gave a sense that teaching aids are the things teacher can use in the teaching-learning processes in order to make the learning processes more effective and efficient.

The functions of teaching aids are to visualize something that cannot be seen or difficult to see, and to lead to the understanding or improving one’s perception. Sidhartha and Winduono (2009) described the functions and benefits of science teaching aids as follows:
   a. As the alternative or replicative objects.
   c. Motivating students to be more active and creative in learning.

While the benefits of science teaching aids are:
   a. Students will easily understand the concepts they learn by using teaching aids.
   b. Students can utilize or apply the knowledge and skills of science-technology.
   c. Students’ skills will increase and more active in learning.
   d. Students’ creativity will increase.
   e. Relationship between teachers and students will be more closely.
   f. The cost is relatively cheaper and the procurement time can be adjusted as needed.
The school will have more teaching aids. Below are some results of the science teaching aids that have innovation value of simple technology from used materials:

1. Electrolyte solution test device
   Electrolyte solution test device has a function to explain the concept of science in chemistry. The production of this electrolyte solution test device is the advance development and modification the existing simple test tool. This simple test tool uses two metal rods and carbon linked to the source of electric current which is then put/soaked in the electrolyte solution. The indicator is the emergence of bubbles around the metal rod/carbon. It certainly has a lot of shortcomings/weaknesses. Therefore, it needs to make a portable electrolyte solution tester equipped with complete indicators such as LED lights, VUmeter and Buzzer. These three indicators are intended for high accuracy of the experiment/test results; in addition to anticipate whenever one of the indicators gets “error”. Beside as the electrolyte solution tester, this tool can also be used to test the (high-low) level of conductor materials, or a conductor or an insulator.
   As the indicator of the strong-weak electrolyte of test solution, the tool will provide the light-dim of LED lights, large-small deviation of VUmeter hand, as well as hard-soft bell buzzer (those there indicator can also work altogether). To test the next sample, two rod electrodes must be dried, by wiping the surfaces using tissues (this is to anticipate the sticky electrolyte ions on electrode rods).

![Electrolyte solution test device](image)

Figure 1. Electrolyte solution test device.

2. Earthquake detector
   This earthquake detector is one of the examples of science teaching aids. Seen from the working principle, it is one example of the change in energy, the chemical energy into electrical energy. This also provides an example of vibration concept. To make this earthquake detector is not too difficult and does not need a lot of budgets. Besides as teaching aids, this detector can be also used at home to alarm the earthquake strikes so that it can reduce loss of lives.
   This detector works by vibrating the detector in order skein in the wire lop to vibrate and touch the wire loop. When the skein touch the wire loop, therefore the copper wire which has been
elasticiized in the FCB (containing relays, switches, and circuit) with the help of batteries can conduct electricity that generate the sound of the buzzer. Switch located on the FCB serves to turn off the earthquake detector. While the relay in this detector functions as a breaker.

![Figure 2. Earthquake detector.](image)

3. Flood Detector
"Flood detector" teaching aid is designed to facilitate students learn about the simulation of flood simultaneously detect impending flood by using a detector alarm. This teaching aid is assembled using electrical circuit which is equipped with a switch that will turn on if the float touches the switch so that the alarm will buzz.

This teaching aid is designed to resemble the surface the earth, i.e. in the form of land and water where most of the approximately 20 cm of the aquarium used as miniature of land and in the middles of it is water area. In the next of water area, there is an empty space which is used to place the equipment such as alarm circuit. In the water area, there is a sort of float which is used as an indicator of low and high water surface. When water tides, the float will be lifted so that it will nudge the switch to turn on the alarm. This detector uses a 220 V electrical series. It is also able to explain to students how the floods came, and how the detector is able to detect the presence of flood that would be associated with the tidal material. It is made of used materials such as paralon, glass, wiring, etc.

![Figure 3. Flood detector.](image)
After teaching and learning process using Science teaching aids finished, teacher and student were asked to fill in questionnaire in order to know their response towards the teaching aids used in the teaching – learning process. The below table is the summary of teacher and student response.

**Table 1. The Result of Teacher and Student Response towards Science Teaching Aids Test**

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Percentage (%)</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher</td>
<td>92.9%</td>
<td>Very Good</td>
</tr>
<tr>
<td>Student</td>
<td>95.8%</td>
<td>Very Good</td>
</tr>
</tbody>
</table>

After the students completed the questionnaire of developed teaching aids assessment, it is known that the students feel that the teaching – learning by using teaching aids are very useful, it is based on the student response data that obtain an average percentage of 95.8% (Very Good). Students assume that Science teaching aids are very good to use in teaching – learning process. Moreover, there was an analysis to know the weaknesses of the teaching aids. The result showed that there were some weaknesses in that developed teaching aids.

Furthermore, there was an analysis to know the teacher response towards the teaching aids. The teacher response data is used to know the teacher response about the appropriateness of teaching aids that applied in Science teaching and learning process. The questionnaire is given to Science teachers before the teaching aid is used and the questionnaire is asked to be returned after the teaching – learning process finished. The teacher response towards the teaching aids is categorized very good. It is shown from fourteen questions in the questionnaire that gave to five Science teachers, only one question with “No” answer from each teacher. Total amount of the result is 92.9%. The suggestion from the teacher is to develop more teaching aids for other Science concepts.

The importance of using teaching aids in particular fields especially in science education is based on the fact that the field of science there are a lot of topics that require teaching aids to help explain, such as the abstract learning materials. Therefore, teaching-learning processes using the teaching aids for specific learning materials is considered to be appropriate to help students understand the materials. On the other hand, it will lead to make the atmosphere of classroom activities live, and communication between teachers and students can be maintained. It is considered it can assist students in improving academic achievement in the field of science education.

The fact that the use of teaching aids at school have not entrenched, in the sense that not all of science teachers use teaching aids on their teaching-learning processes. It is due to they have not be aware of the important use of teaching aids as well as its influences in the teaching-learning processes, teachers have lack of skills, as well as the expensive materials used to design and
make the teaching aids. Therefore, it needs to produce the teaching aids by taking the beneficial of cheap and used materials. The application of teaching aids in the teaching-learning processes was important because students in receiving the learning experience or deepening the learning materials are considered that they need a lot of objects and events that are concrete and easy to understand, more impressing and living longer in their memory. Piaget (in Bower & Hilgard, 1981) suggests that cognitive development of junior high school students is in the concrete operational stage. Accordingly, in order to succeed with good learning, teachers should use teaching aids. The importance of using teaching aids is reinforced by the opinions of Edgar Dale (2003) about learning success which is measured by the levels of students' learning experiences gained by students depend on teaching-learning treatments, both teacher treatments or student activities while learning.

The utilization of used materials available in the environment can be maximized so that it can help maintain and conserve the environment. Items of household waste and used materials can also be used. Therefore, making teaching aids do not always require a lot of budgets. Below are several things to consider while making the science teaching aids:

a. Using used materials that are easy to obtain in surrounding environment, or a material that can be obtained at the store or at a nearby market.
b. Developing materials that could lead students to think critically, encouraging students to ask, curious, and seek the truth. The teaching aids hopefully will encourage students to make an assessment and analysis of the credibility and validity of the subject matter they receive.
c. Making teaching aids with simple technology which is related to the concepts of science.

4. Conclusion
Based on the research findings and discussion, it can be concluded that the use of used materials and simple technologies can be used to produce several useful science teaching aids to explain the science concepts in the teaching-learning processes.

5. References:


