Proceeding of International Conference on Green Technology
ISSN:2355–3456
September 10th, 2015, Semarang, Indonesia

Increasing Skill of Science Teacher to Create Clean Technology as a Science Teaching Aids

Arif Widiyatmoko[1] and Sita Nurmasitah[2]
[1]Science Education Study Program, Mathematics and Natural Science Faculty, Semarang State University, Semarang, Indonesia
[2]Engineering Faculty, Semarang State University, Semarang, Indonesia
arif.gnpt@gmail.com[1], sita_nurmasitah@ymail.com[2]

***Abstract*—A good Science Learning Criteria, based on curriculum, does not solely refer from the book, but the learning must also be equipped with the learning media, teaching aids and it should relates to the environment. One of the approaches in Science is known as SETS (Science, Environment, Technology and Society). It is necessary to have science teaching aids which can connect the concept of science and technology. The said teaching aids are called "clean technology". One of the competences that is owned by a teacher is known as professional competence. The professional competence means that the teacher is able to design a prop which will be used in the learning process. The objective of this research is to produce a science teaching aids which is called "clean technology" from the used materials and to improve teacher's ability in making the science teaching aids from by using used materials. The detail stages/steps of this activity consist of: identification, tools preparation, experiment/practice activity, action program, program implementation evaluation and feedback giving. To find the success rate of this activity, the evaluation process will be done by using methods such as observation, questionnaire and discussion of the study result. The study result shows the increasing of science teacher's skill in making science teaching aids, and it also shows the result of some "clean technology" as science teaching aids.**

Keywords—simple technology; science; teaching aids

I. INTRODUCTION

Teaching aid is defined as an aid used by the teacher in teaching process so that the concept of the subject can be easily understood, and it also become an aid in the learning process made by the teacher or student from a simple material which can be easily found in the surroundings. This tool is used to help facilitate in achieving a learning competence. A science teaching aid can be created in accordance with the learning concept, with affordable and simple materials which can be found everywhere even from the used materials. The experience shows that science learning which use teaching aids is more effective compared with the one without any (Widiyatmoko & Pamelasari, 2012). Teaching aid is a medium of learning message. Learning process which use teaching aids will optimize all function of students' senses. It increases students' learning effectivity by listening, seeing, touching and using their brain logically and realistically. Therefore, it can be assumed that teaching aid is a media to send the learning message or information. Through that solid concept, the function of teaching aids in a learning process is not simply as ad aid for the teachers but also as a messenger for whatever materials delivered by the teacher to the students according to the needs (Hamalik, 2003).

Teaching science as emphazised in the reform documents, however is not easy. Science teachers experience various constraints, such as lack of time, equipment, pedagogical contenct knowledge, and pedagogical skills in implementing science teaching strategies (Guzey and Roehrig, 2009). Science learning is oriented to the applicative ability, thinking skill development, learning skill, curiosity and the development of caring and responsible attitude towards the social and natural environment (Munegumi, 2013). One of the objectives of learning science at school is that students understand the concepts of science and its relevance to everyday life (Depdiknas, 2006). If a teacher does not use teaching aids during the science learning process, students will feel difficult in absorbing the learning concepts which will result in the lack of students' success rate in learning. Learning activity is the most significant activity among all educational process. It means that the success of the education objective achievement depends on how the students experience the learning process. Every object which can describe an idea, principal, natural syndrome or law, can be entitled as a teaching aid. The function of a teaching aid is to visualize a thing which cannot or is difficult to be seen, therefore it can be clear and can create a comprehension or increase a person's perception (Widiyatmoko, 2013).

In a learning process, teaching aids hold an important role as an aid to create an effective teaching-learning process. Related to science learning, the existence of teaching aids influence the success rate of teaching learning process. Alat peraga dalam mengajar memegang peranan penting sebagai alat bantu untuk menciptakan proses belajar mengajar yang efektif. Dalam kaitannya dengan pembelajaran IPA, keberadaan alat peraga jelas mempunyai pengaruh terhadap keberhasilan belajar mengajar. Teaching is basically a process of student teacher interaction through an integrated activity formed by two activities, which are student's learning activity and teacher's teaching activity (Sudjana, 2002).

According to Permendiknas No 16 of the year 2007 about Standard of Academic Qualification and Teacher Competence, it is mentioned that one of professional

competences of Science Teacher in Junior High School (SMP)/MTs is being creative and innovative in implementing and developing science by manufacturing teaching aids which can help explain the concept of science, which is originally abstract to become more concrete. The manufacturing "clean technology" teaching aids emphasizes the using of affordable tools and materials and even to the extent of using used materials so that the production cost will be low. It can also utilize garbage to become more useful things. The advantages of the utilization of used materials are reducing production cost and reducing environmental pollution (Widiyatmoko and Nurmasitah, 2013).

II. Research Method

The objective of the research is to produce "clean technology" science teaching aids by utilizing used materials, and also to increase teacher's skill in making science teaching aids from the used materials. The materials used in this research are arranged according to the result of field identification, and data collection which is sourced from literature study and situation analysis, and continued with data processing and report making. The activities included in this research are (1) method of theory providing which is related to the innovative science teaching aids using used material-based learning process, continued by practices which emphasize the knowledge and skill delivery to the science teachers about how to make innovative science teaching aids, and its implementation, (2) method of skill delivery to the target public (junior high school science teachers) through practices of making science teaching aids and review of the effectivity of science teaching aids utilization of the learning process in schools. Detailed stages/steps of this activity are: identification, tools preparation, experiment/practices activity, action program, program implementation evaluation and feedback giving.

1. Identification, this stage is needed to find out how to prepare a learning process which is based on innovative teaching aids using used materials.
2. Tools Preparation, it includes activity of preparing medium for the research implementation, such as the tools and materials to make and produce science teaching aids by utilizing used materials.
3. The activity of science teaching aids making, it includes the practice of "clean technology" science teaching aids making.
4. Program Evaluation and feedback giving, Evaluation is conducted toward the whole implementation of community service program. During this activity, advantages and disadvantages of science teaching aids-based learning process will be evaluated. In order to obtain accurate data about whole program evaluation data, then the program evaluation and feedback giving are conducted through interview/observation, questioning, and questionnaire distribution.

In order to find out the success rate of this research, there are two evaluations which are done to the two main forms, which are (1) evaluation towards products (clean technology teaching aids) made by teachers, and (2) evaluation towards training process and result of "clean technology" science teaching aids making. These two evaluations are considered important because this program has a side objective which is to explore teacher's potential in making science teaching aids and its implementation. In order to find out the success rate of this research, the evaluation will be conducted by using observation, questionnaire, interview and discussion of research activity method.

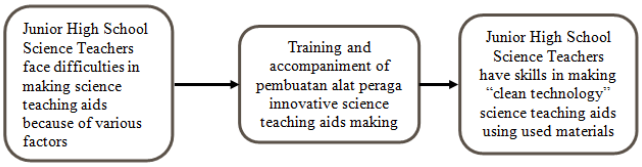

Figure 1. Research Design of "Clean Technology" Science Teaching Aids Making

III. Findings and Discussion

To understand science teaching aids, it is better to understand the media; since the teaching aids are included in media. Altamirano (2015) 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 or teaching aids. 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.

Initial stage in the making of "clean technology" science teaching aids is designing stage, which includes pre-production activity which is about arranging GBIM (Garis Besar Isi Media)/Media Content Outline. GBIM is a media which is used to conduct the production stage, which is the making process of teaching aids with a topic that has been determined. Teacher will be divided into groups, where a group consists of 4 teachers. This teacher group consists of teachers from various education backgrounds – physics, chemistry and biology. The result of science teaching aids making can be seen in table 1.

TABLE I. List of "Clean Technology" Teaching Aids which are Developed by Teachers

Group	Title	GBIM Score	Teaching Aids Score	Average Score	Criteria
1	Biogas Miniature	88	86	87	Very Good
2	Hydroelectric Power Plant Miniature	85	87	86	Very Good
3	Wind Power Plant Replica	88	88	88	Very Good

According to Table 1, there has been a production of 3 science teaching aids which are based on "clean technology", with the evaluation criteria based on the accordance between GBIM and teaching aids. The average scores of those three teaching aids made by teachers are in the "very good" criteria. It happens because the teaching aids made by the teachers match with GBIM. After the "clean technology" teaching aids are made, the next step is to implement them during learning process.

The "clean technology" teaching aids which are made by teachers group possess innovation value and are useful for the students. The said teaching aids are:

1. Biogas Miniature

   Biogas generator is a tool that can be used to generate alternative source of energy. By making this biogas miniature, students are able to know the process of biogas making and it can train the students on how to save the energy by utilizing existing resource in life.

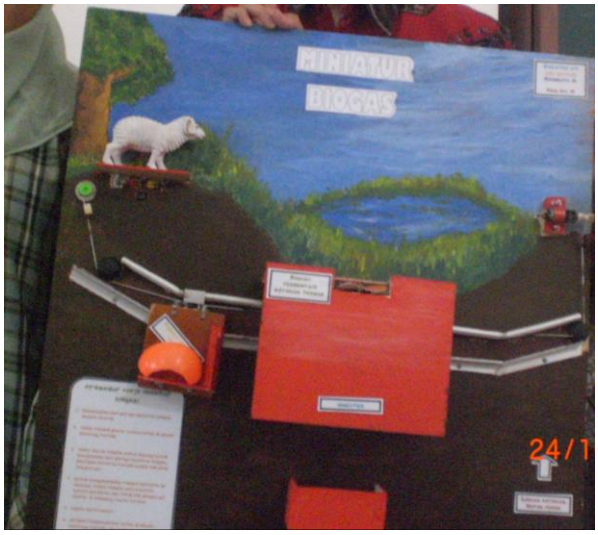

Figure 2. Biogas Miniature Teaching Aids

2. Hydroelectric Power Plant Miniature

   Energy is a course which most students find difficult to absorb because of its nature of verbalism. Usually, students find it difficult in understanding the concept of energy source implementation in the nature. Energi merupakan salah satu materi yang sulit dipahami siswa karena bersifat verbalisme. Biasanya siswa kesulitan dalam konsep penerapan sumber energi yang ada di alam ini. Hydroelectric Power Plant is a sample of energy utilization of water. This Hydroelectric Power Plant model can be used to deliver two subjects at once, which are energy source subject (Hydroelectric Power Plant Model) and energy alteration (the alteration of motion energy become electric energy).

Figure 3. Hydroelectric Power Plant Miniature

3. Wind Power Plant Replica

   This Wind Power Plant teaching aids is an integrated science teaching aid. This teaching aid can be used to deliver three subjects at once, which are energy source subject (Wind Power Plant Concept), the atmospheric layers, and photosynthetic reaction.

Figure 4. Wind Power Plant Replica

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. Once the teaching aids are made, they are used in the science learning process in Junior High Schools. After learning process, questionnaires are distributed to collect students' responses about these science teaching aids. The data of students' responses towards "clean technology"-based science teaching aids can be seen in Table 2.

TABLE II. STUDENTS' RESPONSES TOWARDS "CLEAN TECHNOLOGY" TEACHING AIDS IMPLEMENTATION

No	Statement	Students' Response			
		Strongly Agree	Agree	Dis-agree	Strongly Disagree
1	Teaching aids are easy to use	24	8	2	-
2	Teaching aids can relate between science concept and technology	22	12	-	-
3	Teaching Aids makes the learning of clean technology concept easy	18	16	-	-
4	Teaching Aids makes the learning of science concept easy	18	9	7	-
5	It is necessary to use science teaching aids for other science concepts	10	20	4	-

According to Table 2, students' responses about the easiness of science teaching aids utilization are: 24 students (71%) say "strongly agree", 8 students (23%) say "agree" and 2 students (6%) say "disagree. This happens because the teaching aids are accompanied with instructions for use, starting from title, learning objectives and materials. Regarding to responses about whether teaching aids can relate between science concept and technology, there are 22 students (65%) say "strongly disagree" and 12 students (35%) say "agree". This happens because the teaching aids made by teachers can relate science material with the utilized technology, that is hydroelectric power plant and biogas miniature.

Regarding to students' responses about the easiness of teaching aids to learn clean technology concept, there are 18 students (53%) say "strongly agree" and 16 students (47%) say "agree". Regarding to students' response about the easiness of teaching aids to learn science concept, there are 18 students (53%) say "strongly agree", 9 students (26%) say "agree" and 7 students (21%) say "disagree". Regarding to students' responses about the needs of science teaching aids for other science concepts, there are 10 students (29) say "strongly agree, 20 students (59%) say "agree" and 4 students (12%) students say "disagree". It is because the biogas miniature used by the students is one of clean technology products which produces energy from utilizing animal or human waste. The Wind Power Plant teaching aids are also useful for learning the concept of Energy Conservation Law. This result matches the research (Jennifer & Amanda, 2015) where there is a correlation between science teaching aids and technology as well as the needs of teacher's skill to design and to make science teaching aids with a goal that is to make science learning becomes more fun and meaningful.

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.

IV. CONCLUSION

Based on the research findings and discussion, it can be concluded that there have been produced "clean technology"-based teaching aids which can correlate the science concept and technology by utilizing used materials, and that there is an improvement of teacher's skill in making science teaching aids using used materials.

REFERENCES

[1] Altamirano, N. Economics, Engagement and Deeper Learning: Game Design Methodology Approach. Journal of Research in Innovative Teaching vol 8 issue 1, 132-143, 2015.

[2] Depdiknas. Permen Diknas No. 22 tahun 2006 tentang Standar Isi untuk Pendidikan Dasar dan Menengah. Jakarta: BSNP, 2006.

[3] Dimyati dan Mudjiono. Belajar dan Pembelajaran. Jakarta: PT. Rineka Cipta, 2002.

[4] Guzey, S.S., & Roehrig, G,H. Teaching Science with Technology : Case studies of Science Teachers' Development of Technology, Pedagogy, and content knowledge. Contemporary Issues in Technology and Teacher Education, 9(1), 25-45., 2009.

[5] Hamalik, O. Media Pendidikan. Bandung: Penerbit PT. Citra Aditya Bakti, 2003.

[6] Jennifer, C., & Amanda S. Technology Integration in the Resource Specialist Program Environment: Research Based Strategies for Technology Integration in Complex Learning Environments. Journal of Research in Innovative Teaching vol 8 issue 1, 81-97, 2015.

[7] Munegumi, Toratane, Interdisciplinary science education and "origin of life": An exemplification with teaching aids, Science Journal of Education, 1(2): 20-27, 2013.

[8] Permendiknas No 16 Tahun 2007 tentang Standar Kualifikasi Akademik dan Kompetensi Guru.

[9] Sudjana, N. Dasar-dasar Proses Belajar Mengajar. Bandung: Sinar Baru Algensindo, 2002.

[10] Widiyatmoko, A,. & Pamelasari, S, D. Pembelajaran Berbasis Proyek Untuk Mengembangkan Alat Peraga IPA Dengan Memanfaatkan Bahan Bekas Pakai. Jurnal Pendidikan IPA Indonesia, 1 (1), 51-56, 2012.

[11] Widiyatmoko, A. Pengembangan perangkat pembelajaran IPA Terpadu Berkarakter Menggunakan Pendekatan Humanistik Berbantu Alat Peraga Murah. Jurnal Pendidikan IPA Indonesia, 2 (1), 76-82, 2013.

[12] Widiyatmoko, A., & Nurmasitah, S.. Designing Simple Technology as a Science Teaching Aids from Used Materials. Journal of Enviromentally Friendly Processes, Vol 1 Issue 4, 26-33, 2013.