Briquettes production as teaching aids physics for improving science process skills

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Abstract. The aim of this research is production briquettes as teaching aids in order to improve students' science process skill. Research design used in this study was using experimental methods. One of the learning methods that can be used to equip student's science process skill is the experimental method. In this study, students utilize agricultural waste and plantations around the school. Then they make the briquettes from the waste. This research used waste rice husk waste, durian leather and coconut fiber. After that, the results of briquettes will be assessed as the feasibility of teaching aids. The results of students' affective and psychomotor ratings show excellent results. Among them are: classical affective average score for group 1 is 82.80; group 2 is 87.20; and group 3 is 85.20. While the classical average psychomotor score for group 1 is 82.80; group 2 is 86.20; and group 3 is 84.20.

1. Introduction

Learning media is very important in the learning process because it can be one of the critical success factors of learning. Utilization of physics learning media especially teaching aids is needed to streamline the learning activities. Teaching aids are valuable instructional tools that can help make learning more effective and interesting. One of the advantages of using media is that media can motivate students in learning activity and to improve science process skills. Media can be used to present information that is needed to deliver the message to the students. Instructional media can be defined as the physical means including traditional means such as chalk, blackboard, textbooks and modern means such as videos, tape, recorders, computers, overhead projectors, and others presenting instructional activities delivered to the students. Studies are examined that illustrate how these characteristics, and instructional designs that employ them, interact with learner and task characteristics to influence the structure of mental representations and cognitive processes. Of specific interest is the effect of media characteristics on the structure, formation, and modification of mental models [1].

The selection of teaching media is an integral part of curriculum planning and delivery in schools. In teaching media, there are some aspects that teacher or listener should know. The media should directly relate to a curriculum policy and program on the departments' framework standard and

relevant for students. The media also support an inclusive curriculum thus helping students to gain awareness and the importance of respectful relations with the other. The media also can motivate students to examine their attitudes and behavior. The media are relevant for the age of students for whom they are selected. Due to an inadequate level of inquiry skills students often learn science through direct observations and problem solving tasks without spending efforts to experience natural phenomena, or construct abilities and knowledge to understand how natural world works [2,3]. Although most relevant research studies provided little guidance about how students acquire and develop these skills over time, some show that factors like students' self-efficacy, effective scaffolding, and collaborative learning environments, and utilization of cognitive tools may have an impact on students' abilities and skills to progress through inquiry tasks [4,5]. Therefore, to support the implementation of a fun learning process needs to be provided with sufficient teaching aids and can provide experience directly to students through practicum or demonstrations conducted by teachers. Learning process that occurs will provide more experience and results that are more meaningful than just providing an abstract experience and difficult to understand by students.

Teaching aids is learning media used in teaching activities and serves to clarify the concept in understanding science process skills. In the world of education and learning activities, especially those associated with natural phenomena desperately need the teaching aids. In learning activity of course not all students can easily catch the science being studied. Some students only can understand the concepts or science studied by reading and help from teachers. But for students who have difficulties with existing concepts need teaching aids. It is expected that through the teaching aids students can be absorbed by their eyes and ears to more effectively and efficiently science process skills. The overall learning objectives are set for students to demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills: initiating and planning, performing and recording, analyzing and interpreting [6].

This research will be used teaching aids by utilizing agricultural and plantation waste, such as waste rice husk, durian peel and coconut shell. That Waste was used made briquettes as learning media to improve science process skills. Based on observations, there is considerable waste that is around the school. Utilizing waste in the manufacture of learning media, therefore we have contributed in the preservation of the environment. The use of agricultural and agro-industrial wastes as biomass is being increasingly studied and could be an alternative solution to the problems related to them [7].

Densification process can produce briquettes with uniform shape and sizes that can be more easily handled using existing handling and storage equipment and thereby reduce cost associated with transportation, handling, and storage [8]. In the briquetting process, particles of solid materials are pressed to form blocks with defined shape and dimensions. Briquettes produced from this waste at low cost are an excellent source to produce cheap energy following an environmentally correct way and they are, in many cases, ideal for replacing fossil fuels in use today, with significant economic and environmental advantages [9].

Interview result showed that students have never done activities in production briquettes. Learning physics will be more attractive if students are actively involved in observing, understanding, and utilizing natural phenomena which in environment. In the process students are trained to have observation and experiment that are more emphasized on science process skills. Problem solving in science process skills includes knowledge and skills [10]. In addition students are trained to experiment with equipment used in the laboratory. Achievements learning can be measured through science process skills. Science process skills are a teaching-learning process designed so that students can find facts, concepts, and theories with their own process skills and students' own scientific attitudes [11]. Therefore, in this research will be developed physics props by utilizing agricultural waste and plantation as a medium of learning. Based on the above explanation, the objectives of this research are: (1) improving the science process skills, (2) improving the creative and innovative education and teaching process, (3) developing creative and innovative learning media alternatives, (4) improving awareness of approximately environment.

2. Method

Design of research used experiment methods. One of the learning methods that can be used to equip students' science process skills is experiment method [12]. To determine the best practices in experiential learning, it is necessary to first define experiential learning. In its simplest form, experiential learning means learning from experience or learning by doing. Experiential education first immerses learners in an experience and then encourages reflection about the experience to develop new skills, new attitudes, or new ways of thinking.

The first theories of experiential learning arose in the mid-nineteenth century as attempts to move away from traditional formal education, where teachers simply presented students with abstract concepts, and toward an immersive method of instruction. Students would learn by doing, applying knowledge to experience in order to develop skills or new ways of thinking [13].

Experiential learning is also built upon a foundation of interdisciplinary and constructivist learning. Experiential methodology doesn't treat each subject as being walled off in its own room, unconnected to any other subjects. Compartmentalized learning doesn't reflect the real world, while as the experiential classroom works to create an interdisciplinary learning experience that mimics real world learning. Similarly experiential learning is aligned with the constructivist theory of learning in that the outcomes of the learning process are varied and often unpredictable and earners play a critical role in assessing their own learning. How one student chooses to solve a problem will be different from another student, and what one student takes away from an experience will be different from the others [14].

The science process skills (SPS) are the thinking skills that we use to create knowledge, to reflect on problems and to formulate results [15]. It has been reported that the SPS helps learners understand Physical Sciences [16]. Furthermore, it has been maintained that the basis of learning how to recognize, define and, to some extent, solve individual and social problems is learning how to gain the science process skills [17]. In this way, individuals can use the SPS for identifying the problems in their daily lives and overcoming them via appropriate hypotheses [18]. The data used in this research activity includes two aspects, namely in terms of affective and students psychomotor. In this study students are guided by teachers in the manufacture of briquettes. As for the stage of making briquettes shown in Figure 1 [19]:

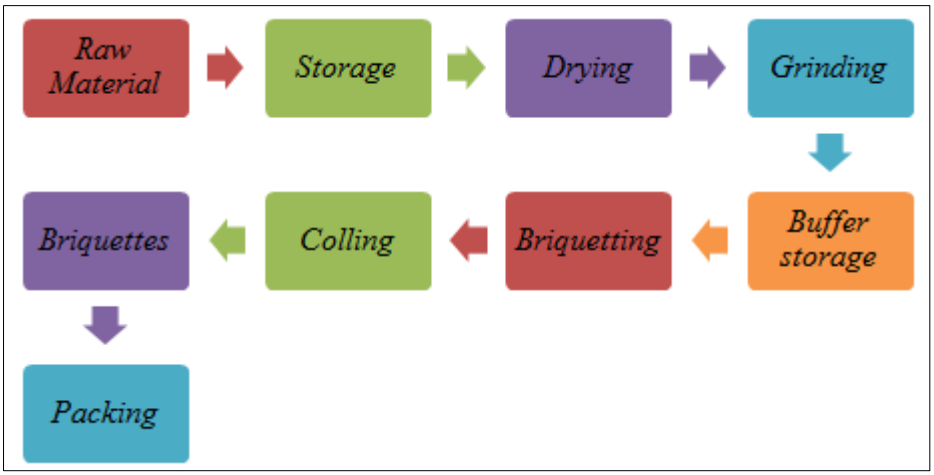

Figure 1. Briquettes production process.

Figure 1 shows the basics of the bio-briquette production process. The raw materials, coal and biomass, are pulverized to a size of approximately 3 mm or smaller, and then dried. The dried mixture is further blended with a desulfurizing agent, Calcium hydroxide. The mixture is formed by compression molding in a high-pressure briquetting machine. Powder coal may be utilized without being pulverized. A small amount of binder may be added to some coal ranks. The production

process does not involve high machine. The process has a simple flow, which is safe and which does not require skilled operating technique. Owing to the high- pressure briquetting process, the coal particles and the biomass strongly intertwine and adhere to each other, thus the process produces rigid formed coal, which does not separate during combustion.

3. Result and discussion

3.1. Students' science process skills

The briquette quality parameters are including heating or calorific score, moisture, ash, volatile matter and fixed carbon. Heating score consists of HHV (high heating score) and LHV (low heating score) [20]. Calorific score of fuel is a heating score that produces from heating [21]. Moisture is a comparison between water mass in fuel briquette and wet mass in that fuel [20]. Ash is a residue of fuel briquette after it is burnt [20]. Volatile matter is relay to the igniting time. The higher the volatile matter is the easier the igniting time of the briquette will be and the shorter the combustion time will be. Fixed carbon is a hundred percent minus the sum of heating, moisture, ash and volatile matter [20]. The results of briquette production indicate that: (1) Non-smoky and odorless; (2) Having a compressive strength so that it is not easily broken; (3) Having a fixed burning temperature for a long time (8-10 hours); (4) Gas resulting from the combustion process does not contain high CO; (5) Hands are not dirty; (6) It does not burn quickly; (7) It can ignite without fan and not splatter.

In the implementation of this research activity, analysis of the results of students' science process skills is divided into two, namely affective and psychomotor. Student affective assessment is done to know the extent to which students are able to show the nature and character at the time of experiment activities take place. Student affective assessment consists of five aspects, namely student participation, student attention when explained, student discipline, timeliness in completing the experiment, and the ability to obtain data. Based on the data of affective scores on average can be seen Figure 2.

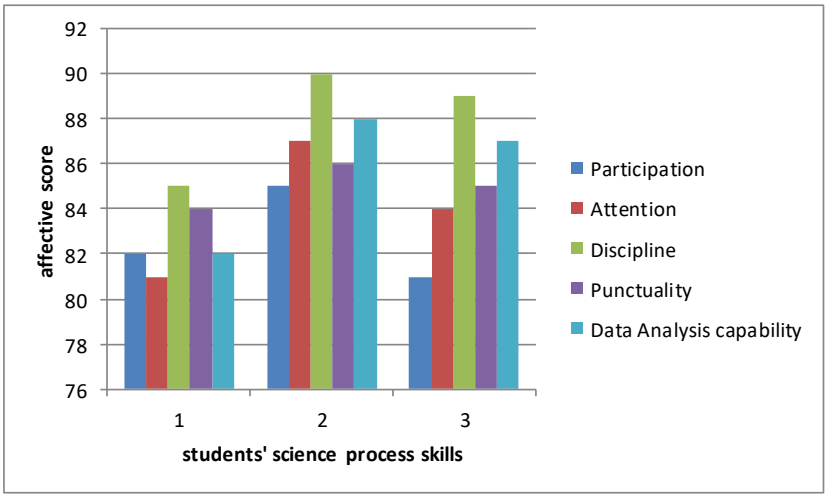

Figure 2. Student affective scores.

From Figure 2, it can be seen that from affective average score for group 1 is 82.80; group 2 is 87.20; and group 3 is 85.20. The highest grade average score is achieved by group 2 which is 87.20. This is due to high student learning interest so that most students are active in learning activities such as by asking questions, record each experiment result, and complete the practice well.

Psychomotor assessment of students is done to determine the ability and readiness of students at the time of the experiment. Psychomotor assessment of students consists of five aspects, namely assembling the tools properly, neatness and pay attention to safety, observations done carefully without any data manipulation, data obtained complete, organized and written correctly, inter-group

cooperation during the experiment, and conclusions. Based on the average psychomotor score data can be seen Figure 3.

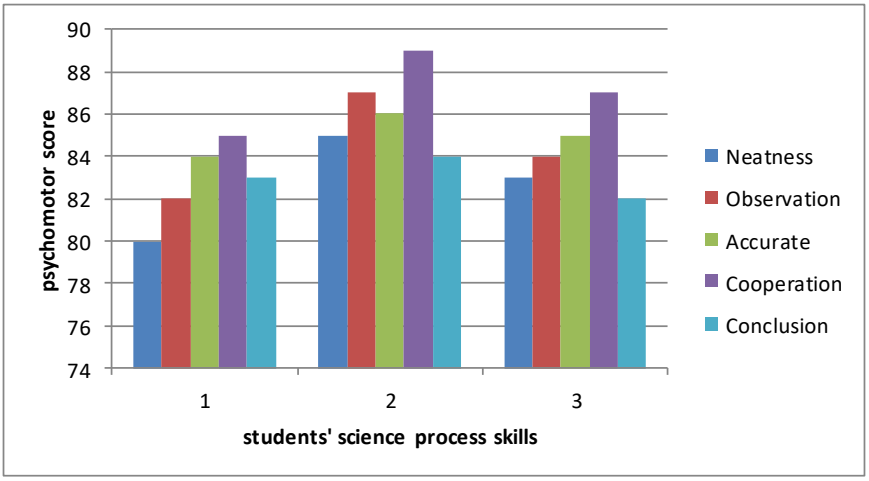

Figure 3. Student psychomotor score.

From Figure 3, it can be seen that from psychomotor average score for group 1 is 82.80; group 2 is 86.20; and group 3 is 84.20. The highest grade average score is achieved by group 2 which is 86.20. From psychomotor assessment data, it can be concluded that group 2 have higher psychomotor ability than other group.Based on the results of the above SPS assessment can be categorized as very good criteria, because all group gets score an average above 80. Students are also advised that they prefer to learn from props when compared to simply listening to lectures from teachers. Applying the science process skill approach, causing the students not to passively accept and memorize the information provided by the teacher, but to try to find the concept through direct experience rather than just hearing and accepting the concept of what the teacher has to say [22]. Ramayanti said that student's experimenting skill due the progressing with the implementation of SPS approach in the learning process [23].

In addition, these teaching aids can visualize the material that it is so that students are more interested, concerned, and more focused in learning, and make the students more easily understand information [24]. The application of teaching aids is important in the teaching-learning process because students receive learning experiences and easy to understand [25]. In addition, learn used learning media in the form of teaching aids can show various psychomotor activities performed by students [26]. Thus, teaching aids in the learning process plays an important role that is as a tool to create an effective learning process and can improve science process skills.

4. Conclusion

Based on the results and discussion then the conclusions shows agricultural and plantation wastes can be utilized as alternative energy in households, i.e. as a substitute for LPG (liquefied petroleum gas). Result of briquettes production activity can improve in science process skills. The results of students' affective and psychomotor ratings show excellent results. The affective average score for group 1 is 82.80; group 2 is 87.20; and group 3 is 85.20. While the average psychomotor score for group 1 is 82.80; group 2 is 86.20; and group 3 is 84.20.

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