EARLY STUDY IN DEVELOPING TAKE-HOME PHYSICS EXPERIMENT: AN ALTERNATIVE STRATEGY TO IMPROVE SCIENCE PROCESS SKILLS AND SCIENTIFIC ATTITUDES

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Abstract

In science instruction, students are instructed to find out the answer of the natural phenomena. To enable the students to seek out the natural phenomena in science instruction, students should have science process skills and scientific attitudes as well as scientific knowledge. Therefore, appropriate teaching methods are an experiment. Unfortunately, this method is still rarely used by science teachers. Several previous studies indicated that this condition is caused by a number of constraints faced by teachers and students. Some of them are limited time to do the experiment at school, lack of materials and equipment in the laboratory, and sharing of the laboratory. To solve this problem, the researcher is trying to develop an alternative strategy that allows students to practice science process skills and their scientific attitudes. This strategy is by taking home a number of science experiments which enable them to conduct at home. These experiments can be done by students in their spare time and repeatedly, thus expected to improve their science process skills and scientific attitudes. To develop this strategy, the researcher used Addie instructional design model and reported in this paper on analysis phase of Addie model.

Keywords: home experiment, scientific attitudes, science process skills.

Introduction

Reality on the ground shows that the learning of science in general, just use the method that puts the ability in cognitive domains only, where scientific inquiry is expected to build science process skills and scientific attitudes in accordance with the mandate of the curriculum, it is not fully implemented. Cooley (2006) suggested that teaching methods such as teaching inquiry, problem solving, problem based learning, and project based learning depends on students' science process skills to complete the research. Meanwhile, Trumper (2002) stating that the practical work in the laboratory has been widely used as a teaching strategy and a strategy that is crucial in building and 'understanding the procedures of scientific inquiry. But, in our country science teachers almost never to practice science process skills that must be done. Suyana (2011) states that learning physics is usually done in lecture and students tend to memorize a lot of terminology relating to physics concepts to their knowledge of physics and nature verbalistik meaningless.

Science process skills and scientific attitudes are very important in the teaching and learning of science. To learn about nature, two things are absolutely necessary. Harlen, (1999) states that science process skills in developing an understanding of science is something crucial, he said construction of the science process skills should be a major result in science education. Meanwhile, Kamisah Osman (2012) argues that in the learning process meaningful and effective science, students not only have to develop the concept, but also must learn how to acquire and organize various information and apply and test ideas. Further, Kamisah Osman (2012) asserts that scientific knowledge was revealed directly through the observation of a phenomenon activities.

As for the problems faced by teachers and schools in conducting science experiments in school. Some causes of things including: not available laboratory space for experimental activities, absence or lack of experimental tools and materials, no special staff available to help prepare for an experiment in a lab activities (Sumintono, 2011). In addition, Norlander-Case (1998) states that the implementation of experimental methods take a long time.

Alternative strategy would be developed by researchers is a take some science experiments to students' home. This term well-known as a take home experiment. Gendjova (2007) has done a study about the take home experiment in chemical education and provide positive outcomes for improved knowledge and attitudes. Meanwhile, Turner (2008) studied the effectiveness of home kits experiment in physics for adult distance learners. In this study, researchers will develop strategies home experiment in teaching science, especially physics to junior high school students will focus on the impact of rising home experiment science process skills and scientific attitudes. In general case, science teachers give homework assignments to students that can be done with paper and pencil. Thus, researchers are attempting to replace paper and pencil tasks to be experimental activities, so students not only acquire scientific knowledge but also skills to carry out research and scientific attitude. Accordingly home experiment will build science process skills and scientific attitudes of students. In order to conduct home experiments required teaching and learning modules that can assist students in conducting scientific work at home. To develop this home-based experimental module, the researcher uses the ADDIE instructional systems design model. ADDIE model consists of five stages, namely: Analysis, Design, Development, Implementation, and Evaluation. ADDIE model is a generic and simple model in instructional systems development (Wang and Hsu, 2009; Sabar Nurrohman, 2011). This paper reports the initial study done by

researchers to obtain information related to the development of a variety of home experiment module. This preliminary study aims to identify various problems that cause science teachers conduct the experiments rarely, especially physics teaching in junior high school, and to identify the frequency of experiments was conducted specifically on the topic of light and optics. This preliminary study also aimed to identify students' perception on the possibility of conducting science experiments at their home.

Literature Review

Science process skills are very important in the study of the universe and an absolute must-have for students in learning science. Science process skills (SPS) is defined as a skill that can be exercised in respect of behavioral science reflect scientists (Ergul, et.al., 2011). If students have science process skills, then they will think and work, especially in scientific research seprti befits a scientist and science process skills can enhance their scientific literacy. This is in accordance with the opinion of Harlen (1999) that mean science process skills to prepare future scientists, a science literacy, enabling students to use scientific information in everyday life (individual, community, and global).

Ergul, et.al. (2011) says that, development of science process skills enable students to solve problems, think critically, make decisions, draw conclusions, and satisfy their concerns. According to him, not only do scientific research, but also students can obtain information science, learning science process skills to help them think logically, ask reasonable questions and find answers and solve problems they encounter in everyday life. According to Walter & Soyibo (2001), science process skills can be divided into the two parts. First, the basic process skills (basic science process skills) include: observation, measurement of and use the number, and classifying. Skills policy is a fundamental process in scientific inquiry. Second, the integrated science process skills (integrated science process skills) include: handling variables, sorting hypothesis, and conduct research. These skills are built on the basis of skills.

A study conducted by Turner (2008) for students taking first year physics course at university, found that the use of take-home experiment kits can reinforce the concepts learned. According to him, the students can adjust experiment time and can do it over and over. In chemistry lesson, the activity has been studied home-based experiment to be a way to improve the quantity or quality of the learning of chemistry. Gendjova (2007) found that nearly 100% of students level 7 sets of the experimental work in school is not enough. One among the ways of solving the problem is to expand the content and function of teaching chemistry experiments by inserting the experiment at home in chemistry education (Gendjova, 2007). Findings indicated that the students in learning home chemistry experiment resulted in an increase in the level of knowledge is very high, adding a sense of confidence and satisfaction, positive changes in the attitude towards education, a good understanding of the practical application of knowledge and skills.

Attitudes toward science can be interpreted in two dimensions. The first dimension is the attitude towards science (attitude Toward science) and scientific attitudes (scientific attitudes). According to Harlen (1991), there are at least 4 attitudes that influence student learning, especially in science, namely: attitudes toward school tasks, attitude toward himself

as a student, attitudes toward science as a product of, and attitudes towards objects and events in the environment. In simple terms, the attitude towards science is 'like' or 'dislike' towards science. Kuppan (2009) noted that when students' attitudes towards science understandable, especially to the ground like and do not like science, we will easily make up that inquiry-based learning curriculum more friendly with the students.

Methodology

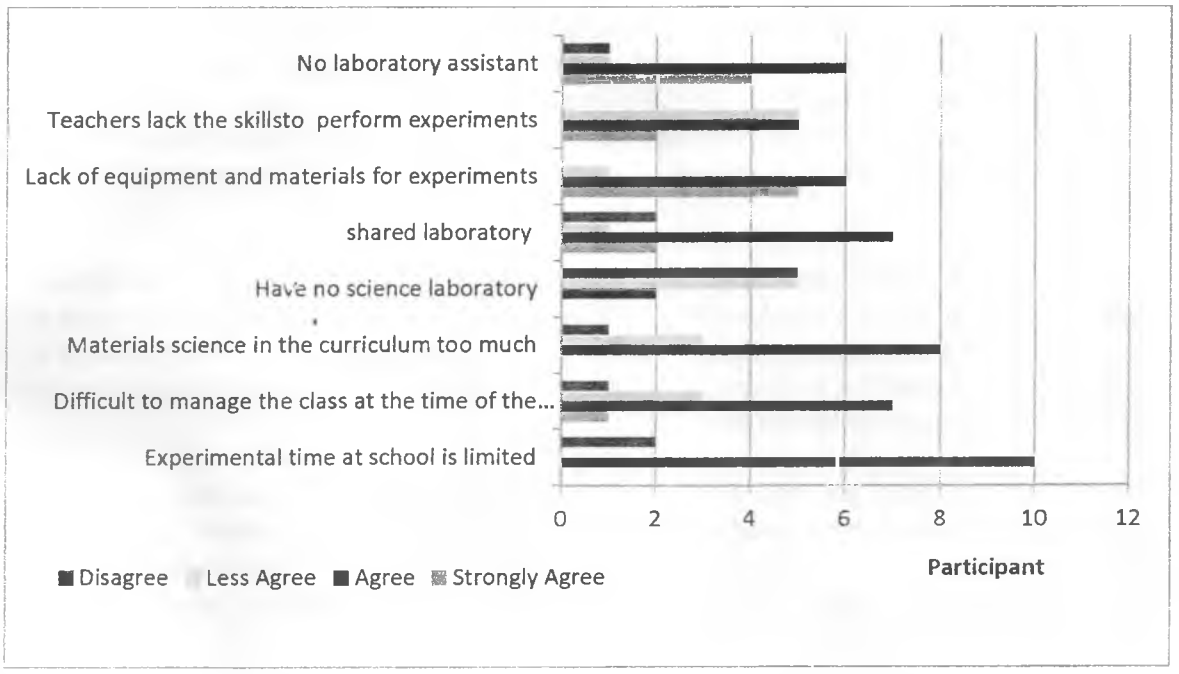
In this preliminary study, the researchers would like to get some information about the possibility of home science experiment applied in the teaching of physics in secondary schools, especially low. The information to be obtained as: the factors that cause scientific experiments conducted science teacher rarely, frequency of experiment of light and optics as sample learning topics, students' attitudes towards science teaching, and student opinion about the possibility of an experiment carried out at home. A total of 12 teachers from several schools that joined the group Pekanbaru science teachers have participated in this preliminary study. Science teachers in this group often do meetings and discussions in order to improve teaching skills to teach science in junior high school. The teachers are 30 to 50 years old and has been teaching science for more than 5 years. In addition to science teachers, participants in this study is 50 students of 8^{th} grade from two primary schools in Pekanbaru.

To identify the problems faced by teachers in implementing the experiment or practical work in the laboratory, participants were asked to fill out a questionnaire with responses strongly agree, agree, less agree and disagree. The same is done to obtain information about the frequency of science teachers conduct experiments. To be more directed, researchers choose the topic of light and optics. The choice of this topic is based on basic competencies related to investigation of the properties of light, mirror and lens. Two senior science teachers and performers in addition to the 12 people have been interviewed to obtain supporting information from the tendency of participants' answers. Meanwhile, information about students' attitudes towards science teaching and student opinion about the possibility of take-home experiment is obtained based on questionnaires given to students. Student responses in the questionnaire is done by selecting behavior strongly agree, agree, less agree, and disagree. Data analysis using descriptive statistics by calculating the percentage, frequency and bar chart for describe the tendency of attitudes and perceptions of teachers and students.

Results and Discussion

Obstacles for the implementation of experiments in science teaching

Many factors become obstacles for the rare implementation of the science experiments in the lab at school. From 12 science teachers as participants in this survey, obtained at least 8 causative factor that makes them rare implement experimental methods in the teaching of science, especially physics. However, not all participants experience the same obstacles. Survey result of 8 factors that cause science teachers perform experiments rarely in science teaching methods shown by Figure 1.



Gambar 1. *Obstacles Factor for the Implementation of Experiments in Science Teaching*

Most of the participants (10 out of 12 participants) agreed that one of the factors causing teachers hardly perform the experiment in the teaching of science in schools is time limited experimental study hours. This matches the findings Norlander-Case, et.al. (1998) which revealed that one among the challenges in implementing an inquiry-based learning is lack of time. In Education Curriculum Unit (KTSP) science education in junior high school in Indonesia provided 4 credit or 4 x 40 minutes that the implementation per week divided into two meeting times of 80 minutes for each meeting. According to participants, the time of 80 minutes is short enough to carry out scientific experiments, especially if there is more than one type of experiment to be performed. to make students successful experiment, the science teacher must implement inquiry-based teaching and scientific activities. Stage-level academic work must be followed. The teaching starts by presenting the problem to be researched, studied the problem need clarification, how to study, equipment and materials needed for the study, analyze the ways and means of observations and the application of the concept of drawing conclusions obtained in the context of everyday life or technology. The levels of scientific inquiry is making it hard for science teachers teach science in this way until the end prefer lecture method. Not only happened in our country, Wang and Lin (2009) found that scientific inquiry is the least frequent in both the elementary and secondary school science classrooms in Taiwan.

Participants also feel difficult to manage when implementing classroom teaching of science with experimental methods. It is seen from the results of the survey in Figure 1 which shows 8 out of 12 respondents indicated agree and strongly agree that it is difficult to manage the class when students experiment. According to them, the students are busy with themself, play and show disinterest. As a result, the purpose of the experiment is difficult to be achieved in this way.

Eight of the 12 respondents had the perception that the content of the material to be taught in science students is too dense. That perception makes science teacher refused to perform the experiment as the experimental method, not many science concepts can be taught to be a waste of time. Science teachers like this put science into content but not in process to obtain scientific knowledge. Content oriented science teaching is probably due to misunderstanding about science and science education assessment system which only measure the cognitive domain.

Although many theories state that science experiments must be performed in the laboratory, but the results of this survey show that 10 of the 12 participants expressed do not agree and if the absence of the laboratory being a reason to make laboratory experimental method is not implemented. According to them, the science experiments in science teaching can be done in class, when there are no labs in the school.

In general, the lower secondary school there was only one or two science labs separated laboratory science ie physics and biology laboratories. Total class that much cause trouble to arranging schedules for each lab class. Nine participants felt that this factor makes them rarely conduct experiments, although some of them are of the opinion that ekpserimen not only be carried out in the laboratory only.

Eleven participants noted that the lack of equipment and materials available in the lab to make them not want to perform the experiment. Learning with experimental methods generally performed in groups with 4-5 members of the group. If the experiment is less equipment and materials, the teacher had to create a group with a large size. This large work groups make teaching becomes ineffective and difficult to manage the class.

Lack of skills of science teachers in implementing the experiment is a factor that become obstacles for the implementation of the experiment. Seven participants noted that many scientific experiments that are still poorly understood.

Almost all participants (10 out of 12 participants) do not agree and do not agree on hardly experiment in science teaching due to lack of energy or laboratory assistant laboratory assistant. This shows that science teachers are always willing to prepare equipment and materials required for the experiment and update again after the experiment performed. They say that the students can also be involved in updating equipment and materials back experiments.

Some experiments in science teaching on the topic of Light and Optics

The Indonesian government has set the standard household consisting of competency standards and competency base for all subjects at all levels of education except for college. Content standard for the unit Educational Basic and Junior High School include a minimum material and minimum competency level to achieve higher level of competency and graduate at least certain types of education according to Permendiknas No. 22, 2006. In this study, the researchers focused on the competencies of junior high school science education policy on competency-oriented scientific undertaking. Therefore, researchers consider one of the basic competency for science subject is the ability to investigate the nature of light and its relationship to various forms of mirrors and lenses. Summary of minimum competency is demonstrated that key learning outcomes expected after students learn about light and optics tific knowledge about light and optics is a

product produced by the process of the research. In actual fact, science is considered to be the main product of science teaching on the topic of this light and optics. Offense of science teachers in the interpretation of such basic competence has been going for many years until it has become accustomed.

To make students can achieve this competency, then the minimum required teaching materials among others: the propagation of light, light reflection, reflection on flat and curved mirrors, refraction of light, refraction of light at the lens, and the decomposition of light. Because competency is the ability to set policies do research, the ability to run must be taught. In carrying out this scientific work, a variety of science process skills and scientific attitudes should be taught and exercised to the students. Teaching science process skills are generally integrated with the experiment conducted. Based on the analysis of teaching material, at least there are 12 types of experiments that can be done in light and optics learning. Figure 2 shows the results of the implementation of the twelfth survey frequency is meant according to the type of experiment 12 participants who have a profession as a science teacher for more than 5 years of working time.

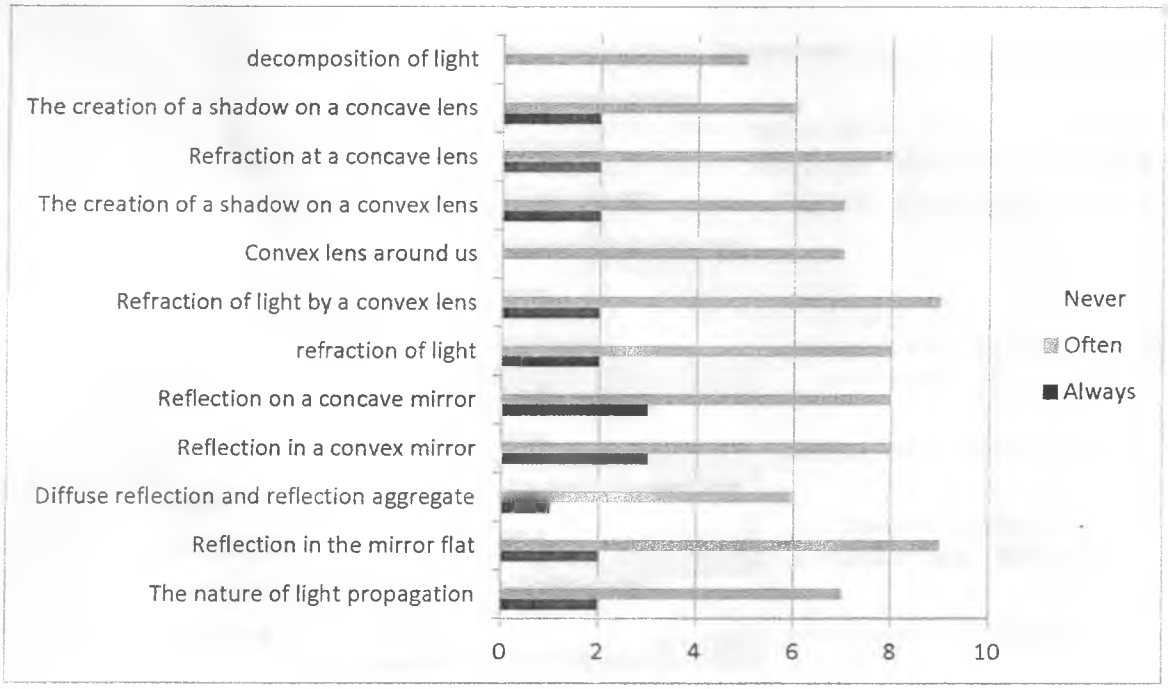


Figure 2. Frequency of the Implementation Science Experiments On Topic Light and Optics

Light is an electromagnetic wave that propagates without the need for a medium and moving in a straight path with speed c, 3x108 m / s. The concept of light propagation in a straight path can be obtained through a simple experiment in junior high school. Two of 12 teachers under survey stated that they always perform an experiment to get the concept. Nonetheless, 3 teachers said never implemented and 7 teachers say rarely do them, even this simple ekpserimen prepared teachers and students easily implemented. Equipment and materials used are readily available already.

Reflection experiments on flat mirror needed to acquire concepts about the nature of light reflection and formulating the Law Snellius to rebound. This experiment is very important because the policy of forming a shadow on the mirror. This experiment also easily implemented by teachers for equipment and materials used are simple. even so, only 2 of 12 science teachers who always implement it, the rest do not perform and rarely implemented.

The experimental reflectivity aggregate and regular reflection, some say rarely implemented, and some said never implemented, and only one science teacher stating always perform. In this experiment required a mirror flat and wavy mirror and light file line. Difficult to get wavy mirror and a light source with parallel files is also a cause of this experiment rarely and never implemented.

For reflection experiments on convex mirror and concave mirror, little teacher who always carry and many science teachers rarely implement it. Experiment to find the concept of light refraction, light on the nature pembiasanan convex lens and a concave lens used was not even a science teacher. Most of the science teacher never even invite students to do experiments convex lens around us and decomposition of light.

Students' attitudes towards science teaching

Revenue survey of 50 participants who were grade 8 students, from two junior high school in Pekanbaru show the trend of attitudes toward science and their perception of the possibility of a science experiment brought it home. The result is shown in Figure 3.

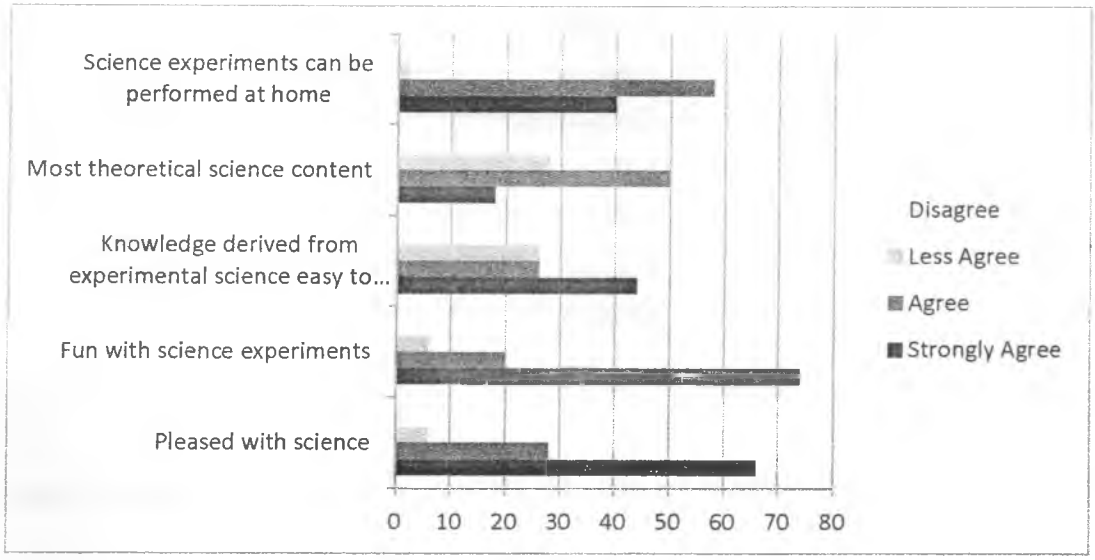


Figure 3. *Students' Attitudes Towards Science Teaching*

Almost all students stated that science is a subject they like, even 66% of them expressed very pleased with science. Only 6% felt less pleased with science. Attitudes toward science experiments showed more than 90% of students turned out like science experiments and 70% of them really love science experiments. Only a small portion is less like science experiments. Meanwhile, most of the students stated that the concept of science or knowledge

they acquired through scientific experiments give effect to such knowledge can be understood well and stick firmly in the cognitive structure of students. Around 70% of students stated that scientific knowledge acquired from the results of experimental and is not effective for them. They are more pleased when scientific knowledge is explained by teacher lecture method only.

Almost 70% of the students stated that the content of science education in general theoretical. This attitude is very desirable when associated with science teachers hardly teach science using experimental methods. Presentation materials science in general by means of lectures. This situation will affect the students that the content of science education in general theoretical.

Because of its rarity and even science experiments conducted in school never to various reasons outlined above, the researchers also want to know how the students' attitudes on science experiments performed on their home. It turned out almost all students agree and strongly agree that they can do science experiments at home or outside of school. Only one of the students expressed less agree.

Some of the reasons experiment performed by students at home

In relation to student attitudes that science experiments can be done at home as described by Figure 3, where almost all students felt that agree and strongly agree on science experiments done at home, then ask a few more A survey about their reasons so. Survey result shows that at least there are 6 players that reason science experiments they can do at home, as shown by Figure 4.

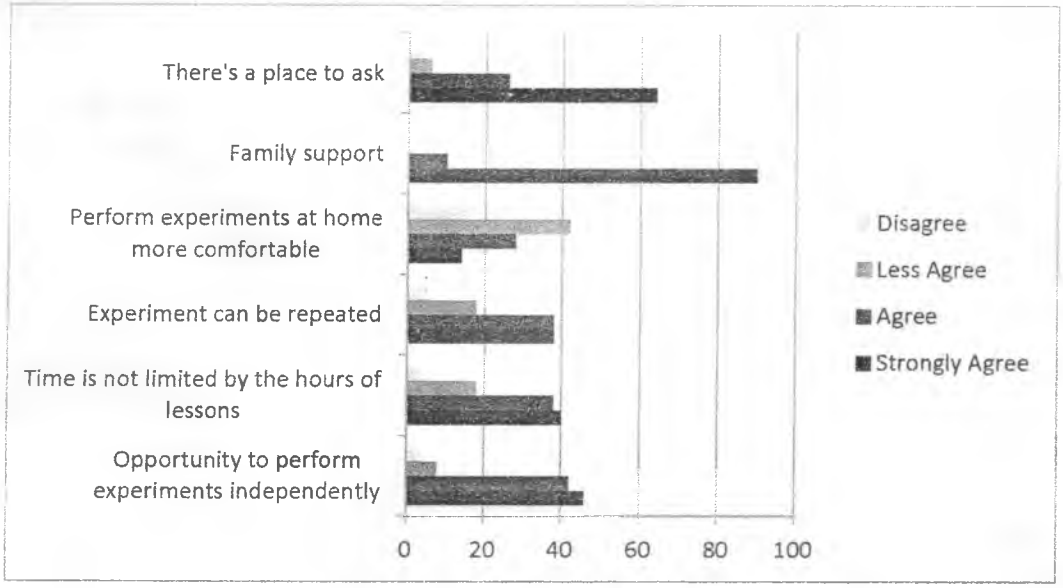


Figure 4. *Some of the Reasons Experiment Performed by Students At Home*

Figure 4 shows that almost all participants stated that when a science experiment brought it home, then there is a chance for them to try out their own science experiments that are assigned to them. This view is due to the lack of participation of all the students in the e experimental methods implemented by

teachers in the teaching of science in schools. Dominance of a few students in the cause of the other students had the opportunity to do a lot of research. Another reason is the desire to be more independent and have a sense of pride on the work itself.

In terms of time, around 80% of the participants felt that the home experiment, they no longer worry about a time limit school hours. They do not have to worry about the turn of the hour lesson, while they have not completed the experiment. When experiment which they run the in home yet to finished, they can extend back at the other the time. In addition, almost 75% of participants also felt that the experiments carried out at home can be repeated at the time they want. According to Abraham, I (2008), there is also evidence that students find practical work relatively useful and enjoyable as compared with other science teaching and learning activities.

Unlike the three views described above, more participants gave a negative response to a statement that at home more comfortable to experiment. Approximately 42% of participants agree on the view that iti is more comfortable to perform experiments at home and 16% felt strongly disagree. The remaining 42% of the participants expressed their agreement and strongly agree. Turner's study (2008) found that through home experiment kits, students can arrange a time and be able to work in a comfortable atmosphere they desire without the pressures.

Opinion of the participants that the experiment at home will get family support is very extreme. There are 90% of the participants expressed very confident and only 10% of participants feel confident about they will get a family supported in performing science experiments at home. Van Voorhis, F,L (2011) said that all parents, regardless of formal education, should be able to participate in the student-family interaction. He also said that the family partner serves as an assistant, never the teacher.

Participants also believe that when they perform science experiments at home there are obstacles, they will have many places to ask. It is seen from the results of the survey indicate that 90% of participants agree and strongly agree will matter. They can ask parents, relatives, friends, and find information on a variety of sources, eventhough according to Van Voorhis, F, L (2011), not all activities should ask students to interview a family partner. Students might like to conduct different interactions such as a game, demonstration, or experiment, or collect reactions, memories, or ideas.

Conclusion

In general, in the interval of 5 years, most of the science teachers tend to rarely perform science experiments, some do not ever perform science experiments and only a fraction of those states regularly carry out scientific experiments in school. Cause rare or never even science teachers undertake experiments in science lessons include: limited experimental time in hours in school, difficulty managing the class when the experiment progresses, the perception of science teachers that the material compact, laboratory partnerships between the many parallel class, unskilled teachers managing student experiments, lack of equipment and materials in the laboratory, and no energy laboratory assistant who can help provide and update equipment and material experiments

Revenue survey experiment execution frequency by junior high school science teacher in Pekanbaru on physics lesson on the topic of light show that all kinds of experiments to acquire the concepts and apply the concept of light and optics rare and never implemented by science teachers, although only a small part that always execute. Rarely or never carried out experiments in science teaching, leading science process skills students almost never exercised by the teacher. When the research has not been done then the scientific attitude of students will not be formed. In fact, science process skills and scientific attitudes are important products in the teaching and learning of science.

Meanwhile, students have positive attitudes towards science and science experiments although they rarely realize that they are doing science experiments in school laboratories. Because like a science experiment, and realized that the experiment is rarely implemented in school, so the students felt that they could do experiments at home. There are several reasons that according to the students that the experiment can be carried back to the house: they can try it by theirself, not constrained by the short hours of lesson, can be repeated, getting support from family and provide place to ask. Solomon (2003) pointed out that the equipment used by students for science activities at home are simple items readily available at home. According to him, to understand science at home, everything that came out of the house can be used and when these things have been used wisely, it can use other items that are available at home.

Survey result described above, as a platform for researchers to develop strategies take home experiment more. Although not all experiments will be carried home by students, but at least some important experiments with simple equipment and materials readily available and can be brought back home. Because the primary purpose of the study is a home experiment to practice science process skills and scientific attitude, then in performing experiments, students must follow the rules of scientific work or scientific inquiry. For this reason, in implementation of the experiment, the students are guided by student worksheets. In the early stages, student worksheets will be a full-guided inquiry. When students are trained exercise levels of scientific inquiry, the scaffolding in experimental tasks assigned teacher should be reduced so that students become more independent and more creative.

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