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Chemistry outreach program and its impact on secondary school students

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Abstract

Chemistry is one of the most difficult subjects and usually feared by the students in elementary schools. Some of the students in Malaysia, especially in the rural area, they memorized experiments and the theories without really understand the beauty of chemistry. They also believed that the chemistry experiment can only be done in the laboratory equipped with a huge fume hood since all of the experiments are dangerous, explosive and costly. Chemistry outreach program held by a team from Universiti Kebangsaan Malaysia was meant to change the perspective of the elementary students towards chemistry and to develop their interest in exploring the beauty of chemistry. The program took place in Perlis as part of the Science on Wheels Program organized by National Science Centre. Few experiments using chemicals which can be found in daily life were first demonstrated and explained. Then the students were given chances to try on their own. They were also asked to relate what they had learned from the experiments to the phenomenon that occurred in the world. Survey on knowing their interest in chemistry before and after the experiments was given and analyzed. The results showed that the level of liking chemistry and choosing chemistry as one of the career option depended mainly on the exposure towards chemistry. The result showed that 80% of the students were interested in chemistry after they performed the experiments compared to 72% who were interested in the chemistry subject taught in school prior to the experiment. The 8% increment was possibly a reflection of the effective learning through experiment. Overall, 58% of students were interested to choose chemistry as their future career and suprisingly it was not depended on the background of the family. The chemistry outreach program really gave the impact on the elementary students and reached their hearts and should be continued from time to time to attract students to science and technology.

Keywords: Chemistry outreach; experiments;chemistry subject; secondary school students; survey

1. Introduction

Based on the Malaysia Education Syllabus, the chemistry subject was introduced in the secondary school since 1972. The implementation of the subject was aimed to develop student's interest in chemistry, as well as enhancing

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the knowledge and skills in specific science basis through activities and learning experience. Chemistry subject emphasized practices and the use of knowledgeto enhance the competency based skills such as thinking skills, information handling skills and problem solving skills (Abu Hassan, 2003).

Examination-based learning system as it is now, still appoints the teachers as the centre in the teaching and learning process (Abu Hassan, 2003). Many teachers thought that students do not understand the concept of chemistry and they practices teacher-centered teaching and learning process in the class. This makes the low level cognitive learning being carried out such as memorization, re-memorized and understanding (Gabel, 1983). The stress on developing cognitive skills such as idea searching, analyzing, application, synthesizing, judgement making and problem solving is very limited (Bowen & Bunce, 1997). As a result, it is hard for students to understand chemistry effectively and their interest in this subject will decrease gradually.

The problem is compounded by the changes of learning language in science and mathematics that currently takes place in this country. When the learning language keeps on changing, it is possible that the student will have less interest in learning science as they will think that it will be difficult to understand.

Therefore, the students should be exposed to a much more interesting learning process such as the application of chemistry in daily lives. In this way, students will have better understanding on what they see without the need to fully understand what they have learned in the class. This program is seen as a proactive alternative in making the chemistry subject interesting by approaching the students in a different way than what it is in the class.

2. Methodology

Two methods were used during this chemistry outreach program which are demonstration of simple chemistry experiments using materials that can be found easily in daily life and questionnaires to obtain students response. Eight types of experiments were chosen which include some aspects in chemistry:

i) material density (density column and dancing raisin)
ii) polymer (slime)
iii) surface tension (milk magic)
iv) pH (red cabbage indicator)
v) oxidation reaction (invisible ink)
vi) gas production reaction (invisible fire extinguisher)
vii) polymer and solvent (melting cup)

Demonstration was done in front of the students and after the theory of each phenomenon was explained, they were given the chance to try the experiments themselves. Some questions were also asked in order to test the students' understanding to relate the theory of the experiment with the phenomenon occurs around them.

Column density experiment (Helmenstine, 2011a) was done according to density differences of several materials varied in colour while the 'dancing raisins' experiment (Spangler, 2011a) was based on the nature of CO_2 bubbles in carbonated water which adhered on the surface of the raisins causing the raisins floated on the water and sank after the CO_2 bubbles were gone. SLIME experiment (Rich 2009), on the other hand shows the production of polymers using a detergent (Dynamo) and polivinylacetate (PVA) glue while the 'milk magic' experiment (Lahav, 2008) highlights the different hues produced when the milk surface tension was disturbed by the surfactant.

In the red cabbage indicator experiment (Anon, 1998), the acidity and base properties of a material was tested by using a red cabbage. The colour of red cabbage solution which is purple containing anthocyanins will change when an acid or base is or mixed into it. Other two experiments that were done during the program were invisible ink (Helmenstine, 2011b) and invisible fire extinguisher (Spangler, 2011b). In the invisible ink experiment, lemon juice was used as ink and was written on a white paper. The writing will be visible when the paper is heated over a fire. In the invisible fire extinguisher experiment, the reaction between vinegar or acetic acid with sodium bicarbonate was done to produce CO_2gas which can extinguish fire. The last experiment which is the melting cup experiment showed the solubility of polystyrene in organic solvents such as acetone (Rease, 2011).

After the demonstration of experiments was done, the students were given questionnaires. They were asked to fill in their school name, class and the background/work of their parents in the section provided before continuing with answering the following questions:

1. Their level of interest in chemistry subject.
2. Their level of interest in chemistry outreach experiments.
3. Did the experiments increase their interest in chemistry?
4. The level of understanding of the experiment's theory.
5. Will they be able to make use of the knowledge gained?
6. Are they interested in making the field of chemistry as their career in the future?

The questionnaires were collected and analyzed.

3. Result and discussion

Filled survey forms were analyzed. Data from the scale of 4 and 5 were summed to obtain the following data:

3.1 Percentage of students according to question

Figure 1 illustrates the percentage of male and female students who had chosen the scale of 4 and 5 according to the questions in the survey form. In total, 90% of students really liked the experiments demonstrated in the chemistry outreach program. Student's interest in chemistry subject increased after watching and doing the experiment was calculated based on the difference between the percentage of question 1 (72%) and 3 (80%). This increment of 8% shows that effective learning had took place after the experiment. Surprisingly, students were able to built their interest in chemistry subject only after less than 1 hour of demonstration time. However, the level of understanding of the theory of the experiments was still low which is 63% and most of the students stated that they can apply what they had learned during this program in their daily lives.

3.2 The tendency of students to the profession of chemistry

Based on Figure 1, only 58% of students tend to choose chemistry as a career. This percentage was compared with their background in order to know whether the decisions they have made were influenced by their parent's profession. Figure 2 shows the distribution of students who had chosen chemistry as a career according to their family background. Parent's jobs that are classified as educated (EDUCATED) are doctors, engineers, lecturers, teachers, pharmacist, managers and officers. The result shows that only 12% of male and female student from that category chose chemistry as career while the rest comes from ordinary families. This shows that family factor did not influence the career path of the students but the interest and the influence of the subject on the students did.

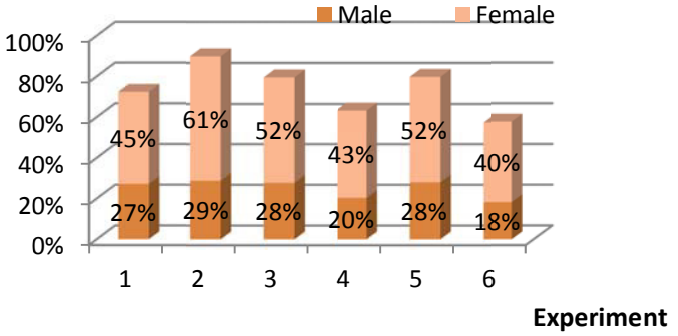

Figure 1.Percentage of students who chose scale 4 and 5 according to the questions in the questionnaire

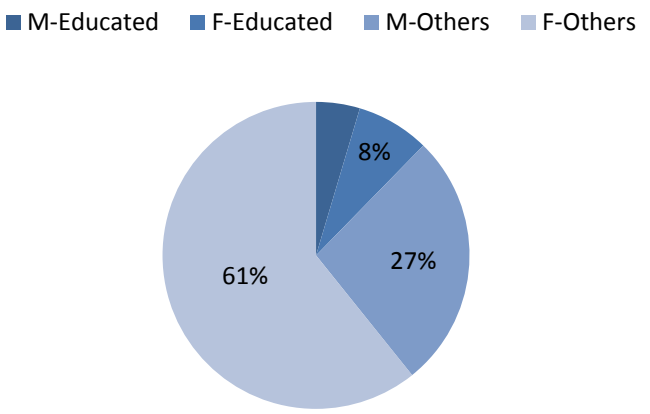

Figure 2.Percentage of students who chose chemistry as career according to family background

3.3 The impact and effects of chemistry outreach program to the students.

The impact and effects of chemistry outreach program to the secondary school students was shown by the increased in the percentage of student's interest in chemistry subject after they watched and did the experiments. This shows that a couple of simple experiments can be done using materials that are easily found in daily life to explain the phenomena and facts learned in school. The student's perspective to chemistry especially those who come from rural areas where most of them did not get the chance to do experiments had also changed by the end of this program. This type of program will be pursued in the future not only to rural schools but also in urban areas in order to see the difference in acceptance of students in chemistry subject and to further encourage them to venture into the field of chemistry.

4. Conclusions

The Chemistry Outreach Program which aims to expose the students to chemistry based experiments had achieved its objectives. The result showed an 8% increase of interest in chemistry after the program which addressed that effective learning through experiments took place. An overall of 58% students also tend to choose chemistry as their career. The tendency was not influenced by the background of the family but wasdue to their interest and the influence of the subject to the students. The chemistry outreach program really gave the impact on the elementary students and reached their hearts and should be continued from time to time to attract students to science and technology, especially chemistry.

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