Students’ learning in Physics laboratory

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Abstract. The aim of this study was to explore the students’ learning in Physics laboratory with 103 undergraduate students. The data were collected by ASELL survey to investigate students’ experience in the Lab, open-ended questions to investigate students’ ability to do experiments and semi-interview to investigate students’ attitude in learning Physics laboratory. Results from ASELL survey showed students’ attitude towards Physics lab that they did not strongly agree with the Physics lab are; developing data interpretation and laboratory skills, interesting, clear assessment, clear learning objectives, increasing understanding of Physics, sufficient background, effective laboratory instructors, good laboratory manual, relevance to Physics studies, developing teamwork, responsibility for own learning, sufficient time and overall learning experience. The open-ended questions were used to confirm the data from ASELL survey and found that most students explain experiments in the lab unclear. Some of them cannot explain and have no idea about what they did in the lab. These showed that learning in Physics laboratory did not efficiency. In addition, from the interviews showed that they need reflection from teacher about the experimental result in the end of the lab and they need to share their experiment results to classmate.

1. Introduction

Twenty years ago, laboratory is used in Physics teaching which causing usefulness and effectiveness in Physics teaching [1]. However, Physics laboratory is still being problems in learning of students. They are not able to describe and analyze the data acquired from the experiments [2]. Often students are not able to achieve logical deductions based on data, received from the experiments that they conducted [3]. Some students have difficult with the experiment in the sequence and techniques in laboratory [4]. The main cause of the problem is caused by learning experience that students gained from teachers’ teaching in Physics laboratory. In Australia, the ASELL (Advancing Science by Enhancing Learning in the Laboratory) was used to improve the problem in teaching science laboratory [5]. The beginning of ASELL is from ACELL project, the ACELL project team started to explore the possibility of applying the principles and processes developed in Chemistry to other science disciplines. The ACELL project has three principal aims: (i) to make available, materials relating to undergraduate Chemistry experiments and have been evaluated by both students and academic staff; (ii) to provide for the professional development of Chemistry academic staff by expanding the understanding of issues
surrounding student learning in the laboratory and (iii) to facilitate the development of a community of practice in Chemistry education [6]. Consequently, the purposes of ASELL survey there are 14 statements consisting of: 1) Data interpretation skills, 2) Developing laboratory skills, 3) Interest, 4) Clear assessment, 5) Clear learning objectives, 6) Increased understanding of Physics, 7) Sufficient/appropriate background, 8) Effective laboratory instructors, 9) Good laboratory manual, 10) Relevance to Physics studies, 11) Developing teamwork, 12) Responsibility for own learning, 13) Sufficient time and 14) Overall learning experience.

In Thailand, physics laboratory is the foundational subject of science curriculum and specify for undergraduate science students learn in the first level [7]. In Physics laboratory, most teachers do not know the experience of students’ learning in the lab. It made them difficult to develop and solve the problem of students learning in the lab. Therefore, the aim of this study was to explore students’ learning in Physics laboratory of undergraduate students in order to develop skills and knowledge of students’ learning in Physics laboratory in the future.

2. Methodology

The participants in this study were 103 undergraduate students from Faculty of Science at Yala Rajabhat University in southern of Thailand. The research tools researchers used ASELL survey, open – ended questions and semi – interview form to explore students’ learning in Physics laboratory. In the first of collecting data, researchers provided the students to do ASELL survey which were 14 statements. The statements in items 1 – 12, there are 5 levels of comments including: 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree and 1 = strongly disagree. The statement in item 13, there is scales to indicate 5 level including: 5 = way too much, 4 = too much, 3 = about right, 2 = not enough and 1 = nowhere near. The final statement is item 14, there is scales to indicate 5 level including: 5 = excellent, 4 = good, 3 = average, 2 = poor and 1 = very poor. Then, we provided the students to do open – ended questions for investigation students’ ability to do experiments. In this study, the Measurement, Equilibrium of mass experiment and Friction to measure the coefficient of the friction of the ground were studied. Consequently, the whole of open – ended questions there are four questions as follows;

- Question 1: If you want to measure the size of the PVC pipe, which equipment will be used for measure the size of pipe? Why and how to measure it?
- Question 2: If you want to measure the size of the banknote, which equipment will be used for measure the size of the banknote? Why and how to measure it?
- Question 3: The equilibrium of mass experiment, how to set up the experiment?
- Question 4: The Friction experiment, how to measure the coefficient of the friction of the ground?

Then, the semi – interview of 10 students was used to investigate students’ attitude in learning Physics laboratory. In addition, the data from ASELL survey was descriptive statistics. The data from open – ended questions and interview were analysed by interpretation method, which there are grouped and coded then categorizing and interpretation.

3. Research Findings

The students experience in the Physics laboratory were showed in table 1.

Table 1. Students experience in the Lab.

| Items | Students experience in the Lab | Level comments from ASELL survey (%) |
|-------|------------------------------|-------------------------------------|
|       |                              | 5        | 4        | 3        | 2        | 1        |
| 1     | Data interpretation skills   | 2.055    | 39.726   | 55.479   | 2.740    | -        |
| 2     | Developing laboratory skills | 2.740    | 42.466   | 51.370   | 3.425    | -        |
| 3     | Interest                     | 7.534    | 36.986   | 52.055   | 3.425    | -        |
| 4     | Clear assessment             | 1.370    | 28.082   | 67.123   | 3.425    | -        |
| 5     | Clear learning objectives    | 2.055    | 30.137   | 64.383   | 3.425    | -        |
Table 1. (Cont.)

| Items                  | Students experience in Lab | Level comments from ASELL survey (%) |
|------------------------|----------------------------|--------------------------------------|
|                        |                            | 5 | 4 | 3 | 2 | 1 |
| 6 Increased understanding of Physics | 2.740 | 34.931 | 54.110 | 8.219 | - |
| 7 Sufficient/appropriate background | 4.795 | 37.671 | 55.479 | 2.055 | - |
| 8 Effective laboratory instructors | 10.959 | 48.630 | 36.986 | 3.425 | - |
| 9 Good laboratory manual | 5.479 | 43.151 | 50.000 | 1.370 | - |
| 10 Relevance to Physics studies | 3.425 | 30.137 | 62.329 | 3.425 | 0.685 |
| 11 Developing teamwork | 10.959 | 52.055 | 31.507 | 4.794 | 0.685 |
| 12 Responsibility for own learning | 6.849 | 27.397 | 55.479 | 10.274 | - |
| 13 Sufficient time | 6.849 | 47.260 | 37.671 | 6.164 | 2.055 |
| 14 Overall learning experience | 7.534 | 36.986 | 45.205 | 9.589 | 0.685 |

The result in table 1 found that students have low percentage in strongly agree towards experience learning in Physics lab, which they did not strongly agree that Physics lab are; developing data interpretation skill, developing laboratory skills, interesting, clear assessment, clear learning objectives, increased understanding of Physics, sufficient background, effective laboratory instructors, good laboratory manual, relevance to Physics studies, developing teamwork, responsibility for own learning, sufficient time and overall learning experience. In addition, the most advantage of doing the lab are developing teamwork, working in a team to complete this experiment. There are 50.055 % of students agree with this item. Students’ ability to do experiments by using open – ended questions for whole 4 questions as showed in figure 1.

Figure 1. The students’ experimental ability.

Result from open – ended questions (figure 1) showed that the students’ answers indicated their experimental ability as following: Group 1: students understand the lab completely, Group 2: students explain the lab completely but based on the instruction, Group 3: students explain the lab unclear, Group 4: students cannot explain the lab and Group 5: No idea. The result showed that the Physics lab does not effective in helping students to learn physics. Some of students no idea, cannot explain or explain the lab unclear. In addition, result from interviews found that students’ attitude in learning Physics laboratory were: Physics laboratory is difficult and not fun. In the end of the experiment, teachers do not reflect and discuss about the experimental results. Furthermore, the student does not have chance to share their experimental results to their classmate.
4. Conclusions
Results from ASELL survey showed students’ attitude towards Physics lab that they did not strongly agree with the Physics lab are; developing data interpretation and laboratory skills, interesting, clear assessment, clear learning objectives, increasing understanding of Physics, sufficient background, effective laboratory instructors, good laboratory manual, relevance to Physics studies, developing teamwork, responsibility for own learning, sufficient time and overall learning experience. From the open – ended questions explain experiments in the lab unclear. Some of them cannot explain and have no idea about what they did in the lab. The result from open – ended questions found that the percentage of students who understand the lab completely are every low. In all of the lab which are Measurement, Equilibrium of mass experiment and Friction.

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