The analysis of student’s laboratory work skill on chemical equilibrium topic

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Abstract. Assessing the student’s performance during practicum is important to measure the student’s skill during practices. This study aims to analyze student’s scientific skills during the Chemical Equilibrium practicum. For this research, researchers used one shot case study design of experimental methods. The data were obtained through the description of students activities during the practical training and the analysis of performance assessment. The result showed that 100% of the students are well-skilled at using spray bottles, dropping plates, reading the universally-indicated pH trajectory, and cleaning the equipment. 93.75% of the students excelled the skills of using pipettes, measuring the volume of the solution, and stirring the solution. The students are less-skilled at shifting the solution and diluting the solution, with only 68.75% of the students passed the expected activities. The skill of choosing and disposing the waste of the practical training has the lowest number of students excelled, with only 50% of them passed the expected standard. The student’s scientific skill needs an upgrade especially on the skill of choosing and disposing the waste.

1. Introduction

Chemical equilibrium is a part of chemistry in an abstractive concept [1]. Teachers need to do the practical training so that the students understand its abstractive characteristic [2]. Practical training helps to develop students’ critical thinking [3]. Practical training is also an effort to increase the quality of teaching and learning process in higher education [4]. The learning process and assessment is part of the practical training, as the assessment and the measurement hold an important role for the students’ learning process [5]. One cannot rely on the cognitive aspect during the process of learning, the students’ attitude and skills also help to build the knowledge.

There are three challenges on science. First and foremost, scientific learning is still on the level of knowledge-based, not the process [6]. Second, teachers only deliver theories to their students instead of practical training [7]. Last, the learning process is still teacher-oriented. The students’ assessment is a process where it shows the abilities of the students of both during the process and the outcome and most importantly, the students are involved [8].

To assess the score of students’ practical training, teachers can use Performance Assessment as an alternative [9]. The advantage of using Performance Assessment is that teachers are allowed to obtain more information regarding to students’ skill of both during the process and the result of the practical training [10]. The fact is the students’ scientific skills are below average [11]. The characteristics of performance assessment during the chemical equilibrium practical training include pipetting, using the
spray bottle, using the dropping plate, measuring solutions, shifting solutions, stirring, diluting solutions, analyzing the pH trajectory, cleaning the equipment of the practical training and disposing the waste.

There are many studies regarding the students’ performance during practical training, one of them discusses about the significant differences between male and female students [12]. Students’ performance during the practical training holds an important role in learning process [13]. Students may improve their scientific skills through laboratory practices [14]. Improving student performance with laboratory learning [15]. Assessing the students’ performance could be through a lot of presentation mode in the laboratory [16]. Unlike the previous research, this research focuses to analyze students’ scientific skill during the Chemical Equilibrium practical training. The data obtained were inputted to the website after the research.

2. Methods
This research used the experimental method with one shot case study design [17]. The subject of the research was 38 semester-2 students of Chemistry Education Department UIN Sunan Gunung Djati Bandung. Most of the students came from various public schools. This implies to students’ awkwardness to practical training. The research began with problem identification, preparation, the practical training, and reportage. The data of the students’ activities were obtained through the observation sheet during the practical training while the data of students’ scientific skills were obtained through the analysis during the practical training.

The data analysis used in this research is the description of students’ activities during the practical research and the analysis of students’ work through their score from the performance indicator, which were calculated to the score of 100-percent-scale scoring system later on [18].

3. Result and Discussion
The results obtained after the observation and filling out the scientific performance sheet of students on the chemical equilibrium practicum can be seen in table 1.

| NO | Performance Indicator | Developed skill | Success Rate (%) |
|----|-----------------------|-----------------|------------------|
| 1  | Students using the pipettes properly | Using the pipette | 100              |
| 2  | Students using the spraying bottle properly | Using the spraying bottle | 100              |
| 3  | Students using the dropping plate properly | Using the dropping plate | 100              |
| 4  | Students measuring the volume of the solution using the proper technique | Measuring the volume of the solution | 100              |
| 5  | Students shifting the solutions correctly | Shifting the solution | 100              |
| 6  | Students stirring the solution correctly | Stirring the solution | 100              |
| 7  | Students diluting the solution using the proper technique | Diluting the solution | 100              |
| 8  | Students reading the pH trajectory (universal indicator) using the proper technique | Reading the pH trajectory (universal indicator) | 100              |
| 9  | Students cleaning the equipment of the practical training correctly | Cleaning the equipment | 100              |
| 10 | Students disposing the waste properly | Disposing the waste | 50               |

The score of 9 performance indicator were perfect with all scored 100% while the other one indicator with the lowest score is disposing the waste, scored only 50%. Table 2 below shows the students’ group score of their chemical skills.
### Table 2. The Developed Skills during the Practical Training

| No | Developed skill | Group 1 | Group 2 | Group 3 | Group 4 | Mean | Category |
|----|-----------------|--------|--------|--------|--------|------|----------|
| 1  | Using the pipette | 100    | 100    | 100    | 75     | 93.75| Skilled  |
| 2  | Using the spraying bottle | 100    | 100    | 100    | 100    | 100  | Well-skilled |
| 3  | Using the dropping plate | 100    | 100    | 100    | 100    | 100  | Well-skilled |
| 4  | Measuring the volume of the solution | 100    | 75     | 100    | 100    | 93.75| Skilled  |
| 5  | Shifting the solution | 75     | 50     | 75     | 75     | 68.75| Less-skilled |
| 6  | Stirring the solution | 100    | 100    | 100    | 75     | 93.75| Skilled  |
| 7  | Diluting the solution | 75     | 75     | 50     | 75     | 68.75| Less-skilled |
| 8  | Reading the pH trajectory (universal indicator) | 100    | 100    | 100    | 100    | 100  | Well-skilled |
| 9  | Cleaning the equipment | 100    | 100    | 100    | 100    | 100  | Well-skilled |
| 10 | Disposing the waste | 50     | 50     | 50     | 50     | 50   | Not skilled |

From the table above, we can conclude that the students are well-skilled on using the pipette, using the dropping plate, reading the pH trajectory, and cleaning the equipment of the practical training with the score of 100. This occurred due to the high standard Chemistry Education Department UIN Sunan Gunung Djati Bandung’s laboratory equipment. The skills are the basic skill the students have to possess before the practical training [19].

At the pipetting skill, three out of four groups are able to use the pipettes correctly. However, there was still a group who cannot figure out the proper usage of pipette, as shown on Figure 1 and 2.

![Figure 1. Correct technique of using pipette](image1.png)

![Figure 2. Incorrect technique of using pipette](image2.png)

From Figure 1, students are able to pipette the solution properly. However, in Figure 2 the students were supposed to balance the position of their hands and their shoulder. The pipettes use the principal of air pressure inside the pipette. The rubber on the pipette should be pinched before the tip of the pipette reaches the solution. Release the pinch to let the solution gets inside the pipette. Pinch the rubber again to release the solution inside the pipette. One pressure (one pinch) is equal with a drop of solution [20].
The skill of measurement scored 93.72%, categorized as skilled. This showed from students’ skill on measuring the volume of the solution although one out of four groups faced challenge measuring the solution as shown on figure 3 and 4.

From figure 3 we can see that the students were properly measured the volume of the solution while on Figure 4 the students measured the volume of the solution improperly. To clearly read the number on the graduated cylinder, put the cylinder on a flat surface. The eyes should line with the surface of the solution so that the measurement is more accurate [21].

At the skill of shifting and diluting the solution, the students scored 68.75% categorized as less-skilled. This was proved by the skill of the students when shifting and diluting the solution. Almost all of the groups are not well-skilled. The pictures are shown on figure 5 and 6 below.

Figure 5 shows the student shifted the strong acidic solution into the Erlenmeyer flask properly but shook the pipette to squeeze the remaining solution while she should not. The proper way to squeeze the remaining solution is to blow a soft air into the pipette or tap thrice the pipette softly to the side of the jar [22]. Figure 6 shows the students correctly shifting the solution but was not focused.

The skill of disposal, whose score is the lowest by 50% was caused by the students’ incapability of analysing the characteristic of the waste. Each chemical substance is different, causing it to have different characteristics of the waste [23].
4. Conclusion
The score of completion reached 100% at 9 skills, categorized as well-completed. Students’ scientific skills are also in a good grade on using the spraying bottle, using the dropping plate, reading the pH trajectory, and cleaning the equipment of the practical training with the score of 100%. The students are also good at using the pipette, measuring the solution’s volume and stirring the solution with the score of 93.75%. The students are less-skilled at shifting and diluting the solution with the score of 68.75%, while the skill of waste disposal scored the lowest with 50%. This means that the students need to improve their skills more, especially at disposing chemical waste, specifically during the Chemical Equilibrium practical training.

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