Profile of Students’ Science Process Skills in Acid Base Titration Practicum at Class XI MIPA 3 SMA Negeri 1 Singaraja Bali

M D Adiningsih¹, I W Karyasa², I W Muderawan³

¹,²,³ Universitas Pendidikan Ganesha, Jalan Udayana 11 Singaraja Bali 81116 Indonesia

Email : darmaprathiwi.id@gmail.com

Abstract. The research was aimed to describe the profile of students’ science process skills and the factors that influence science process skills of class XI MIPA 3 SMA Negeri 1 Singaraja in the implementation of acid base titration practicum. This research conducted by using a phenomenological qualitative approach. The methods that used to collect data were observation, interviews, and documentation. Data were analyzed by qualitative descriptive techniques. The result that obtained is profile of students’ science process skills at class XI MIPA 3 SMA N 1 Singaraja which is limited to mastery of science process skills. Science process skills that have been mastered by students consist of 7 aspects of skills, namely skill to measure the volume of the solution with volumetric pipette and burette included in the good category with the number of students 100%; the skill to use universal indicator, communication skills, and applying concepts included in the excellent category with the number of students 100%; observing skill, titration skill, and interpreting skill included in the excellent category with the number of students 60%; and predicting skill included in the excellent category with the number of students 80%. Skill that is less mastered by students was concluding skills based on the results that 60% students included in the poor category. Science process skills that are not trained for students consist of 4 skills, namely the skills of formulating hypotheses, controlling variables, designing investigations, and classifying. The factors that influence students’ science process skills in the implementation of acid base titration practicum are classified into four factors, namely tools, materials, humans, and methods/technical.

1. Introduction

Science not only concerned on the mastery of knowledge, but also the process of discovery. Process of discovery through science can be labeled as science process skills. Science process skills are activities which students carry out to enable the acquisition of scientific knowledge and skills through scientific investigations [1]. Science process skills (SPS) are the thinking skills that used to construct knowledge in order to solve problems and formulate results scientifically [2]. Science process skills are useful for solving problems in life, helping students to construct their own concepts, and also increase creativity.
The acquisition of science process skills by “learning to do” enables students to understand the concepts of Chemistry as one of the key science subject easily [3].

Science process skills are classified into basic and integrated science process skills. Basic science process skills are the skills which is refer to the intellectual groundwork in scientific inquiry, such as the ability to order and describe natural objects and events [4]. Integrated science process skills requires a more advanced knowledge base rather than basic science process skills [2]. The integrated science process skills involve utilizing of various basic level skills [5]. Basic science process skills are divided into 6 skills, namely the skill of observing, classifying, predicting, measuring, communicating, and concluding. Meanwhile integrated science process skills are divided into 6 skills, namely the skills of formulating hypotheses, controlling variables, designing investigations, experiment, interpreting, and applying concepts. One of the ways which is used to improve students’ science process skills is learning through practicum methods. Practicum is a method that focuses on learning for directing students to conducted experiments. Based on that experiment, students are able to prove what they have learned.

Students' science process skills were influenced by various factors. Factors that influence science process skills have been stated by Puspita, Masriani, and Sartika (2015). Factors that cause students to be very lacking in interpretation of data, namely mistakenly making tables in horizontal or vertical form, not reading information on worksheets, and usually given observation table by teacher at each practicum so it was difficult to do it by theirselves. The ability to make students' hypotheses is less considering that students are not successful in making hypotheses. The cause of students' difficulties in determining variables are students have never been taught to determine variables and can not understand information about variables in the worksheet. The difficulty that students faced in making conclusions is students have never been taught how to make conclusions in practicum [6].

Research on science process skills through practicum was conducted at SMA Negeri 1 Singaraja. SMA Negeri 1 Singaraja is located on Pramuka street number 4 Singaraja, Bali. Chemistry laboratory as a place to do practicum in SMA Negeri 1 Singaraja was good and complete. Based on the results of an interview with one of the chemistry teachers in SMA Negeri 1 Singaraja, it was obtained that beside on mastering theory, students also had to have skills in practicum. The skills required in practicum are science process skills. Condition in the SMA Negeri 1 Singaraja indicate that science process skills have been applied by students during practicum. However, the teacher did not make an assessment of the students’ science process skills due to limited time to do practicum. This research was conducted on the XI MIPA class in the even semester considering that students have the skills used to do practicum. Therefore, this research was aimed to describe the profile of students’ science process skills and the factors that influence science process skills of class XI MIPA 3 SMA Negeri 1 Singaraja in the implementation of acid base titration practicum.

2. Methods

This research was phenomenology study conducted by using qualitative approach. The research was carried out at SMA Negeri 1 Singaraja in the even semester of the academic year 2018/2019. The subjects of this research were student of class XI MIPA 3 which divided into 5 groups in one class and each group consists of 6 people. Meanwhile, the objects in this study were the students’ science process skills. In this research, the activities of students in conducting practicum were observed.

The methods used to collect data were observation, interviews, and documentation. The research was used direct observations method to obtain students’ science process skills through practicum with assisted by observation sheet. The interview method aimed to determine the factors that influence students' science process skills through practicum. The sources of information used were the students’ XI MIPA 3 and their chemistry teachers. Documentation was used as the complementary of observation and interview methods.

Data analysis was carried out before entering the field, while in the field, and after its completion in the field of qualitative research. The analyzed data was preliminary study results to determine the
focus of research. The stages of data analysis in the field, namely data reduction, data presentation, and conclusion or verification. Data reduction was done after obtaining data through observation and interviews. Data presentation was done by describing the results of observations and also interviews method assisted by using Ishikawa diagram. The final stage was drawing conclusions related to students’ science process skills profile and the factors that influenced it. Testing the validity of the data in the research was carried out by testing the credibility of the data using triangulation method and membercheck.

3. Results and Discussion

3.1 Students’ Science Process Skills

Science process skills were observed in acid-base titration practicum consists of 12 skills, namely the of skill formulating hypotheses, controlling variables, designing investigations, classifying, measuring skills which divided to measuring the volume of solution with a pipette volumetric and a burette, the skills to conducting experiments consisted of titration skill and using universal indicator, the skill of observing, predicting, interpreting, applying the concept, concluding, and communicating. Profile of students’ science process skills obtained by observing each aspect of science process skills based on three criteria (Table 1). Score given in each aspect of skills, namely excellent category (score 3), good (score 2), poor (score 1), and very poor (score 0).

| The Aspect of Science Process Skills | Criteria                                                                 |
|-------------------------------------|--------------------------------------------------------------------------|
| Measuring the volume of the solution using a volumetric pipette | a. The volumetric pipette used to measure the volume of the same solution. |
|                                     | b. The suction ball is deflated before use.                              |
|                                     | c. The solution were filled until it shows the concave meniscus scale at the volumetric pipette boundary markers. |
| Measuring the volume of the solution with a burette | a. The burette in a stable and perpendicular state.                     |
|                                     | b. The volume of the solution seen from the concave meniscus scale that is read parallel to the eye. |
|                                     | c. The indicated volume read with two digits behind the comma.           |
| Doing titration                     | a. The student doing titration done alone.                               |
|                                     | b. The position of one hand holding the tap and the other hand holding Erlenmeyer while shaken in a circular fashion. |
|                                     | c. The tap is immediately closed when the color change of the solution turns pink. |
| Using universal indicators          | a. The universal indicator paper is cut into several parts.             |
|                                     | b. All the colored parts on the paper are dipped in solution.            |
|                                     | c. The color change of the paper is matched exactly to the standard color which indicates the pH of the solution. |
| Observing                           | a. Observing the color changes that occur.                              |
|                                     | b. Stopping the titration process when the color changes pink.          |
|                                     | c. Observing the volume of the solution just as the color changes.      |
| Predicting                          | a. Making a forecast of the volume of the titrant based on the volume of the titrant that was obtained in the first trial. |
|                                     | b. Making a prediction of the volume of the titrant that will be obtained both orally and in writing. |
|                                     | c. Making a precise time forecast to stop the titration based on the volume of the titrant that has been obtained in the first trial. |
| Interpreting                        | a. Finding an orderly pattern of the volume of the titrant written in tabular form correctly. |
|                                     | b. Analyzing the experimental data correctly.                          |
| Applying concepts                   | a. Connecting the experimental results obtained with the theory to draw conclusions. |
|                                     | b. Titration curve neatly and completely made.                          |
|                                     | c. Titration curve in accordance with the theory.                      |
| Concluding                          | a. Making conclusions in accordance with the data obtained.             |
|                                     | b. Making conclusions in accordance with the purpose of the experiment. |
|                                     | c. Making conclusions with short, concise, and clear sentences.        |
| Communication                       | a. Explaining data obtained as is in accordance with the results of the experiment. |
b. Communicate reports systematically.
c. Communicate reports in clear and straightforward language.

Profile of students’ science process skills was limited to the mastery of the science process skills. Science process skills that have been mastered by students consist of 7 aspects of skills, namely skill to measure the volume of the solution with volumetric pipette and burette included in the good category with the number of students 100%; the skill to use universal indicator, communication skills, and applying concepts included in the excellent category with the number of students 100%; observing skill, titration skill, and interpreting skill included in the excellent category with the number of students 60%; and predicting skill included in the excellent category with the number of students 80%. Skill that is less mastered by students was concluding skills based on the results that 60% students included in the poor category. Science process skills that are not trained for students consist of 4 skills, namely the skills of formulating hypotheses, controlling variables, designing investigations, and classifying.

The results obtained are different compared to the research conducted by Puspita, Masriani, and Sartika (2015). The results of research conducted on buffer solution practicum, namely (1) students are very good in classifying, writing reaction equations, measuring and observing; (2) students are very lacking in the interpretation and lacking in making hypotheses; and (3) very lacking in skills to formulate problems, determining variables, determining buffer components, and making conclusions [6]. Research was conducted by Puspita, Masriani, and Sartika shown that most aspects of science process skills are examined in a buffer solution practicum and students’ science process skills vary in each aspect. It also indicates that the teacher is able to manage the time in learning to practice aspects of the science process skills as a whole skills.

3.2 Factors that Influence Students’ Science Process Skills
Factors that influence science process skills in acid-base titration practicum based on Ishikawa diagram (Figure 1) divided into four factors, namely materials, tools, people, and method or technical.

![Ishikawa diagram](image)

**Figure 1.** Ishikawa diagram factors that influence students’ science process skills

The two factor that influence science process skills are materials and tools factor. Material factors is affected by the sodium hydroxide (NaOH) as a contaminated solution. Sodium hydroxide is used as titrant or the solution that has known concentration. Lack or excess of NaOH solution are inserted into the burette by using a dropper pipette. An unsterile pipette condition causes NaOH solution to be
contaminated. As a result, students have difficulty when observing color changes at the end point of the titration. The results of this research are in line with the research of Aghisna (2017). Research from Aghisna shown that the dropper pipette used to take the excess from NaOH solution is not yet clean and cause NaOH solution contaminated [7]. Beside that, tool factors that influence science process skills is tools that do not work properly. The main cause of that factor is a leaky tap on the burette. It caused inaccurate variable volumes in the first, second and third experiments. As a result, students have difficulty in titration. According to the theory, the tools used for practicum in the laboratory must be in useable condition, clean, and functioning properly [8].

Human factors that influence science process skills divided into four factors, namely the teacher who reminds the procedure, the initial demonstration by the teacher, the explanation of the material, and the understanding of the students. The procedure reminded by the teacher is how to observe the volume of NaOH solution in the burette properly and how to use universal indicators efficiently. The teacher demonstrates how to measure the volume of the solution with volumetric and burette pipettes, doing titrations, and observing. The results of this study are in line with research by Rahmawati and Astuti (2017) which states that professional competencies possessed by chemistry teachers, especially the ability to master standard material affect students’ skills in learning in the laboratory. The higher the professional competency of the teacher, the higher the student's skills in learning in the laboratory [9]. The student's understanding referred to student's initial understanding of the titration before the practicum conducted. Students can understand the titration practicum because they have sought information by watching the titration practicum video and reading the practicum report. The results of this study are supported by research from Firdausi (2014) which states that student’s initial understanding of the material also plays an important role in influencing student learning outcomes. Good initial student understanding can provide reinforcement to student understanding related to material so it contributes significantly to student activities during learning [10].

Method or technical factors that influence science process skills divided into four factors, namely limited time for practicum, the skills have been trained in the last practicum, the opportunity provided by the teacher to the students to test the tool, and clarity of the information obtained by the students. Practicum is carried out for 2 hours of learning (2 x 45 minutes) so it is not possible to practice the skills of formulating hypotheses, controlling variables, and designing investigations to students at the same time in acid-base titration. In addition, these skills also require special time to be trained. The results of this study are in line with research from Mauliza and Sari which states that the limited of effective time in learning becomes an obstacle during the application of science process skills so the results of science process skills are not applied optimally [11]. The skills that are always trained in 11th grade chemistry practicum are interpreting, concluding, and communicating skills. This causes students to have understood the things that must be done when interpreting, concluding, and communicating the results of experiments. Students are given the opportunity first by the teacher to use a volumetric pipette on aquades before performing a titration. Another method or technical factor that influences science process skills is the clarity of information students get from the teacher. Clarity means how clear and complete the information provided by the teacher regarding the practicum. Clear and complete information was provided during the demonstration as well as in the practicum caused students to be skilled in measuring the volume of the solution with a volumetric pipette and titrations. However, there is also information that is not given clearly and completely by the teacher, namely how to read the volume scale on the burette by using two digits behind the comma and how to make correct conclusions.

4. Conclusion
Based on the research and discussion above, the following conclusions can be drawn.
1. Profile of students’ science process skills at class XI MIPA 3 SMAN 1 Singaraja on acid-base titration practicum was limited to the mastery of the science process skills. Science process skills that have been mastered by students consist of 7 aspects of skills, namely skill to measure the
volume of the solution with volumetric pipette and burette included in the good category with the number of students 100%; the skill to use universal indicator, communication skills, and applying concepts included in the excellent category with the number of students 100%; observing skill, titration skill, and interpreting skill included in the excellent category with the number of students 60%; predicting skills included in the excellent category with the number of students 80%. Skill that is less mastered by students was concluding skills based on the results that 60% students included in the poor category. Science process skills that are not trained for students consist of 4 skills, namely the skills of formulating hypotheses, controlling variables, designing investigations, and classifying.

2. Factors that influence students’ science process skills in the acid-base titration practicum are classified into four factors by Ishikawa diagram, namely (1) material caused by the contaminated solution; (2) the tool caused by a tool that is not work properly; (3) human factors classified into four factors, namely the teacher who reminds procedures, the initial demonstration by the teacher, the explanation of the material, and the understanding of the students; and (4) method or technical classified into four factors, namely limited time for practicum, the skills have been trained in the last practicum, the opportunity provided by the teacher to the students to test the tool, and clarity of the information obtained by the students.

5. Acknowledgement
The author would like to express profound thanks and appreciation to SMA Negeri 1 Singaraja as a place for conducting research, especially for the teacher and student as an object of the research.

6. References
[1] Abungu H E, Okere M I O, and Wachanga S W 2014 J. Educational and Social Research 4 6 359–372
[2] Ozgelen S 2012 J. Mathematics, Science and Technology Education 8 4 283–292
[3] Jack G U 2018 J. Global Research and Higher Education 1 1 80–97
[4] Feyzioğlu B 2009 J. Turkish Science Education 6 3 114–132
[5] Yumuşak G K 2016 J. Education and Practice 7 20 94–98
[6] Puspita D R, Masriani, and Sartika R P 2015 J. Pendidikan dan Pembelajaran 4 9 1–13
[7] Aghisna D 2017 Komparasi Kemampuan Psikomotorik Mahasiswa Reguler dengan PAPK pada Percobaan Titrasi Asam Basa (Pontianak: Universitas Tanjungpura)
[8] Vendamawan R 2015 J. Metana 11 2 41–46
[9] Rahmawati A S and Astuti A P 2017 J. Pendidikan Sains Universitas Muhammadiyah Semarang 5 47–55
[10] Firdausi N I 2014 J. Pendidikan Sains 2 4 193–199
[11] Mauliza and Sari R P 2018 J. Pendidikan Kimia dan Ilmu Kimia 1 1 26–34