Science Process Skills of Pre-service Teacher Through Inorganic Chemistry Practicum Activities

Mellyzar Mellyzar, Ayu Rahmi(✉), and Henni Fitriani

Department of Chemistry Education, Universitas Malikussaleh, Jl. Cot Teungku Nie, Reuleut, Aceh Utara 24355, Indonesia
ayu.rahmi@unimal.ac.id

Abstract. This study aims to analyze the science process skills of students by studying indicators of basic science process skills through inorganic chemistry practicum experiments on the properties of alkaline earth elements. This study uses a quantitative descriptive method. The research sample was 30 students of 2020 chemistry education who took the structure and reactivity of inorganic compounds. Data collection techniques are carried out by observing practical activities. The instrument used was a science process skill observation sheet with a skill score used was a Likert scale. The results showed that the students' science process skills with a percentage of 70.67% were in the high category. The percentage details for each science process skill indicator include the ability to observe and ask questions with a percentage of 77.50% and 75.00% in the high category, respectively. The scores for making hypotheses and planning experiments in the medium category were 58.33% and 62.50%, respectively. The indicator uses practical tools and materials with a percentage of 75.83% in the high category, applying the concepts that have been studied in the high category with a percentage of 70.83%. The indicator scores for classifying and predicting are 80.00% in the high category and 69.58% in the high category, respectively. The students' ability in interpreting data and communicating was 78.33% in the high category and 58.75% in the medium category. Based on these findings, it can be concluded that the inorganic chemistry practicum activities that have been carried out can analyze students' science process skills. This study found several recommendations, first, science process skills must be applied in every science lesson, especially for chemistry education lecturers because it is a major part of the educational curriculum. Second, the science process skills of prospective teacher students must be improved on the indicators of making hypotheses and communicating by being trained intensively in each learning process.

Keywords: science process skill · pre-service teacher · inorganic chemistry · practicum activities

1 Introduction

Education performs an essential function in enhancing human resources [1]. Education can deserve someone, both in the family and society. Other than that, education is a

M. L. Firdaus and A. Defianti (Eds.): MASEIS 2021, ASSEHR 718, pp. 171–177, 2023.
https://doi.org/10.2991/978-2-38476-012-1_23

preparatory effort made by someone to acquire skills, knowledge, and habits in life [2]. Education in Indonesia is organized and needed better development [3]. Development can be done in schools and colleges. The implementation of education in higher education is expected to lead students to develop potential and skills that will be applied in society. The expected skill one of them is science process skills [4]. Science process skill help students to improve a sense of duty in mastering and make bigger a sense of the significance of the approach research in the studying manner [5].

Chemistry is one of the fields of scientific find out about developed primarily based on experiments that seek answers to the questions of what, why, and how natural phenomena, especially these associated to composition, structure, transformation, dynamics, and energetics of components that involve reasoning and capabilities [6]. Chemistry is a science family which can be seen as a manner and a product. Chemistry as a system includes the competencies and attitudes possessed by scientists to gather and improve knowledge. Chemistry as a product consists of a series of knowledge consisting of fact, concepts, and chemical principles.

The practicum technique is a very nice technique for studying chemistry [7]. Objectives from practicum so that students can practice science manner abilities in mastering [8]. Science system abilities are thinking competencies that can answer the demands of mastering following the principles of constructivism and the nature of science learning. [9]. Science procedure capabilities supply meaningful learning to college students and lead college students to greater order thinking [10]. Science procedure abilities are used by students to manner information, solve problems, and make conclusions [11]. In science studying science system skills consist of basic technique competencies and built-in technique competencies [12]. Basic manner competencies include observing, measuring, classifying, inferring, predicting, and others [13]. Science technique competencies belong to the psychomotor area associated with the skills to act after a man or woman receives mastering [14]. Students gain science manner competencies if they can function all indications of science method skills such as observing, classifying, interpreting, predicting, asking questions about a problem, making hypotheses, planning experiments, imposing concepts, and speaking consequences [15, 16]. These abilities can be received via students thru sure science training things to do [17, 18]. Science method capabilities can increase the ability to observe, classify, examine or interpret, predict, research, plan, and talk [19, 20].

2 Method

This finds out about uses a quantitative descriptive approach because this lookup describes descriptively in the form of words according to the determined results, and performs statistical measurements, particularly calculating the proportion of science technique skills. The research was once carried out in the chemical schooling laboratory of Malikussaleh University. The pattern in this find out about were all students of chemistry education who programmed the structure and reactivity of inorganic compounds as many as 30 people. The research was carried out in the ordinary semester of the 2021/2022 tutorial year. The sampling method in this learn about is total. The total sampling approach is a sampling technique if all participants of the populace are sampled [21]. The instrument used is a statement sheet. Data retrieval of students' science

Table 1. The formula for category level of mastery of science process skills

Score Range	Category
Mi + 1.5 SDi < X	Very High
Mi + 0.5 SDi < X ≤ Mi + 1.5 SDi	High
Mi- 0.5 SDi < X ≤ Mi + 0.5 SDi	Medium
Mi - 1.5 SDi < X ≤ Mi - 0.5 SDi	Low
X ≤ Mi - 1.5 SDi	Very Low

Table 2. Category of science process skills

Percentage	Category
81.25 < X	Very High
68.75 < X ≤ 81.25	High
56.25 < X ≤ 68.75	Medium
43.75 < X ≤ 56.25	Low
X ≤ 43.75	Very Low

process skills thru inorganic chemistry practicum things to do in the scan on the homes of the alkaline earth elements. The indicators of science system competencies measured in this find out about are fundamental science procedure abilities which encompass the ability to observe, ask questions, make hypotheses, format experiments, use experimental equipment and materials, follow concepts, classify, predict facts interpretation and talk experimental results. Data about science manner skills have been collected using two observers the usage of a performance appraisal sheet and analyzed descriptively the use of percentages that had been analyzed using Microsoft Office Excel. The percentage of science method competencies is regarded through calculating the score got on the science procedure capabilities indicator divided by the most score on the science system skills indicator. The calculation formulation used to be adapted from Purwanto [22].

Information:

X = Percentage of respondents obtained

Mi = Mean ideal

SDi = Ideal Standard Deviation

Mi = ½ (ideal highest score + ideal lowest score)

SDi = 1/6 (ideal highest score - ideal lowest score)

The vary of values to decide the category of mastery degree science process capabilities is performed by way of deciding the value of Mi and SDi. After the Mi and SDi values are obtained, they are then entered into the method in Table 1. Next, the share cost range of the mastery level of science method skills will be obtained. The proportion price that has been bought is used in deciding the class which can be considered in Table 2.

Table 3. Observation results of science process skills

No	Science process skills indicators	Percentage (%)	Category
1	Observing	77.50	High
2	Asking questions	75.00	High
3	Making hypothesis	58.33	Medium
4	Planning experiment	62.50	Medium
5	Using tools and materials	75.83	High
6	Applying the concept	70.83	High
7	Classifying	80.00	High
8	Predicting	69.58	High
9	Interpreting data	78.33	High
10	Communicating	58.75	Medium

3 Results and Discussion

The results of the observation analysis of student science process skills indicators can be seen in Table 3.

From Table 2, it is known that the value of students' science process skills for each indicator, where the highest value is the classifying indicator with a percentage of 80.00%. Classification is the activity of recording each observation separately, knowing the differences and similarities from the results of the experiments carried out, contrasting characteristics, comparing, finding the basis for grouping or classifying, and connecting the results of observations [23, 24]. Classifying is a skill that can develop students' ability to think logically and flexibly [25]. This indicator shows that students are skilled in classifying the characteristics of experimental data. Students can classify experiments to determine the properties of alkaline earth metals which are most reactive with water. In the experiment of calcium and magnesium metals reacted with cold water data obtained that calcium metal reacts easily while magnesium metal is difficult to react. From this experiment, students were able to compare the reactivity of alkaline earth metals. In an experiment to determine the acid and alkaline properties of alkaline earth metals using solid MgO, Ca $(OH)_2$ and Ba $(OH)_2$ dissolved in water and measuring pH with universal indicators. From this experiment, students can distinguish the strength of acid and base properties of each alkaline earth metal.

The results of the analysis of data interpretation aspects are 78.33% (high) this shows that students are quite skilled in data interpretation, during practicum students can record experimental/observed data, can process experimental data, and can conclude something from the data obtained by true and correct. The indicator observes 77.50% (high). Observation is the activity of gathering relevant facts by using as many senses as possible. The results of the analysis explain that students can collect relevant facts from the results of the experiments carried out. In the indicator of observation skills, students observe practicum activities well, starting from knowing the tools and materials that will

be tested in practicum activities as well as in determining the reactivity of alkaline earth metals, acid and alkaline properties of alkaline earth metals which are determined by paying attention to universal indicator colors. In this indicator, students have observed the observation activities well.

Indicators using tools and materials in practicum are in the high category with a percentage of 75.83% on this indicator students can test the properties of alkaline earth elements on several tools and materials correctly. In the indicator of asking questions the percentage of 75.00% with a high category, shows that students are quite skilled in asking questions. The results of the analysis of aspects of applying the concept obtained a percentage of 70.83% in the medium category, this shows that students are quite skilled in applying concepts, students can apply the concepts they have learned to solve certain problems and explain a new event by using the concepts they have properly and accurately.

Furthermore, in the predicting aspect, the percentage of 69.58% (high) shows that students are skilled in predicting. Prediction is stating what might happen in circumstances that have not been observed by using a pattern of observations. The predictive ability of students can be continuously improved through discussion activities [26]. In addition to discussion of practicum activities, there are also appropriate solutions to improve students' predictive abilities. Previous research stated that science process skills in predicting indicators can be trained with learning activities other than group discussions, namely by practicum activities [27]. On indicators of students' prediction skills, students make predictions that calcium metal is more reactive with magnesium metal. In an experiment when the metal is reacted with water, some students already know that the reaction of calcium is faster than magnesium. The predictions that students can make are following the theory they have learned that the reactivity of alkaline earth metals increases periodically from beryllium to barium.

The indicator for planning a moderate category experiment with a value of 62.50% of students is still confused in determining the tools and materials used in the experiment, determining the variables or determinants of an experiment to be carried out and some students do not know what will be observed and recorded. This is because some students do not study the practical guidelines. The communication skill indicator is in the medium category with a percentage value of 58.75%. Communication is an activity in describing empirical data from experiments or observations to present the results obtained. On the indicators of communication skills, students discuss the experimental results with their group friends and students present the experimental results either directly or in the form of a practicum report. In communicating the experimental results in the report, the report is still not systematic, and in explaining the experimental results cannot be connected with the theory that has been studied. In this indicator, students are still less skilled in presenting the results obtained while in discussions there are still students who do not participate or are not active in discussion activities.

The indicator makes a hypothesis with a moderate category and a percentage of 58.33% on this indicator, students can make assumptions that are considered correct regarding the existence of a factor in a situation, but are less precise in predicting certain consequences that will arise because of these factors. Overall, the students' science process skills measured in the practical activity of the alkaline earth element properties

were in the high category with a percentage of 70.67%. Science process skills can be improved by training students and applying science process skills indicators in the learning process.

4 Conclusion

The conclusion of this research is the percentage of science process skills mastered by students of Chemistry Education at Malikussaleh University in the medium category with an average percentage of 70.67%. The highest indicator classifies 80.00% and the lowest indicator formulates a hypothesis of 58.33%.

Acknowledgment. We would like to thank Research and Community Service Institutions (LPPM) of the University of Malikussaleh for supporting in the completion of this research and also thank all participants in the research.

References

1. Syahrial,S., Asrial, A., Kurniawan, D.A., Nugroho, P.R. Septiasari, Primary RA Prime R, Increased Behavior of Students' Attitudes to Cultural Values Using the Inquiry Learning Model Assisted by Ethnoconstructivism AJournal of Educational Science and Technology EST) **5** pp. 166–175 (2019).
2. Syahrial, S., Asrial, A., Kurniawan, D.A, Chan, F. R., Septianingsih, R. Perdana, Multimedia Innovation 4.0 in Education: E-module Ethnoconstructivism Universal Journal of Educational Research **7** pp. 2098–2107 (2019).
3. Kurniawan, D.A., Perdana. R., Kurniasari, P. Identification of Student Attitudes Toward Physics Learning At Batanghari District High School The Educational Review, USA **2** pp. 475–484 (2018).
4. Elvanisi, A., Hidayat, S., Fadillah, E.N., Analisis keterampilan proses sains siswa sekolah menengah atas Jurnal Inovasi Pendidikan IPA **4** pp. 245–252 (2018).
5. Ongowo, R.O., Indoshi,F.C., Science process skills in the Kenya certificate of secondary education biology practical examinations Creative Education **4** pp. 713–717 (2013).
6. Emda, A., Laboratorium sebagai sarana pembelajaran kimia dalam meningkatkan pengetahuan dan ketrampilan kerja ilmiah Lantanida journal **5** pp. 83–92 (2017).
7. Wiwin, E., Kustijono, The use of physics practicum to train science process skills and its effect on scientific attitude of vocational high school students Journal of Physics: Conference Series **997** 012040 (2018).
8. Harahap, F., Nasution, N.E.A., Manurung, B.,The Effect of Blended Learning on Student's Learning Achievement and Science Process Skills in Plant Tissue Culture Course International Journal of Instruction **12** pp. 521–538 (2019).
9. Novak, J.D., Meaningful learning: The essential factor for conceptual change in limited or inappropriate propositional hierarchies leading to empowerment of learners Science education **86** pp. 548–571 (2014).
10. Tilakaratne, C.T., Ekanayake, T.M, Achievement level of science process skills of junior secondary students: Based on a sample of grade six and seven students from Sri Lanka International Journal of environmental and science education **12** pp. 2089–2108 (2017).

11. Özgelen, S., Students' science process skills within a framework domain cognitive Eurasia Journal of Mathematics, Science and Technology Education **4** pp. 283–292 (2012).
12. Mohan, M. K., Vethamani, R.E., Inculcation of science process skills in a science classroom. Asian Social Science **9** pp. 1911–2025 (2013).
13. Anwar, R.Y., Profile of science process skills of preservice biology teacher in general biology courses. Journal of Physics: Conference Series **1006** 012003 (2018).
14. Sagala, Konsep dan Makna Pembelajaran Bandung: Alfabeta (2013).
15. Bell, T., Detlef, U., Sascha, S., Rolf, P., Collaborative inquiry learning: Models, tools, and challenges international journal of science education 32 pp. 349–377 (2010).
16. Dimyati, D., Mujiono, M., Belajar dan Pembelajaran Jakarta: PT Rineka Cipta (2009).
17. Hopper, K., Reasons to go hybrid Distance Education Report **7** p. 7 (2003).
18. Harlen, W., Purposes and procedures for assessing science process skills Assessment in Education **6** pp. 129–140 (1999).
19. Sumantri, M., Perman, J., Strategi Belajar Mengajar Bandung: CV Molana (2001).
20. Hamalik, O., Kurikulum dan Pembelajaran Jakarta: PT Bumi Aksara (2008).
21. Creswell, J.W., Research Design: Qualitative, Quantitative, and Mixed Methodd Approaches (California: SAGE Publication, Inc) (2014).
22. Purwanto, M.N., Prinsip-prinsip dan teknik evaluasi pengajaran Bandung: PT Remaja Rosdakarya (2013).
23. Darmaji, D., Kurniawan, D.A., Astalini,A., Heldalia, A., Analisis Keterampilan Proses Sains Siswa Pada Materi Pemantulan Pada Cermin Datar Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan **5** pp. 1013–1019 (2020).
24. Poppe, R., A survey on vision-based human action recognition Image and vision computing **28** pp. 976–990 (2010).
25. Lestari, P., Ristanto, R.H, Miarsyah, M., Analysis of conceptual understanding of botany and metacognitive skill in pre-service biology teacher in Indonesia Journal for the Education of Gifted Young Scientists **7** pp. 199–214 (2019).
26. Nelyza, F., Hasan, M., Musman, M., Implementation of the discovery learning model on the reaction rate material to improve science process skills and social attitudes of MAS Ulumul students Qur'an Banda Aceh Indonesian Journal of Science Education **3** pp. 14–21 (2015).
27. Anggereini, E., Septiani, M., Hamidah, A.. Application of guided inquiry learning model in biological learning: it's the influence to science process skills and students' scientific knowledge in class XI MIPA high school Journal of Physics: Conference Series: **1317** 012179