Analysis of Student Science Process Skills in The Practicum of Physical Chemistry Based on Linguistic and Interpersonal Intelligence

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Article Info	Abstract
	This study aims to determine the level of mastery of science process skills in physics chemistry practicum students based on linguistic and interpersonal intelligence. This research was conducted with a quantitative descriptive method. This research was conducted with a quantitative descriptive method. The respondents of this study were 66 students of the 2017 class of chemistry study program consisting of two classes. The data collection technique is done by interview, observation, documentation, and test. This research was conducted in the physical chemistry laboratory of the Department of Chemistry, Universitas Negeri Semarang. The research results obtained were the percentage of science process skills of students of the 2017 batch of chemistry study program students. The result of the percentage of science process skills in class 1 students is an indicator of formulating hypothesis with a percentage 74.26%, interpreting data 73.53%, and asking question 77.57%. The result of the percentage of science process skills in class 2 students is an indicator of formulating hypothesis with a percentage 71,88%, interpreting data 74.22%, and asking question 72.27 %.

INTRODUCTION

Humans are created with various characteristics, one of which is intelligence. Every individual has different intelligences (Prameswari *et al.*, 2019). Gardner (2003) has divided intelligence into eight types of intelligence. The intelligences include: linguistic intelligence, logical mathematical intelligence, visual intelligence, kinesthetic intelligence, musical intelligence, interpersonal intelligence, intrapersonal intelligence, and naturalist intelligence. In the learning process, an educator must pay attention to each intelligence possessed by students so that their potential intelligence can be maximally developed, to improve 21st century skills.

According to Bybee (2013) the skills needed in the 21st century include: adaptation skills, communication and social skills, problem solving skills, self-management skills and self-development, systems thinking. One aspect of self-management skills is knowing the dominant multiple intelligences possessed by individuals. Individual differences in students in the world of education are important things that need to be considered. Multiple intelligence and learning styles need to be optimized to generate motivation, joy and positive emotions for students to achieve (Amalana *et al.*, 2013). Learning that is presented in a fun, positive and challenging atmosphere can increase student understanding (Noor & Wilujeng, 2015; Wilson, 2018). According to Julia (2007), the theory of multiple intelligences is an approach that takes into account differences in individual intelligence. The theory of multiple intelligences not only recognizes these individual differences for practical purposes, such as teaching and assessment but also considers and accepts them as normal, natural, even attractive and very valuable. This theory is a giant step towards a point where individuals are valued and diversity is cultivated.

Linguistic intelligence is the ability to use words effectively, both spoken and written. This intelligence includes the ability to manipulate the syntax or structure of language, phonology or sounds of language, semantics or language meaning, and the pragmatic dimension or practical use of language (Armstrong, 2013). Students' linguistic intelligence is facilitated by the presence of an oral pretest, writing experimental reports and presenting the results of the experiment in front of the class. Based on data analysis on the multiple intelligences test on students, it was obtained that class 1 student data had an average linguistic intelligence value of 10.83% and class 2 is 11.55%.

According to Syurfah (2017), interpersonal intelligence involves the ability to understand and cooperate with others, from the ability to empathize with others, to the ability to manipulate a large group of people towards a common goal. Practical learning makes the learning process more lively and meaningful for students (Sukaesih, 2011). Physical chemistry practicum is carried out in groups with 2-3 students, so the practicum can facilitate students' interpersonal intelligence. Based on data analysis on the multiple intelligences test on students, it was obtained that class 1 student data had an average interpersonal intelligence of 15.71%, while class 2 is 14.30%.

Learning activities that can facilitate all types of intelligence possessed by students are learning activities in the laboratory or practicum. According to Novianingsih (2017), activities in the laboratory have the aim of teaching students process skills in the laboratory and understanding chemical concepts through practice. Based on the opinion of Nelson (1998), Demïrcïoğlu and Yadigaroğlu (2011), practicum has an important role in science education because it can improve students' abilities in direct activities in the laboratory. Chemistry is a subject that cannot be separated from laboratory activities. While the experiment according to Irwanto *et al.* (2017) is a way of teaching that involves students doing an experiment about something, observing the process and writing the results of the experiment, then the results of the observation are made a report and submitted to the class and evaluated by the lecturer. Therefore, laboratory skills are very important for students to realize the profile of a chemistry graduate.

One of the profiles of chemistry program graduates is to become a skilled and professional chemical analyst. Students are given laboratory skills through practicum activities, one of the practicum that supports student skills in the laboratory is the physics chemistry experiments. One of the skills that is suitable to be applied to the physics chemistry lab is science process skills (SPS). Sukarno *et al.* (2013) stated that SPS is a physical and mental skill related to the basic abilities possessed, mastered, and applied in a scientific activity, so that scientists can find something new.

According to Semiawan *et al.* (1985), SPS is very important for students, not only in the process of learning science but also having a positive impact on student life in the future. Sukarno *et al.* (2013) argues that by developing SPS, students will be able to discover and develop their own facts and concepts as well as foster and develop the attitudes and values required. Learning activities in class should be

carried out as chemical concepts are found. This will allow chemistry to be conveyed to students in a more real way, thereby increasing their thinking skills, scientific attitudes and scientific skills (Fitriana *et al*., 2019).

SPS are categorized into basic SPS and integrated SPS. According to Devi (2010) and Yildirim *et al*. (2016) basic SPS indicators include: observation, measurement, predicting, classifying, and communicating. Meanwhile, the integrated SPS indicators are controlling variables, defining operationally, formulating hypotheses, interpreting data, conducting experiments, and formulating models (Cruz, 2015). Meanwhile, indicators of science process skills according to Sukarno *et al*. (2013) and Antrakusuma *et al*. (2017) namely observing, classifying, predicting, asking questions, hypothesizing, planning experiments, using tools and materials, applying and communicating. This study uses the three SPS indicators described by Sukarno *et al*. (2013), Cruz (2015), and Antrakusuma *et al*. (2017) namely the skills of formulating hypotheses, interpreting data, and asking question.

Based on the explanation above, the researcher wants to conduct research on the analysis of student science process skills in physics chemistry practicum based on linguistic intelligence and interpersonal intelligence.

METODOLOGY

This research is a type of quantitative descriptive research carried out at the Chemical Laboratory of FMIPA UNNES. Respondents in this study were 66 students of the 4rd semester of the Chemistry Study Program which were divided into two groups. Respondents are students of the 2018/2019 academic year who are taking the Physical Chemistry practicum course. Physics chemistry practicum which is carried out uses a multiple intelligence approach, by facilitating two types of intelligence, namely linguistic intelligence and interpersonal intelligence. The observed SPS indicators were formulating hypotheses, interpreting data, and asking question. SPS data is obtained from performance appraisal in the lab title, namely reaction rate determination and reaction rate settings.

RESULT AND DISCUSSION

The results of this research are in the form of data on the skills to formulating hypotheses, interpreting data, and asking question. This experiment was held in two meetings, namely assistance and practice. During assistance, the lecturer provides a general explanation regarding the title of the experiment to be carried out, while the tools, materials and methods of work are explained by the assistant, students also learn how to use the tools and materials.

Reaction rate determination and reaction rate settings are very important to be given to students multiple intelligence approaches. This is because experiments to determine the reaction rate and reaction rate constant are very important for students because they are related to everyday life. The example reaction rate in our daily life: cookies bake faster at higher temperatures, bread dough rises more quickly in a warm place than in a cool one, and low body temperatures slow down metabolism. In previous practicums, students carry out a written pretest, there is no assistance, there are no discussion sessions, and experimental tools and chemical solutions have been prepared by the laboratory assistant. Therefore, physical chemistry practicum based on linguistic and interpersonal intelligence is a solution to the problems mentioned above.

Student linguistic intelligence is honed during oral pretest. Oral pretest is used to determine students' prior knowledge before practicum is carried out. Lecturers and practicum assistants can also straighten out if there is a student understanding that is not correct. Students' linguistic intelligence needs to be facilitated so that students will have good communication skills. Communication skills are needed by students to compile reports and present practicum results. Students with linguistic intelligence are interested in things related to social media, remembering famous quotes or words, writing, doodling and composing (Prameswari *et al*., 2019).

Interpersonal intelligence consists of the stages of gathering basic knowledge, the stage of accepting friends 'input and equating their own opinions, then information analysis and processing, namely the stages of connecting friends' opinions with their own opinions to equalize conceptual understanding in group work, and the stages of higher-order thinking and reasoning are the stage of concluding and developing discussion results to develop research and identify opinions in the form of questions (Lazear, 2004).

Figure 1. Students cooperate in practicum groups

Interpersonal intelligence is one of the intelligences that dominates the implementation of practicum because practicum is carried out in groups with two to three students in each group. With a small number of group members, the division of practicum tasks must be done as well as possible so that the practicum runs effectively and efficiently. Students who have interpersonal intelligence have characteristics like to work in groups, like to help friends in a group, and have good communication skills (Nisa *et al.*, 2019).

The measured aspects of SPS are formulating hypothesis, interpreting data, and asking question. The development of the average student SPS in each aspect is presented in Figure 2.
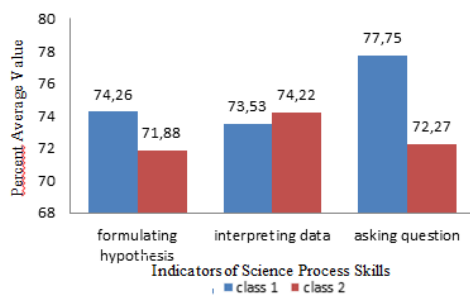

Figure 2. Average score of science process skills indicators

The aspect of science process skills observed during the pretest is to hypothesize. Students hypothesize by solving problems, because in the formulation of a hypothesis there is usually a way to test it (Rustaman *et al.*, 2005). When students make hypotheses, students are given the opportunity to build knowledge about the concepts being taught (Sudarmin *et al.*, 2018). This experiment shows that the reaction of ethyl acetate lathering by hydroxide ions is a second order reaction. Students also determine the rate of reaction. Hypotheses state the relationship between two variables, or propose an estimate for the cause of something happening. In this experiment, students proposed a hypothesis that the volume of NaOH tended to increase in proportion to the mixing time.This is because the longer the NaOH and ethyl acetate solution are mixed, the more NaOH titrant is needed to

neutralize the remaining HCl. The science process skills in the hypothetical aspect of the student class 1 in experiment 2 obtained a value of 74.26%, (high), while the science process skills in the hypothetical aspect of class 2 students obtained a value of 71.88%, (high).
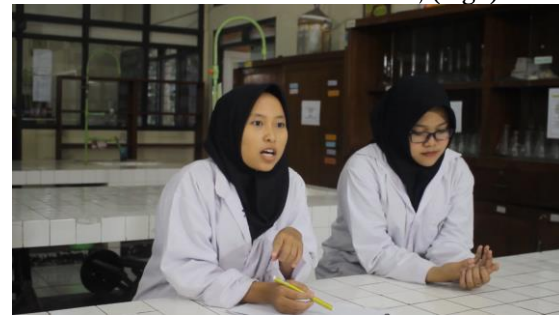

Figure 3. Students submit experimental hypotheses when answering oral pretest questions

Students then interpret the results of their observations on this experiment that had been carried out. Observations are useless if they are not interpreted. Therefore, from observing directly, then recording each observation separately, then connecting the results of those observations. The science process skill in interpreting the data for class 1 students in this experiment was 73.53% (high), while class 2 students were 74.22% (high). Individuals who have linguistic intelligence tend to have better communication skills than others (Amin, 2018). This is supported by the opinion of Agustina and Saputra (2016) which states that the ability to communicate is indispensable because humans interact with other humans through communication, either verbally, in writing, pictures, or through impressions.

Figure 4. Students Interpret Experiment Result Data

Figure 4 shows the students' ability to interpret data. Students carry out presentations in front of the class and interpret the data from their observations. Data analysis results can be in the form of graphs or curves. The ability of students to interpret data is very good, increasing from experiments 1, 2, and 3. This shows that students have understood the experiments that have been carried out, and are able to convey the results of their experiments to others.

According to Ango (2002) and Lepiyanto (2014) the emergence of student curiosity led to the emergence of indicators of science process skills in the form of asking questions., asking questions is one of the most commonly used science process skills. According to Zobisch *et al.* (2015) educators believe that to thrive in the 21st century, students must ask questions, challenge assumptions, and find new ways to solve problems, relate new knowledge to already known information, and apply their reasoning skills to new situations.

Figure 5. Students asking questions in a discussion session

The questions that emerged from the students indicated that the students felt involved and the lessons felt more alive. Students have an excellent ability to ask questions. This can be seen from the large number of questioners who asked questions during the question and answer session during presentation activities. This is consistent with research by Kirch (2007) in Fitriyani *et al.* (2017) stated that discussion activities can improve student skills in asking questions. If students are used to asking questions, students have the ability to think critically (Visilia, 2015).The aspect of science process skills asking questions to class 1 students in experiment was 77.57% (high), while class 2 students were 72.27% (high).

Wardani and Susilogati (2015) research shows that activities in the laboratory can improve students' interpersonal intelligence. Besides communicating, interpreting data, and asking questions related to students' linguistic intelligence. Science process skills can be improved by doing practicum (Winarti & Nurhayati, 2014). However, the practicum is carried out not only to find a result, but to make students better understand the experiment (Nuzulia *et al*, 2017). According to Wardani and Susilogati (2015), laboratory activities carried out continuously will become a habit to develop self-potential to be more optimal.

The results of this study indicate that the physical chemistry practicum based on linguistic and interpersonal intelligence can develop students' science process skills. This is in accordance with the research of Wulandari *et al.* (2013) and Winarti *et al.* (2019), who stated that learning and practicum using the multiple intelligences approach can improve students' science process skills..

CONCLUSION

The result of the percentage of science process skills in class 1 students is an indicator of formulating hypothesis with a percentage 74.26%, interpreting data 73.53%, and asking question 77.57%. The result of the percentage of science process skills in class 2 students is an indicator of formulating hypothesis with a percentage 71,88%, interpreting data 74.22%, and asking question 72.27 %.

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