



## Science process skills structure and activity of inorganic compounds reviewing from knowledge of prospective chemistry teachers

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### ARTICLE INFO

Received: 13-11-2021

Received in revised: 18-04-2022

Accepted: 25-04-2022

Available online: 30-4-2022

### KEYWORDS

Chemistry Teachers;  
Structure and Reactivity;  
Inorganic Compounds;  
Science Process Skills

### ABSTRACT

The purposes of this study is to make it easier for students to understand a material and improve students' process skills, thus making students more interactive. The learning process is carried out in groups, interactively, formulates problems, and evaluates gaps in their knowledge, studies and searches for materials related to problems and solutions to these problems. Then students can ask questions, and determine answers to questions that are excluded from everyday experience. Then they also have the ability to describe, explain and predict natural phenomena in the structure and reactivity of inorganic compounds. This study is a quantitative-research with pre-experimental One-Shot Case Study research with the research target of 7<sup>th</sup> semester students of chemistry education study program who are prospective chemistry teachers. This study uses a rubric test in the form of description questions. The results showed that the results of students' sciences process skills on the structure and reactivity of inorganic compounds had reached the percentages obtained by students on the criteria of observing, classifying, measuring, communicating, predicting, and drawing verbal conclusions, namely 87.50%, 88.75 %, 83.75%, 93.75%, 85%, and 91.25%. So that the average percentage of these criteria is 87.75% with a score of 3.51. With the results obtained, prospective chemistry teachers can improve the learning of science process skills and increase mastery of basic concepts of inorganic chemistry, especially on the material structure and reactivity of inorganic compounds.

### INTRODUCTION

The development of increasingly sophisticated science and technology requires lecturers to be more creative in the learning process (Asmorowati et al., 2021; Hikmawati et al., 2021; Mandasari et al., 2021; Rusmini et al., 2021a, 2021b; Wahyudiati, 2021; Yantoro et al., 2021). This needs to be done so that students are able to play an active role in these activities so that they can have a good impact on their learning outcomes (Juniar et al., 2021; Okafor, 2021; Rusmini et al., 2021a, 2021b). However, the learning process tends to be boring because of the lack of information about the applicative benefits of the learning which results in students participating in learning but being passive (Kurt & Sezek, 2021; Okafor, 2021). Policy of the Ministry of Education and Culture to realize the objectives of national education where the golden generation towards superior Indonesian society the future is achieved (Setiawan and Sugiyanto, 2020). Education should focus on promoting the ability of learners to produce works contex-

tually, either individually or in groups so it is advisable to apply a learning approach based on scientific approach (*scientific*). Chemical learn everything about the substance that covers the composition, structure, properties and changes in substances that involves skill and reasoning so that learning chemistry must pay attention to the characteristics of chemistry as attitudes, processes and products (Asmah et al., 2021; Juniar et al., 2021; Okafor, 2021; Wahyudiati, 2021). In chemistry it is not only about calculations, but in chemistry it is taught to experiment in providing direct learning experiences and being applied in everyday life (Asmorowati et al., 2021; Awaliah & Ikhsan, 2021; Hikmawati et al., 2021; Nurfidayanti & Yonata, 2022; Paembonan & Ikhsan, 2021; Rusmini et al., 2021b).

Characteristics of chemistry requires prospective chemistry teachers to present learning through a scientific approach so that in the implementation of learning they can provide a learning experience by developing scientific skills

(Juniar et al., 2021; Okafor, 2021; Rusmini et al., 2021a; Wahyudiati, 2021). One of the courses within the scope of chemistry is the structure and reactivity of inorganic compounds in which this course discusses the basic concepts of inorganic chemistry (Hikmawati et al., 2021; Rusmini et al., 2021a; Tahya et al., 2022). By studying this course, the expected achievement is that students are able to determine the character of inorganic compounds, explain the structure of inorganic compounds, explain the nomenclature of inorganic compounds, explain the reactivity of inorganic compounds, explain the extraction process of inorganic compounds and can apply inorganic compounds in solving problems (Asmah et al., 2021; Nurfidayanti & Yonata, 2022; Paembonan & Ikhsan, 2021).

Science process skills are one of the scientific approaches that can be used in learning chemistry. Science process skills are defined as mental, physical, and competence abilities that are used as tools needed in effective science learning (Hikmawati et al., 2021; Khotimah et al., 2021; Rusmini et al., 2021a; Wahyudiati, 2021). Science process skills include observing, clarifying, communicating, measuring, predicting, and inferring (Kriswantoro et al., 2021; Rofieq et al., 2021). In other words, science process skills can be interpreted as an approach in learning that emphasizes mastery of concepts and solving chemical problems experienced by students in everyday life. In addition, Science process skills also reflects the behavior of scientists in classifying science (Azimi & Soleimani, 2021; Wahyudiati, 2021).

Based on the explanation above, the efforts of teachers as educators have an important influence on the success of an education, teachers with wider teaching experience have better pedagogical knowledge and content than teachers with less teaching experience (Setiawan and Sugiyanto, 2020). So that in the learning process teachers need a model as a learning support. Learning will be meaningful if the investigation activities and experiments involving students actively and directly related to learning resources science (Wahyuni et al., 2017). With the use of learning models can make it easier for students to understand a material and improve students' process skills. In improving students' process skills and making students more interactive, an appropriate learning model is needed.

One of the learning models that can be used is PBL (*problem-based-learning*). The PBL learning model is a learning process that has characteristics beginning with the provision of problems related to reality (Distyasa et al., 2021; Ichsan et al., 2019; Kaharuddin, 2019; Maulidia et al., 2020; Mulyono et al., 2019; Pratiwi et al., 2020; Reinsini et al., 2021; Siregar et al., 2020). The learning process is carried out in groups, interactively, formulating problems, and evaluating gaps in their knowledge, studying and searching for materials related to problems and solutions to these problems (Aslan, 2021; Mann et al., 2021; Sri,

2021; Suhirman et al., 2021; Suparman et al., 2021; Uliyandari et al., 2021). Then students can ask questions, get, or determine answers to questions that are excluded from everyday experience. Then they also have the ability to describe, explain and predict natural phenomena (Turiman, et al. 2012).

## LITERATURE REVIEW

### Science Process Skills Process

Skills are the steps that must be taken by an individual or group in finding and processing the results obtained to then be used as knowledge for themselves (Khotimah et al., 2021; Mandasari et al., 2021; Rusmini et al., 2021b; Wahyudiati, 2021). Process in an activity or activities related to science dangan called science process skills (Science Process Skills) (Zulaeha, Darmadi, I, W, & Werdhiana K, 2014). Science process skills are abilities possessed by students or students in applying scientific methods in understanding, developing science and discovering natural science based on observations of what a scientist has done (Awaliah & Ikhsan, 2021; Ernawati et al., 2021; Kriswantoro et al., 2021; Sideri & Skoumios, 2021). This is in line with the opinion (Syaputra, A, 2016) who said that Science Process Skills are scientific skills used to find concepts or theories to develop existing concepts and to understand what phenomena occur.

Based on the above understanding the role of science skills in a teaching and learning process is very important to achieve learning success. Science skills in students will be very useful for these students not only as a process for building knowledge and learning but also useful in everyday life, so science skills are very important in owned by students as a provision and training in dealing with the realities of life in the community to solve a problem that exists in the community.

### Components (Indicators) of Science Process Skills

Zulaeha, (2014) says that components of the scientific process skills consists of: 1). Observing skills, namely by finding as many sources of information as possible Using relevant facts, 2). Grouping, namely recording each observation, looking for differences/ similarities, comparing, grouping and connecting observations, 3). Interpreting is connecting patterns in a series of observations, 4). Predicting is using the results of observations and finding out what happened to the conditions before being observed, 5). Asking questions, namely asking questions regarding the background and hypotheses, namely knowing the possibilities that occur in the results of the study, 6). Proposing a hypothesis, namely knowing that there is more than 1 possible explanation of an event, 7). Planning an experiment is to determine the

tools and materials to be used and to design work steps, 8). Sing tools/materials/ sources, namely knowing the reasons for using tools and materials and how to use them, 9). Applying the concept is using the concept in a new situation to explain what is happening, 10). Communicating and carrying out experiments, namely conveying the results of the report systematically in the form of explanations and discussing the results of the report.

The statement above is in line with the opinion of the Minister of Education and Culture of the Republic of Indonesia No. 59 in (Desideria, S, at al 2017) says that the indicators of science process skills include observing, grouping. Interpreting, predicting, asking questions, formulating hypotheses, planning experiments, using tools/materials, applying concepts, and communication. These skills can be developed by conducting practicals or also called experiments.

### Benefits/Advantages of Science Science

Skills Process Skills are also defined as skills that must be developed in students (Zulaeha, Darmadi, at al, 2014) Several reasons why KPS (Science Process Skills) must be developed in the scope of students and must be owned by students, namely (1) Science consists of three aspects, namely product, process and attitude. By using Science Process Skills of the students will understand how the laws, theories, and formulas that have existed previously are formed through experiments; (2) science change over time. Based on this, it is no longer possible for educators to teach all concepts and facts to students from so many courses. Students need to be equipped with skills that can help students to explore information from several sources, not only from educators; (3) students will understand complex and abstract concepts better if they are accompanied by concrete examples; (4) students will have a deep and brilliant understanding of the subject matter and encourage students to be more active in learning (Zulaeha, Darmadi, at al, 2014).

The benefits of developing science process skills, students (*learners*) will be able to find and develop their own facts and concepts, and be able to develop the attitudes and values required (Desideria, at al 2017). In addition, Science Process Skills can encourage students to think critically, science process skills are very important for meaningful learning because they will continue in everyday life for students (Ratnasari, at al, 2017).

Based on the above opinion, it can be concluded that science process skills have advantages, including: 1). Implementation can change the knowledge of students so that the theoretical concepts learned are more complete, 2). Can familiarize students with relating learning to natural knowledge so that students can practice and prove what is learned according to theory or not, and 3). Can increase the

attractiveness of learning for students to learn by involving students in science process skills.

### Structure And Reactivity of Inorganic Compounds

Structure and reactivity of inorganic compounds is part of inorganic chemistry which discusses the structure, properties, reactivity and relationship of chemical elements with their compounds involving quantum mechanics and examines the interaction between inorganic compounds and electromagnetic waves to study the structure

### METHODS

This study is a quantitative-research with pre-experimental One-Shot Case Study research with the research target of 7<sup>th</sup> semester students in academic year 2021-2022 of the Department of Chemistry Education Universitas Malikussaleh who are prospective chemistry teachers.

The research design used, that is:



#### Description:

X = learning using the Problem Based Learning model

O = Evaluation of students' science process skills

The assessment score used to measure the science process skills of prospective chemistry teachers refers to the science process skills topic based on the 2013 curriculum assessment, which is in the range of 4-1.

### RESULTS AND DISCUSSIONS

The study of the structure and reactivity of inorganic compounds discusses the basic concepts of inorganic chemistry. Science process skills were analyzed using the data obtained in the form of an assessment score from the description questions that had been answered by students at the end of the lesson. Science process skills learning activities are carried out in odd semesters by using instruments in the form of questions containing components of science process skills. This activity is carried out to explore the extent of the ability of prospective chemistry teachers. The material presented is an instrument of description questions provided by the educator. The teacher will provide a description of the questions as an initial meeting. In this question there are components of the scientific process, namely observing, classifying, measuring, communicating, predicting, and drawing conclusions. At the last meeting, questions were given posttest. The percentages obtained by students on the criteria of observing, classifying, measuring, communicating, predicting, and drawing verbal conclusions are 87.50%, 88.75%, 83.75%, 93.75%, 85%, and 91, 25%. So that the average percentage of these criteria is 87.75% with a score of 3.51.

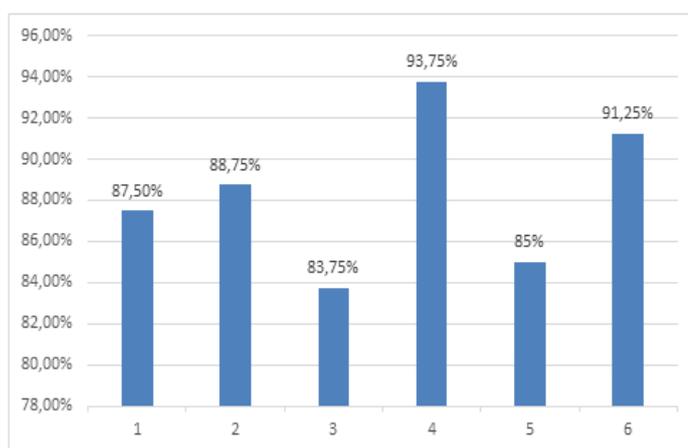


Figure 1. Results of the Post-Test Score

Based on the results obtained, for prospective chemistry teachers through the Problem Based learning model, they can improve the learning of science process skills and increase the mastery of basic concepts of inorganic chemistry, especially on the material structure and reactivity of inorganic compounds.

## CONCLUSIONS

Based on the research objectives and discussion in this study, it can be concluded that the science process skills of students who were trained, namely formulating problems, formulating hypotheses, controlling variables, collecting and processing data, analyzing and interpreting data and drawing conclusions have been trained well through cooperative learning models. This is evidenced by the average score on each indicator 2.67. As many as 100% of students were said to be complete at the first meeting until the third meeting for the learning outcomes of science process skills and the average score of students at the first to third meeting in a row was 3.20; 3.62; and 3.55. With these results, prospective chemistry teachers through the PBL model can improve learning science process skills and increase mastery of basic concepts of inorganic chemistry, especially the material structure and reactivity of inorganic compounds.

## Acknowledgement

Thank you to the Institute for Research and Community Service (LPPM), Malikussaleh University for the support of the 2021 PNPB funding service.

## Author's Contributions

All authors discussed the results and contributed to from the start to final manuscript.

## Conflict of Interest

The authors declare that they have no competing interests.

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