

Analysis of Student Problem-Solving Ability Through Field Study in Chemistry Education Study Program

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ABSTRACT

This study's purpose is to analyze student problem-solving based on field study. The subjects are chemistry education study program 3rd year or semester 5 class B consisting of 9 students, Manado State University. The subjects that be held are Population and Environmental Education Subjects. This study is descriptive qualitative research. This research consists of two steps, planning and implementation. The study used a purposive sampling. The data were obtained from problem-solving questions tests, papers, presentations, and discussions with question-answers. The results showed that the problem-solving analysis test got 74% and it can conclude that students' problem-solving ability is high. The research results showed that we could analysis the problem-solving ability of students using field studies methods in lectures.

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INTRODUCTION

Education is a nation's progress indicator. According to the National Education System of 2003 number 20, the national education's goal is to develop the potential of students to become human beings. Improving the quality of education is related to improving the quality of human resources as the basic capital for national development (Undang-undang No. 20, 2003). Quality of education determines the quality of graduates or human resources. Education not only increases students' knowledge but also to achieve learning competency or learning outcomes. Education consists of three parameters, which are affective aspects, cognitive aspects, and psychomotor aspects (Saputri et al, 2024). Education can build the nation's next generation who are superior and able to compete with other countries (Damianti et al, 2022).

We have entered the Industrial Revolution 4.0 era. Rapid technological developments characterize this era. The increasingly rapid development of technology cannot avoid its influence on the world of education. The global era requires adapt to technological developments that brought the progress of the world of education. The development of learning methods has also made much progress, in both personal learning methods and media in the learning process (Dwipayana et al, 2020).

Developments in the 21st century have brought changes to the national education curriculum. Currently, students are required to have critical thinking skills, problem solving, creative thinking and cooperative work skills (Dilekci et al, 2023).

The problem-solving abilities are the most important cognitive activities that can be used in daily life (Fatma et al, 2019). In educational teaching-learning, student's problem-solving ability is also necessary. When the students get knowledge from the teacher's explanation, they will forget easily because they aren't directly involved. The students will easily understand if they are given examples and allowed to try to solve problems (Sulistyowati et al, 2012). Problem-solving ability is one of the teaching-learning goals. This has to be achieved by students in teaching-learning activities in school or university. Problem-solving ability is a person's efforts to achieve goals because they do not have an automatic solution that can immediately solve the problem (Suryani et al, 2020).

Problem-solving is a process or individual effort to respond to or overcome obstacles when an answer or method of answering is not yet clear. Routine questions are questions that are ordinary exercises that can be solved using procedures that are commonly used, while non-routine questions are questions that require further thought to solve because the procedures are not as clear as routine questions or in other words, non-routine questions present new situations that have not yet been solved. In the new situation in question, there is a clear goal to be achieved but the way to achieve it does not immediately appear in the students' minds (Umrana et al, 2019). Problem-solving ability is a skill or potential within a student so that he can solve problems and apply them in everyday life. So, it can be concluded that problem-solving ability is a basic ability in the learning process. In the learning process, teachers must be able to stimulate students' creativity in solving a problem. Problem-solving abilities are very important for students because by being able to solve a problem students gain experience, and use the knowledge and skills that students already have to apply in everyday life (Suryani et al, 2020).

Several stages can be carried out to solve the problem. The stages in problem-solving are understanding the problem, planning a solution, implementing the plan, and looking back the solution. Students have a good problem-solving skills if they can go through all stages of problem-solving. These problem-solving stages are used as a basis or indicator for knowing and measuring students' problem-solving abilities in teaching-learning activities (Amaliah et al, 2021). Problem-solving abilities are closely related to students' confidence in solving problems because the confidence students have in solving problems will influence student learning outcomes (Utami et al, 2017).

The concept of problem-solving analysis is giving attention to something (objects, facts, phenomena) to the point of being able to break it down into parts and recognize the relationship between these parts in the whole. Problem analysis is the ability to recognize the elements of the situation in the problem and understand which components are critical; the ability to recognize the critical activities being carried out - to be able to sequence the process of these activities into several activity components. In every area of a person's life, there are bound to be some problems that arise either because of mistakes made in the past or even because of mistakes that are not our own. Therefore, we need to analyze a situation or existing problem to find the best way to handle the problem.

The main basic concepts in improving our ability to analyze problems and situations are:

1. Clarifying the problem.

In solving problems, the first thing we have to do is pay attention to the surrounding environment if there is something that is not right that could cause problems to arise. Doing what we know so as not to cause bigger problems when we are faced with problems we don't know yet. Look for missing information from the surrounding conditions and try to gather as much information as possible regarding the problem or condition that is felt to be incorrect.

2. Decide how to solve the problem.

After getting information about the conditions around us, when something is strange and has the potential to cause a problem, as quickly as possible we must find a way to deal with it properly so that the problem that arises does not become bigger. Understanding existing problems and conditions critically and in detail is very necessary at this stage. We don't just have to think about ways to overcome the problem, we also need to calculate what impacts might arise in handling this problem.

3. Analyze problems and conditions more deeply (Ahmad et al, 2020).

The environment is a spatial unity with all objects, forces, and living creatures and their behavior which influences the continuity of life. The environment can also be interpreted as all objects, conditions, circumstances, and influences that exist in the room we live in and influence living things, including human life (Fakihuddin et al, 2020).

Research by Golami et al, 2021, the case-based learning method was used to measure students' problem solving abilities. The results obtained are that this method can improve students' problem solving abilities. This method is carried out using 3 measurement times, before LBL (pre-test/point 1), after LBL (mid-semester/point 2) and after CBL (final/point 3). Based on the research, the results showed that there was no significant difference in points 1 and 2, however, in point 3, the result was that a significant difference was $P < 0.001$, which is the value of the change in the average score with the student problem solving ability test subscale. This means that on average students' problem solving abilities increased after implementing the CBL method (Golami et al, 2021). Due to the success of the CBL method in improving students' problem solving abilities, in this research, the field study method was used in order to test other methods in learning to analyze students' problem solving abilities. Because this is in line with the mandate of the Minister of National Education of the Republic of Indonesia No. 232/U/2000 that changes to the higher education curriculum in 2020, namely from teacher-centered learning to student-centered learning (Dirjendikti, 2020). Several learning models that can be applied to support the 2020 curriculum are discussions, simulations, case studies, field studies, cooperative learning, project-based learning, and problem-based learning (Mardiyanti, 2022).

Field study is a form of outdoor learning where observation activities occur to reveal facts and obtain direct data in the field. Apart from that, it can provide descriptions, explanations, predictions, innovations, and also educational development. Field Study (Field Research) is collecting data directly in the field using

data collection techniques such as observation, interviews, and documentation. Field study is essentially a method for discovering specifically the reality of what is happening at any given moment in people's lives. Field study is a direct study amidst the hustle and bustle of real situations. So that you will get real problems that need handling or solving. Field research is a data collection method in qualitative research that does not require in-depth knowledge of the literature used and certain abilities on the part of the researcher. Field research is usually carried out to decide in what direction the research should go based on context. Field research is usually held outdoors. It can also be understood that bringing students to the field to carry out field studies or study in the community, helps students to increase their knowledge, especially phenomena or problems that exist in community life, with this also when students carry out field studies either through observation or direct student interviews. Finding information from the public who are informants or respondents which can also be easily digested by students. Based on the research that have been done by Ahmad et al, 2020 showed that the application of field studies in lectures is able to provide students with the ability to analyze problems and even solve problems. This is proven when giving an assignment to look for problems in the surrounding environment and then analyzing them and finding a solution to solve the problem can be solved well, so that students not only receive theory in class but are able to apply it in real life. (Ahmad et al, 2020). So we can conclude that by field study, we can analyze the student's problem-solving ability.

In line with research conducted by Ahmad et al, 2020, the author uses the field study method as a way to analyze student problem solving. From the description, problem-solving ability and field study have a mutually influential relationship and play an important role in achieving learning goals. So the researcher hopes that we can analyze the student's problem-solving ability by doing field study. It is hoped that this research will provide information regarding students' problem-solving abilities so that it can improve the quality of teaching-learning activities and become a solution to improve educational conditions at Manado State University. Thus, this research aims to analyze and describe the problem-solving abilities of students in the 5th semester of the Chemistry Education study program.

METHODS

The study uses a qualitative approach. This study is qualitative descriptive research. The purpose of descriptive qualitative research is to provide an accurate description of the situation and/or phenomenon (Utami et al, 2023). In this research, students' problem-solving abilities were analyzed. The subjects of this research were 9 students in the 5th semester of the chemistry education study program, at Manado State University.

The purposive sampling technique was used in this study. According to Sugiyono, purposive sampling technique is suitable for use in qualitative research. This is due to the purposive sampling technique where samples are taken by considering certain criteria. In this research, senior semester students were considered because it involves an in-depth understanding of chemical concepts to analyze environmental problems and solve them. So with the purposive sampling technique,

conclusions will be obtained in accordance with the objectives of this research (Sugiyono, 2015).

Data collection was obtained using a problem-solving questions essay test. The supporting test in this research used papers, presentations, and discussions with question-answers. The purpose is to obtain more in-depth information regarding students' problem-solving abilities in solving test questions that consist of 5 questions. In this research, field notes are written notes regarding what is seen, heard, thought, and experienced for data collection and data reflection in qualitative research. Checking the data validity uses triangulation by comparing written data from tests, papers, presentations, and discussions with question-answer. The purpose of using this data analysis is as supporting data for the test instrument. By using this data analysis, conclusions will be obtained regarding the explanation of students' difficulties in solving problems. Next, it will be obtained and narrowed down into a solution which we hope can be carried out in further research.

During field studies, students made observations and interviews around Lake Tondano. The interview respondents were the people around Lake Tondano, especially farmers. Field observation is an outdoor study aimed at obtaining data directly in the field. Field observations were carried out to obtain more accurate results. This observation was carried out to prove theory during lecture activities (Nikmah, 2023).

Field study learning invites chemistry education students to make direct observations at Lake Tondano to observe the problems that occur there, one of which is the uncontrolled growth of water hyacinth. From this direct observation, students can understand in depth the problem of water pollution that occurs in Lake Tondano. Meanwhile, for interviews, you need to prepare questions in advance or have a structured interview.

The purpose of this interview is to support observation data and find out the causes of problems obtained from observations. Next, students make a field study report in the form of a paper which will later be presented in class. After students carried out observations, interviews and prepared papers, at the 14th and 15th meetings, they presented their results through presentations.

The results of the discussion accompanied by questions and answers will show students' mindset regarding solving problems that occur in the environment. Analysis was carried out by data reduction, data presentation, and conclusion (Doko et al, 2020). Meanwhile, determining the percentage of achievement of problem-solving abilities is presented in Table 1.

Table 1. Category percentage of problem-solving ability achievement

Percentage	Category
80-100%	Very high
61-80%	High
41-60%	Moderate
21-40%	Low
0-20%	Very low

Source: (Damianti et al, 2022)

The stages carried out in this research are:

1. Planning

Activities that researchers carry out at this stage include: determining the research location, compiling research instruments, validating research instruments, and determining research time.

2. Implementation

First, the lecturer explained the material in a class that was suitable to the syllabus for the subjects that be held. After that, the lecturer gave a field study assignment to students. The field study was held at Lake Tondano. The students have to analyze environmental problems. Lastly, the results of the analysis of environmental problems are then provided with solutions based on the problems found in the form of paper. The students must present the problem that they have found in a teaching-learning activity. The last lecturer gives the problem-solving tests to the students to analyze the student's problem-solving ability.

RESULT AND DISCUSSION

This research aims to analyze the problem-solving abilities of 9 respondents from semester 5 class B chemistry students. This problem-solving analysis using field studies was carried out in the Population and Environmental Education course. The field study was carried out after the mid-semester exam. Before conducting a field study, the lecturer gives the theory in teaching-learning activity in class. After that, the students were asked to do a field study to observe the environmental problem. The students also did interviews with people that lived around the Tondano Lake. Next, they analyzed the problem. The students made papers individually, followed by presentation and discussion with question-answer in class. The last lecturer gave the problem-solving tests to the students that consists of 5 questions. The final stage is for the lecturer to give grades based on the results of the problem-solving test. These results are then interpreted in the form of problem-solving ability results. The stages of analyzing problem solving abilities using the field study method can be seen through the scheme in Figure 1.

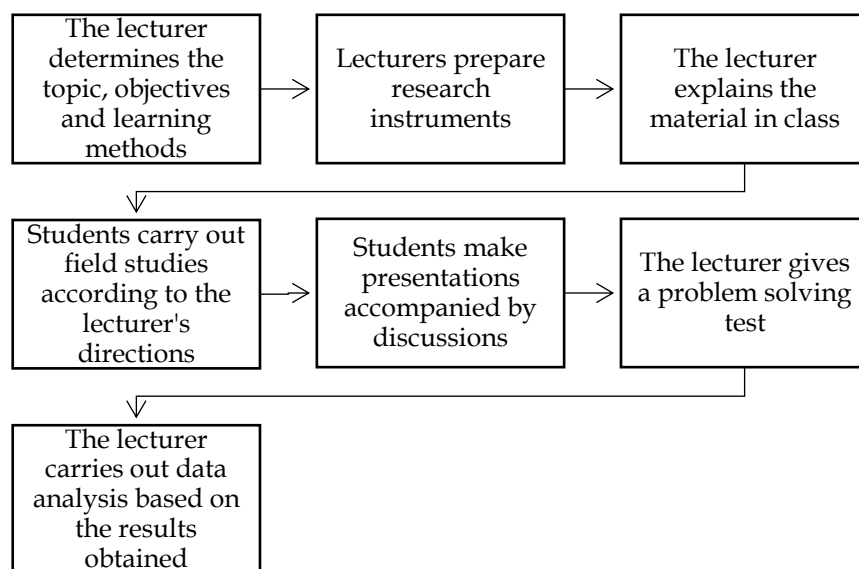


Figure 1. Scheme of the stages of problem solving analysis using the field study method

The application of field studies is a learning method that is suitable for undergraduate students. Students are required to make a final assignment in the form of research. Research is based on existing problems in the surrounding environment, country, or world. Therefore, with field study learning, it is hoped that it can stimulate students' problem-solving abilities. This is in line with research conducted by Ahmad, et al. (2020) which explained that implementing field studies in lectures is a good way or method in the learning process of undergraduate students. Based on the results of this research, it can be explained that the use or application of field studies in lectures can increase student enthusiasm or motivation to learn. Intrinsic motivation to learn is a person's desire to be active or function without waiting for stimulation from outside themselves because within each student there is already a strong will to do something for the sake of it. Intrinsic motivation appears when there is an internal desire to do something for its own sake. Extrinsic motivation to learn is a desire that arises in students because of things or circumstances that come from outside the individual student, thereby encouraging them to carry out learning activities. Apart from increasing student motivation to learn, implementing field studies can also increase understanding of the material presented by the lecturer, especially regarding the theories presented during the learning process in the classroom (Ahmad et al, 2020).

The first data was collected by the results of papers, presentations, and discussions with question-answer. In this case the role of the lecturer as a facilitator is very important. The lecturer's role is to stimulate problem-solving abilities by providing material inducements before students carry out field study activities so that learning objectives can be achieved. The field study was carried out after the mid-semester activities. This activity is carried out for 10 hours (2 hours per week for five weeks). Next, for the next 4 hours before the final semester exam (giving problem solving questions), a presentation and discussion is held about the results of the students' field studies. Four stages of learning have been carried out in order to support data from analysis of student problem solving. This process includes concept maps, learning objectives, multi-scenario field studies, research, problem solving questions, and evaluation and drawing conclusions. The field study process was implemented in the following steps.

- Step 1. The lecturer presents the material briefly to direct students in field study activities. The lecturer gave directions to prepare observation activities at Tondano Lake, prepare interviews with farmers and residents around the lake, and then make a report in the form of a paper. Students clarify and discuss the material presented by the lecturer. Students think and discuss in order to understand the scenario.
- Step 2. Problem analysis: students present the results of detailed field studies in class regarding the water pollution case in Lake Tondano. Lecturers are tasked with providing direction and guidance regarding obstacles, problems and analysis of the results obtained by students.
- Step 3. Discussion and question and answer: this activity is carried out after the presentation ends through the lecturer's direction and guidance. The lecturer presents several questions to analyze students' problem solving abilities. Apart from that, other students are also given the opportunity to ask questions so that

the discussion becomes wider and the problems presented become more diverse.

Step 4. Evaluation, reflection and drawing conclusions: this step is the final assessment carried out by the lecturer and colleagues. The results of step 3 are concluded by the lecturer and the lecturer then provides conclusions regarding the student's problem solving abilities.

The instrument used is a problem-solving ability test. Indicators for problem-solving are listed in Table 2. The last data is taken with a test instrument. The tests given to students are used to collect data on students' problem-solving abilities in Population and Environmental Education courses, especially in material analyzing environmental problems and their solutions. The following is the data on the results of the problem-solving ability test for students.

Table 2. Indicators for problem-solving test

No.	Indicator
1	Identify known elements, asked, and the adequacy of the required elements
2	Formulate the problem
3	Apply strategies to resolve everyday problems
4	Explain or interpret the results according to the initial problem
5	Using knowledge meaningfully

Source: (Amam, 2017)

Table 3. Problem-solving result

Subject	Percentage
S1	90%
S2	65%
S3	88%
S4	78%
S5	62%
S6	50%
S7	85%
S8	80%
S9	68%
Average of Problem-Solving Test Results	74%

Based on research that has been carried out, from the results of data analysis using test questions, it was found that students' problem-solving abilities were classified as high with an overall average percentage of 74%. Based on these results, it can be concluded that the most prominent aspect of student problem solving is when faced with problems in the form of collecting facts which are then drawn to conclusions according to existing concepts and theories. Meanwhile, for questions in the form of unfamiliar cases, it is quite difficult to analyze the solution to the problem.

This research results in line with research conducted by Ahmad, et al. (2020) which explained that with field studies in this lecture, students can prove existing

theories with the reality of people's lives. So the material and theories presented by the lecturer are very easy to digest. The concept of learning using the outdoor learning method has several advantages, including; Students being brought directly into the concrete world of instilling learning concepts so that students can not only imagine the material; The environment can be used at any time and anywhere so it is available at any time, but depending on the type of material being taught; The concept of learning using the environment does not require costs because everything is provided by the natural environment; Easy for students to digest because students are presented with concrete material, not abstract; Students will have more freedom in thinking and tend to think about the material being taught because the material being taught has been presented before their eyes (Ahmad, et al, 2020).

Students' problem-solving abilities can be categorized as high, so further improvement still needs to be done. One way to improve is by training gradually and continuously. The way to do this is by providing various cases with field studies that have a wider scope, for example, Indonesia or even the world. These results are then provided with an analysis of questions with various levels of difficulty. Furthermore, you can also use other learning models such as Problem-Based Learning, Case-Based Method, and Project Based Learning. It is hoped that these methods can analyze and improve students' problem-solving abilities quickly. Further development in this research can be tried by using learning models such as Project Based Learning (PjBL) to analyze problem solving abilities such as research conducted by Hindriyanto et al (2019), which explains that from the results of the study in the discussion it can be concluded that learning is based on project (PjBL) has meaningful benefits for students' problem-solving skills. The benefits that are awakened through project learning activities are critical thinking, creative, spatial skills that are useful for students to carry out problem solving activities. The effectiveness of project-based learning (PjBL) is proven by the difference in average scores between the experimental group who used project learning and the control group who studied using conventional learning (Hindriyanto et al, 2019).

CONCLUSION

Based on the results of research that has been carried out, it can be concluded that field studies are a learning strategy that takes place outside the classroom. Field studies can be carried out by observing the environment and interviewing the adaptations of residents by the students. By implementing field study learning, students can increase their knowledge and experience. The application of field studies can help students learn to understand theory and applications related to environmental problems, especially those that occur in Lake Tondano, analyze the problems, and provide solutions based on the problems found. Apart from that, it also helps provide learning on how to prepare yourself to compose scientific papers and final research assignments later. Implementing field studies, can also build students' memory of the material and theories provided during lectures, in turn creating students who are creative, innovative, think critically, and can find solutions to the problems being studied and provide provisions for the challenges of the future.

The research results conclude that students' average problem-solving ability is high, with a percentage of 74%. Increasing problem-solving abilities can be done

gradually and continuously. What can be done is that lecturers continuously train students to improve their problem-solving abilities by providing a variety of cases.

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