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CASE-BASED METHOD LEARNING DESIGN IN LABORATORY ENGINEERING AND MANAGEMENT COURSES

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Abstract: The study aims to analyze the critical thinking skills of students using the case-based method in teaching-learning activities. The subject that was held was laboratory engineering and management.Thisstudy is motivated by the various problems in the laboratory that were conducted with the teaching-learning material in this course and also related to the student's critical thinkingability to solve the problems in the chemistry laboratory at Manado State University. The subjects were chemistry education study program 5th-semester that consisted of 6 students. The research design was descriptive qualitative. The procedures were: (1) The teacher gave the explanation in accordance learning outcomes of this course; (2) The teacher asked students to observe the chemistry laboratory (case study); (3) The students made paper and presented the paper in class followed by a discussion with question-answer; last (4) The teacher gave critical thinking skill test.Based on the test result, the critical thinking skills students classified as high and the value is about 84.5%. The values for each indicator of critical thinking skills are as follows: (1) interpretation of 96.67%; (2) analysis of 66.67%; (3) evaluation of 93.33%; and (4) inference of 81.33%.Various methods must be taken to improve students' critical thinking skills such as providing varied cases for students and asking students to solve these cases.

Keywords: critical thinking skills, case-based method, laboratory engineering and management, descriptive qualitative

INTRODUCTION

Based on the Decree of the Minister of National Education of the Republic of Indonesia No. 232/U/2000, there has been a fundamental change in the higher education curriculum 2020. The change lies in the learning process, which was originally teacher-centered, now becomes student-centered [1]. Since 2020, the Ministry of Education and Culture has begun implementing the independent learning curriculum. The independent learning curriculum is applied from basic education to higher education. The demands of this curriculum are the implementation of IT in the teaching and learning process, making the learning process easier. Apart from that, the help of IT in learning, makes students more actively involved in learning activities and students can gain learning outside of school activities as well [2]. The implications of these changes include teaching and learning activities. It is known as an independent campus. The learning methods applied in this curriculum include discussions, simulations, case studies, cooperative learning, project-based learning, and problem-based learning. The aim is that learning outcomes can be achieved [3].

In the 21st century, important skills that students must have arecommunication skills, collaboration, critical thinking, and so on. All of these skills are adaptations of the curriculum [4]. The curriculum is a set of plans that serve as a reference for learning and contains guidelines for achieving learning objectives [5]. These skills are considered a reference for student success so they must be realized in teaching and learning activities. Learning approaches that can be applied to make this happen include the inquiry approach. This approach focuses on developing students' scientific attitudes and abilities.

Critical thinking is one of the high-level skills needed to develop 21st-century skills, so every individual needs these skills to be successful in solving problems. Students who have critical thinking skills can complete lecture assignments well and have solutions to the problems they have. The ability to think critically makes learning more meaningful, so that it can build the quality of thinking and produce better learning that has an impact on everyday life [6].

Educationis the process of improving the quality of students. The way is by teaching-learning processes. The other goals of education are to make students have good character, cognitive, affective, psychomotor skills, etc [7]. Educations involve teachers, students, and teaching learning media. Responding to the new curriculum, students are required to have critical thinking skills called High Order Thinking Skills (HOTS). Especially at the higher education level. In higher education, students are also required to think at a higher level and think critically because these stages of thinking can be applied in everyday life [8].

However, efforts to change towards 21st-century skills are not easy. It takes effort and appropriate strategies to achieve the expected skills. Currently, education problems in Indonesia are still very complex. One of them is that there are still many students who do not have the 4C skills which is a 21st-century learning framework. Students are considered not to have the ability to think critically and solve problems in learning or the real world, communication skills are still lacking, they are still embarrassed to express opinions, and collaborative abilities and student creativity are still lacking in learning [9].

Teachers are required to be more creative and innovative. Teachers must be successful in transferring knowledge and can also be agents of enlightenment. Currently, the learning process that is still being practiced is the lecture method. Students in lectures are only asked to listen to lecture material, then take notes, and understand the lecture material. The source of knowledge is only centered on lecturers [10]. However, the reality in the field that occurs in schools, currently the learning methods that are still used are conventional methods. Learning is carried out by memorizing the teaching materials provided and the teacher is the center of learning. The function and role of teachers have become very dominant. Students are only asked to listen, listen, and note down the teacher's explanation. The student's role is very passive. Teachers also become less creative because there is no variety of learning methods. This results in students' potential not being able to develop optimally [11]. So this results in several fundamental problems experienced by students, including limited learning services provided, lack of understanding of the use of learning applications, and internet problems. As a result, students experience learning loss, academic stress, procrastination, learning boredom and decreased learning achievement. These problems do not only occur in primary education but also at the higher education level. To overcome these problems, the Ministry of Education and Culture has established regulations for implementing project-based learning and case-based learning methods in university courses [12].

Teachers or lecturers must continue to strive for strategies so that 21st-century learning goals can be achieved effectively and efficiently. Aspects to be considered in fulfilling this goal include student activity during learning, student responses to the learning carried out, and student mastery of concepts after learning. The effectiveness of learning is not only measured by learning outcomes but also seen by the process and means of supporting learning [13]. Related to this, lecturers can apply the case-based learning model in the classroom learning process. Case-based method learning criteria is a learning method determined by the Ministry of Education and Culture based on the IKU Guidebook [14]. The content of this learning method is that students play a role in solving cases that have been prepared by the lecturer, then carry out case analysis, and finally provide a solution to the case. The role of the lecturer is as a facilitator. With this method, it is hoped that students' communication and critical thinking can be trained and developed [15].

The definition of the CBL learning method is a learning method that requires students to participate actively in solving real problems according to the experience and discipline being studied. Lecturers act as mediators and facilitators for knowledge sources. Finally, students' final competencies are obtained through skills, abilities, knowledge, and personal attributes in the form of personality, honesty, ability to work in a team, and ability to interact with other people. CBL requires students to play a role and actively participate in the learning process. CBL is constructivism-based learning so that students can participate actively and form their knowledge. Textbook modules or reference books used in learning have not been able to measure and develop students' analytical, problem-solving, critical thinking, and evaluation abilities. Applying the CBL learning model in the classroom, allows students to analyze and provide solutions to a problem, connect various learning sources to solve a problem, and train students' communication and collaboration skills. CBL can overcome problems regarding student activity and learning outcomes. This method can encourage analytical skills, critical thinking, creative thinking, practical skills, communication skills, and social and reflexive skills. CBL is used to encourage student activity and cooperation. With this method, the level of thinking based on Bloom's Taxonomy can also be achieved [16]. In case-based learning (CBL) in the Laboratory Engineering and Management course carried out in the Chemistry Education Study Program Semester 5, Manado State University, the cases discussed were about fundamental problems in the chemistry laboratory at Manado State University.Laboratory Engineering and Management (Teklab) is a course that teaches about laboratory management starting from arranging laboratory rooms to disposing of laboratory waste. The benefit of Teklab is that students can manage the laboratory well and follow ISO laboratory standards.

The Laboratory Engineering and Management (Teklab) course is very suitable for the case-solving method (CBL). This course requires students to complete cases related to chemistry laboratories and follow good chemistry laboratory management. These cases include laboratory arrangement, storage of equipment and chemicals, as well as disposal and processing of chemical waste. The lecturer directs students to observe problems that occur in the laboratory. Through the CBL method, Teklab becomes very important which supports case solving with sharper analysis and clear solutions and recommendations. Therefore, the use of the CBL method is expected to reduce the gap between theory and practice. Apart from that, it can provide a

complex and contextual learning experience so that in case method learning, for example looking for case articles to help students relate phenomena that occur and will be discussed in discussion activities based on the results of student observations and perspectives so that students not only memorize the content but can also know, as well as understanding the meaning of the connection between the material taught and real-worldsituations [17].

RESEARCH METHOD

The approach in this research is descriptive qualitative. Qualitative research explores and understands the meaning ofsome individuals or groups of behavior, concepts or phenomena, social problems, etc. CBL is built using the discussion method by presenting real-world example cases. Apart from that, one way to measure the ability to think creatively is by using HOTS-based questions [18].

This research was conducted with a sample of 6 students from the 5th-semester chemistry education study program at Manado State University. The subjects where the CBL method is applied are Laboratory Engineering and Management. As for data collection techniques using critical thinking questions, the results of case studies are in the form of papers and presentations, and discussions.

The procedures in this research process begin with preparing a research plan, determining the research sample, compiling research instruments, carrying out tests on samples to collect data, and finally analyzing the research data.

Several indicators influencing critical thinking skills when solving problems include interpretation, analysis, evaluation, and inference. The essential thinking criteria data is listed in Table 1 below:

Table 1. Critical thinking ability criteria [19]

Criteria	Percentage
High	76-100%
Moderate	60-75%
Low	0-59%

The data analysis stage of the research results was carried out by calculating the percentage value of each student's answer. The students' answers were obtained from the HOTS question instrument which had previously been prepared by the lecturer. Next, the lecturer concluded the results of the student's critical thinking skills.

RESULTS AND DISCUSSION

This research aims to analyze students' critical thinking abilities by applying the case-based method learning model to Laboratory Engineering and Management courses. Critical thinking ability is a logical thinking process in the decision-making process. In the realm of cognitive abilities, critical thinking is very essential [20].

The research process begins with preparing materials and cases tailored to learning outcomes. The lecturer provides an initial explanation to shape the direction of students' thinking to make it easier to analyze the case. The case provided is following good chemistry laboratory managementstarting from laboratory arrangement, ventilation, sanitation, equipment storage, material storage, and fire extinguishers, to waste disposal and processing. Students are asked to analyze and provide solutions to existing problems. Next, the results of the case study are written in paper form and presented accompanied by discussion. Students' critical thinking abilities are then analyzed using a high-order thinking skill question instrument and a percentage is given for each answer. These results are then concluded based on the critical thinking table. For research supporting data, the results of papers, presentations and discussions are used.

The research data is presented in table form which describes the results of students' critical thinking abilities using the CBL method. The following are the results of students' critical thinking ability tests:

Table 2. Table of critical thinking ability results

Indicator	Number of students	Average percentage value
Interpretation	6	96.67%
Analysis	6	66.67%
Evaluation	6	93.33%
Inference	6	81.33%
Average percentage of critical thinking abilities		84.5%

Test result data on 6 chemistry education students shows that the critical thinking skills of 5th-semester chemistry education students are relatively high. The values for each indicator are as follows: (1) interpretation of 96.67%; (2) analysis of 66.67%; (3) evaluation of 93.33%; and (4) inference of 81.33%. The average value of critical thinking skills is 84.5%.

The results of the critical thinking ability test are supported by several other test instruments, namely case study papers, presentations, and question-and-answer discussions. The most prominent point of student critical thinking is the interpretation section. The interpretation section is the initial part of the critical thinking process.

Students tend to find it easier to face questions about interpreting a concept. Meanwhile, students still have a little difficulty with analytical skills, especially when it comes to cases that arise suddenly or new cases. Students tend to take longer in the ability to correlate information given or obtained, the ability to solve problems, and connect concepts to solve new problems. In this case, students need more preparation before solving the case.

Various methods must be taken to improve students' critical thinking skills. The way to improve it is to provide varied cases. Next, students are trained to solve these cases. Exercise is carried out gradually and continuously. Deepening of knowledge and concepts is also needed through learning materials obtained in lectures or from other reference materials such as articles, reference books, modules, etc.

CONCLUSION

The implementation of the Case-Based Method in Laboratory Engineering and Management courses for 5th-semester students of the chemistry education study program at Manado State University can be used to analyze students' critical thinking skills. Determining critical thinking skills using the High Order Thinking Skill (HOTS) question instrument and the results obtained were that the critical thinking ability of chemistry education students was 84.5%, considered high.

Apart from that, data was also obtained with supporting instruments in case study papers, and presentation results and ended with a discussion. From these results it is concluded that students' difficulties in critical thinking lie in their analysis abilities. On average, students still have difficulty in correlating information given or obtained, ability to solve problems, and connecting with concepts to solve problems.

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