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Problem-Based Learning Strategy: Its Impact on Students' Critical and Creative Thinking Skills

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Abstract: The ability to think critically and creatively is essential for students to be able to face the challenges of the industrial revolution 4.0. Lectures must be designed to enhance students' critical and creative thinking skills. This study aims to examine the implementation of problem-based learning in learning management information systems courses to improve students critical and creative thinking skills. The research design carried out was classroom action research. The subject in this study was students of Economics Education, Faculty of Economics, Universitas Negeri Semarang. The research was conducted in April-May 2019. The procedure for implementing class action research are two cycles (plan, action, observation, and reflection). The research data was taken by observation and interview methods. The data analysis method used is descriptive quantitative and qualitative methods. The results showed that two class action research cycles were well implemented. The application of the problem-based learning method can improve students' critical and creative thinking skills. Students are able to solve a given case by doing the right analysis and being able to provide alternative solutions. Students consider the learning process to be more exciting and challenging. Students can express their opinions well in front of the class. The implication of this research is that lecturers can apply PBL with various combinations of learning strategies to improve students' critical and creative thinking skills.

Keywords: *Critical and creative thinking skill, management information system course, problem-based learning.*

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Introduction

The fourth industrial revolution has become a major topic and gained attention among scholars in both developed and emerging countries. The various sectors in the world have started to respond to this issue, including the education sector. The active scholar believes that the emerge of the fourth industrial revolution brings challenges for students to have learning and innovation skills (Yuberti et al., 2019). In more detail, Zainudin and Istiyono (2020) remarked that learners should have several abilities, including critical thinking skills, problem-solving, communication and collaboration skills, creativity and innovation. Indeed, Toheri et al. (2020) pointed out that critical and creative thinking skills are the most essential in schools and life going forward.

Improving the quality of learning in higher Education is compulsory. Students will face challenges in entering the era of 4.0 industrial revolution in the future. Universities must be able to produce competent and competitive alumni. Universities are required to be able to optimize the resources they have to create a quality lecture process. Universitas Negeri Semarang (UNNES) is one of the state universities that has a commitment to continuously improve its quality.

The quality learning process will produce expected learning outcomes. Learning outcomes are outcomes of the learning process. While the ability to think creatively is the ability of students to understand problems and find solutions with various strategies or methods. Learning outcomes can be assessed from several aspects such as cognitive, affective, and psychomotor.

Various efforts have been made by UNNES to improve the quality of the learning process. The efforts can be seen from the comments made by the alumni on the outcomes of learning. According to the alumni what they have got in college really supports the jobs they are doing. Nevertheless, there are still competencies which should be better to master.

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Such competencies are Information Technology competence, English competence, and cooperation and adaptation competence (Nurkhin et al., 2019).

Proficiency of information technology is a very principal competence and must be comprehended by students. One of the subjects aiming at strengthening student competence in comprehending information technology is a course in Management Information System (MIS). MIS learning so far has shown the willingness of lecturers and students to understand the development of information technology for business decision making and education. However, lecturers have to improve the MIS learning to be more meaningful and enhance students' critical and creative thinking skills.

Many strategies can be applied to improve the quality of learning in higher education, especially in economics and business subjects. The author has also applied several learning strategies to improve the quality of lectures, such as the application of peer tutoring learning in cost accounting learning (Nurkhin, 2013), content and language integrated learning (CLIL) strategy in bilingual class (Nurkhin, 2014), and also the PBL based modules development (Thomas & Nurkhin, 2016). The learning strategy was applied in accounting courses, not MIS one.

Problem based learning is one of the learning strategies that can be chosen to improve the quality of MIS courses. PBL premised upon active learning and multi-solution approaches, shares many similar characteristics as the interdisciplinary and "learning-by-doing" approach of entrepreneurship education. As PBL emphasizes the application of knowledge, students are expected to exercise creativity and thinking out of the box when solving problems (San Tan & Ng, 2006). PBL requires that the learner adopt a change in mindset from teacher-dependence to self-reliance (Yeo, 2005). PBL can improve student experience and metacognitive development (Downing et al., 2011). PBL is an effective complementary method because it can expose students to real problems (Tortorella & Cauchick-Miguel, 2018).

Other researchers applied PBL integrated with the strategy of group investigation (GI), and proved that PBL and GI could improve students' thinking skills through planning, arguing, stating questions and problems, and analyzing and providing solutions to the surrounding environmental problems (Asyari et al., 2016). PBL has positive implications in lectures that combine theory and practice, which can increase motivation to continue learning (Silva et al., 2018). PBL activities involve students to think about solutions to problems that are simple, challenging to very complex problems (Grasas & Ramalhinho, 2016).

The research question in this study is whether the implementation of PBL can improve students' critical and creative thinking skills in Management Information Systems learning. And the purpose of this paper is to examine the implementation of PBL in MIS courses. The PBL model used is an original model so that it can identify the effects of PBL implementation as a whole in improving students' critical and creative thinking skills.

Literature Review

New technologies are developed at an extremely rapid rate and bring comfort to our everyday lives. These technologies also bring new challenges. These challenges can be solved by adapting our lives and requires creative thinking skills because these problems can be categorized as nonroutine (ill-structured) problems (Ulger, 2018). Thus, developing students' creative and critical thinking skills is very important to enable them to solve non-routine problems in the modern world. Educators want their students to acquire creative and critical thinking skills during learning activities so they can address complex problems in their everyday lives.

The ability to think requires the ability to remember and understand, therefore the ability to remember is the most crucial part in developing thinking skills (Sumantri, 2015). To make students creative certainly cannot be done instantly, but it requires a process to sharpen the creative potential of each student (Syahidah, 2015). The ability to think creatively is the ability of students to understand problems and find solutions to strategies or methods that are varied (divergent). Improving creative thinking skills means increasing the score of students' skills to understand problems, fluency, flexibility and novelty of problem solving (Siswono, 2005).

Learning models can improve critical thinking, skills collaborate, communicate, and creative thinking are needed in the 21st-century education era. Critical and creative thinking are the two essential competencies of the four skills required in the 21st century (Toheri et al., 2020). Learning models that can improve mathematical creative thinking skills include Problem Based Learning models (Maskur et al., 2020). Previous studies revealed that problem-based learning (PBL) is a student-centered approach that effectively improves student learning (Saputro et al., 2020).

PBL was first introduced to the medical school of McMaster University, Canada, in 1969 under the coordination of Howard S. Barrows. PBL is considered to be an active teaching strategy, as PBL students are encouraged to take the lead in their own professional training and education (Silva et al., 2018). He further explained that there are many ways that can be applied by the teacher or lecturer to implement PBL in the classroom. The following are important aspects that must be considered in implementing PBL in management education.

Table 1. Types of problem-based learning

Type	Description	Challenge
PBL	It is a learning environment in which the problem is presented before the students obtain new knowledge	To provide students with a more effective opportunity to develop problem-solving skills
	Helps students create knowledge structures that will help them apply what was learned to future situations	To facilitate the development of suggestions or clues and a more appropriate knowledge structure
Self-directed PBL	Empowers students through learning tasks. They choose the topics, create the learning objectives and criteria, contact members of the group to learn and teach parts of an unknown activity, teach others, develop and self-assess their learning progress	To make students more responsible
	Empowers students by allowing them to share in the assessment process and provide an opportunity for the teacher to monitor and conduct the assessment	To develop students' self-assessment skills
Small-group PBL	Uses a learning environment in which students are active and cooperative. There is a clearly defined deadline for tasks, with rapid feedback, as well as catalysis of the student's learning style	To create a small-group learning environment that actually incorporates the elements that describe it
	Incorporates principles of self-directed PBL and a process of self-assessment to create an environment for more in-depth learning	To explicitly develop lifelong learning skills such as teamwork, self-direction, teaching skills, self-assessment and communication

Source: (Da Silva et al., 2018)

PBL is considered appropriate in improving students' critical and creative thinking skills in MIS courses learning. Because PBL will involve students to face real problems (Tortorella & Cauchick-Miguel, 2018) and train students to find solutions to problems faced starting from small, challenging to complex problems (Grasas & Ramalinho, 2016). In addition, PBL is a learning method developed from active learning.

The PBL approach is a model for constructivist learning in education. The results of the study indicate that PBL can help students with nonroutine problem-solving processes by maintaining uncertainty and enhancing creative thinking (Ulger, 2018). PBL was more effective in increasing self-efficacy and critical thinking of pre-service elementary teachers than traditional teaching (Saputro et al., 2020). However, Pardamean (2012) did not find a continuous and significant increase in the achievement of critical thinking skills scores in dental education students.

PBL implementation in MIS lectures will affect students' critical and creative thinking skills. Students will interact with real problems in the MIS field and will be asked to find solutions to the problem by discussing, finding supporting data sources, and sharing with others about the solutions. By working together in a cooperative way, it will increase the involvement of each student to contribute to solving problems given by the lecturer.

The PBL model applied in this study is the original model in order for students to be able to develop their critical and creative thinking skills more effectively (Silva et al., 2018). Also the effect of implementing PBL will be more visible if the original PBL model is used. Students can practice critical thinking if they involve in real problems in the field of

management information system. In addition, students will think creatively to find the best solution to their problems. Students will practice formulating problems, submitting statements, and finding the most appropriate solutions.

Methodology

Research Goal

This type of research that has been done is classroom action research. Classroom action research (CAR) is a form of self-reflective enquiry undertaken by participants in order to improve the rationality of their actions in carrying out tasks and deepen understanding of conditions in learning practices (Hopkins, 2011). CAR is intended to improve and enhance the quality of learning and help empower teachers to solve learning problems in school (Muslich, 2016). The model of CAR that we implemented are based on Mulyasa (2009) which involving an iterative process of self-reflective cycles: planning, acting, observing, and reflecting,

Sample and Data Collection

Classroom action research has been conducted in Management Information System course of the Economics Education study program at the Faculty of Economics, Universitas Negeri Semarang (UNNES). There are 33 students, 5 male and 28 females and they are 20-21 years old. CAR was carried out in April-May 2019 in 2 stages of cycle consisting of plans, actions, observations, and reflections.

At the planning stage, the researcher analyzed the scope of the material and developed the lecture tools. The researcher designed the lecture implementation in the first and second cycles. The materials chosen were information security and MIS implementation in the business and education world. These materials are very important and contextual. Discussing about information security, student will face many contextual problems and they will find some idea to solve it. The student will able to improve their critical and creative thinking skill throughout PBL environment. So, these materials are very relevant with PBL that chosen as treatment in this study. At the stage of action, the researcher carried out what has been planned in the planning stage. At the stage of observation, researchers did observations to record and document what happened during the lecture process. At the stage of reflection, the researcher described the reflection of what has happened in each cycle and also took corrective actions that must be taken at the next stage of the cycle.

The first cycle carried out in this classroom action research is the implementation of PBL in MIS class with information security as the topic. Students are expected to achieve the following indicators: (1) able to explain the need for security and control, (2) able to explain the three main objectives of information security, (3) able to explain the threats, risks, and controls to know the process of implementing information security policies. At the second cycle, students are able to explained the implementation of MIS in the business and education field. Students should investigate the real implementation of MIS and evaluate it. Students also should be required to develop good idea about the implementation of MIS in education area.

Analyzing of Data

Data in this classroom action research was primary data taken by doing observation and interview methods. The observation method was used to record the lecture process and obtain data on students' critical and creative thinking skills; and interviews were used to obtain additional data regarding the process of implementing the learning. This research applies descriptive quantitative and qualitative methods for data analysis. The quantitative descriptive analysis method is used to describe the successful implementation of class actions from the first cycle to the second cycle. The qualitative descriptive analysis method is intended to explain the response of students to the implementation of lectures.

Findings

The Implementation of First Cycle

The description of the implementation of the first cycle is as follows;

Planning

At this stage, researcher determined what lecture material will be applied using PBL model in the form of group discussion. The researcher formed a small group (consisting of 3 students) to discuss the latest issues regarding information security. Students were asked to explore cases that occur regarding information security such as cases of data breaches, data leaks, and the like. Students then analyzed why the case occurred and how to overcome it.

Action

The planned design is then implemented in two face-to-face meetings. In the first meeting, students explored cases that occurred in Indonesia and in the world regarding information security. At the second meeting, students continued their

exposure and discussion about the cases that occurred and concluded why information security policy is an important thing to do in solving such cases.

Some of the cases revealed in group discussions included the case of WannaCry Ransomware and cases of hacking of Tiket.com sites. WannaCry's Ransomware is a cyber-attack that took place in Indonesia in early 2017. At least two hospitals in Jakarta (Dharmais Hospital and Harapan Kita Hospital) were affected. Patient data in the hospital computer network could not be accessed. In May 2017, the Minister of Communication and Information later claimed that Indonesia was free of the WannaCry ransomware virus. The next case was about the tiket.com site hacking which caused a loss of IDR 4.1 billion.

In this first cycle, students were given a case regarding information security. Then students worked in groups to look for and explored these problems. The results of the group discussions were then presented in front of the class, and continued with class discussions. In addition to uncovering what has happened, students were also asked to review what causes and solutions were appropriate to overcome these problems. Students looked for problems from the internet and then discussed it within their respective groups.



Figure 1. Students activity in small group discussion

At the end of the first cycle meeting, the researcher delivered material on information security and implementation of its policies. The students were expected to increasingly understand information security policies and relate them to cases they had discussed.

Observation

Observations made in this stage were divided into two forms of discussion, namely small group discussion and large group discussion. In group discussions, researcher focus on students' ability to think critically and creatively in finding cases that are relevant to the lecture material being discussed. The ability measured is the ability to find problems, the ability to express opinions, the ability to argue, and the ability to find solutions to problems faced.

Students were able to demonstrate critical and creative thinking skills in the first cycle, namely by finding cases of information security that do not only occur in Indonesia, but also revealed cases that occur abroad. Students were able to show a strong willingness to find "problems" that are not common, which other groups might get. Students tried to present case findings that are up to date, interesting and worth discussion. In class discussion, students were able to explain the results of small group discussions well even though there were still a number of less structured groups in their presentation. Many small groups were able to argue and express opinions when other group members asked and tried to debate.

Reflection

Cycle I ran well and smoothly in general. Students were able to carry out lecturer instructions as expected. This is because students do not find it difficult in carrying out the tasks given by the lecturer in PBL design. Students are able to find and formulate problems, and they are able to discuss what solutions are appropriate to solve the problems. In this first cycle, students also increasingly understood many terminologies related to information security, especially those that have to do with viruses and others.

The Result of the Second Cycle Implementation

The application of PBL in the second cycle discussed about the implementation of MIS in the field of business and education. This material is more difficult than the one in the first cycle, because it requires students to look for real problems and then find a solution by implementing MIS. The second cycle was held in two face-to-face sessions. The model used was also a group discussion.

Planning

The researcher designed the lecture at the planning stage. The lecture design is the same as the one applied to cycle I. students were divided into small groups then were given assignments to be completed. In this second cycle, students were asked to analyze scientific journal articles that have been provided as material to understand several MIS implementation models in the fields of business and education. After that, students discussed it by looking for and identifying real problems that could be solved by implementing MIS. After group discussion, students would present the results in front of the class and discuss together.

Action

Students discussed the problems they found in their respective groups as did in cycle I. Students first discussed scientific journal articles and then identified real problems that occurred in the fields of business and education. The researcher asked several questions to help students understand the tasks carried out and would eventually be able to find problems and solutions. Students were able to discuss well and enthusiastically. The questions asked covered (1) the benefits of MIS in the field of education and business, (2) three forms of MIS implementation in the fields of business and education, and (3) the real problems faced and the possible solutions.

Students then presented the results of group discussions in front of the class. Most were able to present the findings of the problem and the solution well. Real problems found by students included manually managed school funds, paper-based membership registration forms for student and student organizations, the existence of used books that have not been utilized properly by students who have graduated, and other problems. The proposed solution is the development of a school financial information system, the use of google forms instead of paper-based registration form, the use of google forms for lesson evaluation, information and advice systems, and the like.



Figure 2. Students presented the result of their small group discussion

Students were able to find real problems that are important to solve. This showed that students are able to think creatively and critically. Some groups are still not serious in doing the assignment. At the end of the lecture, the lecturer combined two small groups into one medium group (consisting of 6 people) to once again discuss the problems found

and formulated the best solution. Students did not fully show the satisfying performance. Only a small percentage succeeded in formulating a concrete solution to the problem found.

[The Task of Management Information System Course

Group 4, the members:

1. Riska Mardiyanti	7101417046
2. Aristin Damayanti	7101417128
3. Sri Purwati	7101417178
4. Difa Nur Laela	7101417183
5. Zuriatul Khikmah	7101417265
6. Nilam Tri Windarti	7101417266
7. Martha Dwi Nurjayanti	7101417268

Task I:

Create google form <http://form.gle/J9yDvj7JpCPRABv17>

The assessment contains a collection of multiple-choice questions regarding basic economic material. There are 14 short questions with multiple choice answers and there are some questions with explanations in the form of pictures. Each question with a correct answer is given point 1 and with an incorrect answer point 0.

Task II:

Create an application called "book's store", this application is made through an application called "Create an Online Shop Application" that can be installed on my friends' android phones. This "book's store" application contains a collection of books that are sold easily through the application's services. This application requires data of around 2.72 MB. If you want to buy a book from the "book's store" application, you have to install the "book's store" via <https://os.bikinapikasi.com/download/storebook1234> and register as a member. After that you can access the application smoothly. This application has a product display window, product categories, delivery services including delivery (go-send). This application is not much different from other online shop applications such as media stores. The difference is that this application sells books and this application is only mine in the sense that there are no sellers besides me. In the admin application, I can manage the online store by inputting the code.

Figure 3. the result of small group discussion

Observation

Observations were done by looking at students' critical and creative thinking skills during the discussion session and during the group discussions' result exposure. In addition, the researcher also observed the results of group discussions, whether the issues raised were crucial and worthy of being resolved. The researcher also assessed the solutions provided by students. All large groups were able to find benefits and forms of MIS implementation in the fields of education and business. However, some groups could not identify real problems and present the possible solutions to the problems they found.

Interesting problems identified covered leasing and buying and selling used books. One real problem faced by students when they graduate deals with the reference books they no longer use. One creative solution found by students is to rent or to lease them out. Besides that, students are able to find another real problem that so far is considered simple, namely how students can address complaints, inputs, ideas, and others to faculty or department heads. The solution offered is to have a hearing session.

Reflection

In general, the students' ability to find problems has increased. Students are also able to explain the results of the discussion better. Students simply comprehend the problems and solutions offered. Although there are still groups that are still not serious about finding problems and solutions. This can be seen in the absence of problems and solutions to group discussions. On the other hand, there are groups that are very enthusiastic, aggressive, and serious in finding real problems and solutions.

The formation of student groups is one of the determinants of PBL implementation in this classroom action research. Lecturers should be able to group students more proportionally. So that all groups are able to show the expected performance and the discussion will be far more interesting and vibrant. Student cooperation in group discussions is considered satisfying.

Discussion

The implementation of the first and second cycles of classroom action research has been successful. We have successfully implemented PBL to improve students' critical and creative thinking skills in the MIS subjects. Students

can participate well in lecturing activities throughout the study. Lecturers are able to invite students to be actively involved in the lecture process.

This research has proven that PBL can improve students' critical and creative thinking skills. This is in line with the opinion of Tortorella & Cauchick-Miguel (2018) which explains that PBL is a learning strategy that can expose students to face real problems. The real problem faced by students in the implementation of the first and second cycles is to require students to think creatively and critically. Students are asked to analyze the problems that occur and provide the best solutions. San Tan & Ng (2006) also explained that PBL would be able to train students to think creatively and think out of the box when they face problems to be solved. Saputro et al. (2020) also found that PBL was more effective in increasing critical thinking of pre-service elementary teachers than traditional teaching. Students in the PBL environment performed better than the expository teaching approach.

The ability to think critically and creatively students experience obstacles during the implementation of the second cycle, because the problem to be solved is more complicated. Some students experienced obstacles in finding the real problems faced in connection with the implementation of MIS in the field of Education. The student finally was unable to provide solutions in the form of new ideas about the implementation of MIS in the field of Education. Lecturers should provide stimulus and assistance so that students are able to explore real problems and invite students to find the best solutions.

Conclusion

The method of problem-based learning applied to classroom action research runs well and is able to improve students' critical and creative thinking skills in management information systems courses. Students are more enthusiastic in attending lectures because they are faced with real problems and are involved in finding the right solution. This class action research runs in two stages of cycle. The first cycle discussed information security material and the second cycle discussed MIS implementation in the fields of business and education.

Students' critical and creative thinking skills can be seen in their ability to understand problems and find the solutions. In the first cycle, students are able to find cases that happened in Indonesia and the world regarding information security issues. Students are also able to explore the causes of the problems. In the second cycle, students are able to formulate real and important problems in the field of business and education and then offer solutions to these problems. Students are able to work together in solving problems with members of their respective groups. Students are also able to express their opinions in front of the class and are able to argue to defend their opinions.

Suggestions

Suggestions that can be given in further research are the measurement of the impact of implementing PBL more comprehensively, both quantitatively and qualitatively. The next suggestion is that researchers can provide more intensive assistance to students, so students will be able to unleash their potential. Assistance can also be done by providing stimulus to students. Subsequent researchers can also collaborate on implementing PBL with other strategies or in combination with learning media. Social media can also be an alternative to implementing PBL that is more interesting and challenging. Students are the generation who are very familiar with technology and social media.

Limitations

The limitation of this study is the measurement of student learning outcomes is less than the maximum and only qualitative. That is, researchers have not been able to measure the effectiveness of the implementation of PBL as a treatment to find out the increase in learning outcomes before and after the research is carried out. The next limitation, researchers have not explored the responses of students after being involved in classroom action research.

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