The Effectiveness of Project-Based Learning to Improve Critical Thinking Skills

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Abstract: The era of industrial revolution 4.0 requires us to be "familiar" with the digital world. Not just doing hobbies, people can even do work with the help of digital tools. In facing challenges in the digital era in the form of a rapid flow of information, critical thinking skills are really needed. Students' critical thinking skills need to be trained to solve contextual problems, one of which is through implementing Project Based Learning (PjBL) in learning. This research aims to see the effectiveness of PjBL on students' critical thinking skills. This research is a quasi-experimental research with a one group pretest-post-test design. The population in this study were undergraduate students of the Biology education program in Universitas Jambi. The instrument used in this research is essay questions along with a rubric for assessing critical thinking skills. Data were analysed using SPSS 25.00 software. The results of the analysis show that there is a significant difference between the pretest and post-test scores for students' critical thinking abilities. It can be concluded that PjBL is effective in improving critical thinking skills.

Keywords: 4Cs skills; Learning models; Learning outcomes; Learning strategies

Introduction

The industrial revolution 4.0 has an impact on the rapid development of digital technology. People can use digital technology to pursue their hobbies or interests and do various jobs. Through digital media such as social media, someone can share what activities they are doing, express themselves by showing their mood directly, and so on. Based on the information or data shared by someone on social media, an expert can easily target that person to be used as a market for products or services, or even ideology.

The development and progress of the digital era has caused changes in people's habits and attitudes, including in the education system in Indonesia. The industrial revolution 4.0 has an impact on the world of education through the spread of information and technology which has a major influence on learning activities. The rapid spread of information and technology also provides many conveniences and opportunities and creates competition. Opportunities and competition that arise can affect a person's mental condition. For example, the use of social media to express feelings or emotions that are being felt. With psychology, a person's character can be read easily through what is written on social media.

The development of digital technology also has an impact on changes in student habits. Not only positive impacts, but also various negative impacts such as excessive and inappropriate use of social media, online games, and various other negative impacts. Students who are addicted to social media can experience changes in attitudes such as becoming less disciplined, lazy, and forgetting their duties as students because they are too busy playing social media, students also become more likely to copy other people's work, become less polite, often fight, and often skip school due to negative content

they watch on social media (Khairuni, 2016; Mulyono, 2021).

Digital technology also makes students easier to play online games. The results showed that online games can reduce students' concentration in learning, not doing homework given by the teacher, often being late, and not being able to answer the teacher's questions well (Lena et al., 2023). Not only that, online game addiction also has an impact on health, psychology, academics and finances (King & Delfabbro, 2018).

The role of teachers as the closest element to students is needed in anticipating the negative impact of using technology as described above. Teachers can anticipate these negative impacts by providing appropriate digital care for their students. In order to provide appropriate digital care, teachers must understand digital psychology. Digital psychology or cyberpsychology is a branch of psychology that examines how humans interact with technology, how technology affects behaviour, how technology is developed to meet human needs, and how technology can affect a person's psychological condition (Connolly et al., 2016). Teachers' understanding of Digital Psychology enables them to provide appropriate digital care for their students, so that the positive impacts of using digital technology can be increased and the negative impacts that may arise can be minimized.

The Faculty of Teacher Training and Education (FKIP) of Universitas Jambi is an institution that prepares future educators. As future educators or teachers, FKIP students of Universitas Jambi must be equipped with the knowledge of Digital Educational Psychology as a guide for them in providing appropriate digital care for their students in the future.

The Biology Education Study Program as part of the FKIP of Universitas Jambi requires students to take the Digital Psychology of Education course in semester 2. With this course, students are expected to be able to master theoretical concepts and practice solving problems that arise in the digital native generation in general, and specific theoretical concepts such as educating children in the digital era, parenting patterns, and professional mentoring in depth.

Students must have critical thinking skills to be able to find solutions to problems or issues that occur due to technological developments in society. In addition, the rapid flow of information today also requires critical thinking skills so that students are able to determine whether information is acceptable or not.

Paul & Elder (2014) states that a person is said have a good critical thinking skills if they can ask important questions to the problem, able to collect and assess relevant information, able to make conclusions and solutions through proper reasoning, have an open mind,

and able to communicate effectively in conveying solutions to a problem. Furthermore, Ennis (2011) suggests five indicators of critical thinking skills, namely providing simple explanations, determining basic skills, drawing conclusions, providing further explanations, and organising strategies.

Based on initial investigations, it is known that students' critical thinking skills must be enhanced. Critical thinking skills enable students to understand and assess situations and make decisions using relevant data and facts. Critical thinking skills taught to students can have a great impact on future learning. Teachers must first master critical thinking skills before they teach them to students (Raj et al., 2022).

Students' critical thinking skills can be improved through practice. The exercise given can be in the form of making a product that can solve a problem. Many issues or problems can be discussed in the Educational Digital Psychology course because the topics discussed in this course are generally very close to students' daily lives. Due to the number of problems or issues related to Educational Digital Psychology, this can be used to train students' critical thinking skills.

Lecturers can use the Project-based Learning (PjBL) model in learning so that it can improve students' critical thinking skills. The activities in PjBL model are based on authentic problems that occur in everyday life, so students are challenged to design, solve problems, and make decisions (Pearlman & Thomas, 2000). Through the practice of completing project tasks, students are expected to solve various real-life problems. The application of the PjBL model is also expected to improve students' critical thinking skills, so that when they are in the workplace professionally, students can make the right decisions in providing the right digital care for their students. Various studies have proven that PjBL can improve students' critical thinking skills. (Ramadhani et al., 2024; Selasmawati & Lidyasari, 2023; Wahdah et al., 2023). This study aims to analyse the effectiveness of the PjBL model in improving students' critical thinking skills.

Method

This research is a quasi-experimental study using a non-equivalent post-test only control group design. The population in this study were all FKIP Jambi University students who contracted the Educational Digital Psychology course. The sampling technique used purposive sampling method. The sample in this study were R-001 class biology education students. The sample was given treatment in The PjBL model. Pretest questions were given before treatment to determine students' initial critical thinking skills. After being given

treatment in the form of the PjBL model, students were given post-test questions to take their critical thinking skills again. The flow of the experiment is presented in Figure 1.
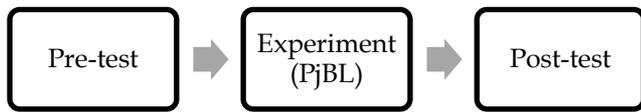

Figure 1. Experiment flow

The data collected in this study is students' critical thinking skills scores. The instrument used to collect data is an essay question based on the indicators of critical thinking skills. Data analysis used t-test using SPSS programme.

Results and Discussion

This study aims to determine the effectiveness of PjBL on students' critical thinking skills. The indicators measured refer to the indicators put forward by Ennis (2011), providing simple explanations, determining basic skills, drawing conclusions, providing further explanations, and organising strategies. The pretest and posttest scores of students' critical thinking skills are presented in Table 1.

Table 1. Students' critical thinking skills pretest and post-test scores

Score	Pre-Test	Post-Test
Highest Score	83	99
Lower Score	60	65
Average	73.15	85.4

Table 1 illustrates the difference in students' critical thinking skills scores in the pretest and post-test. It is known that the average value of students has increased after being treated with the PjBL model. The pretest and post-test scores for each indicator can be seen in Figure 2.
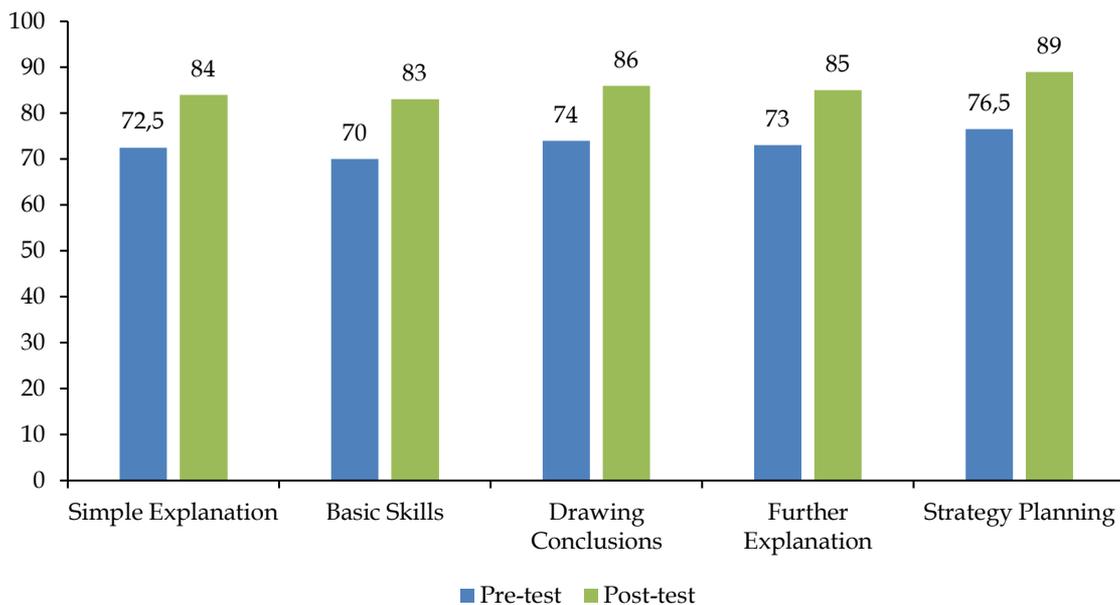

Figure 2. Critical thinking skills scores for each indicator

Based on Figure 2, it is known that the average value of each indicator of critical thinking skills has increased after being given the treatment. The data obtained were then analysed using the t-test. The sig value. (0.000) < 0.05 means H0 is rejected and Ha is accepted. It can be concluded that the student's critical thinking skills pretest score is significantly different from the post-test score. So it can be said that PjBL is effective in improving students' critical thinking skills. the results of this study are in line with research conducted by Semerci (2006) and Srinivasan et al. (2007) which indicates that PjBL is better in fostering students' critical thinking skills development than conventional learning and discussion-based learning. Andari & Asyari (2023), Ramadhani et al. (2024), Rosidah et al. (2019), and Wahdah et al. (2023) also reported that PjBL has an impact on improving students' critical thinking skills.

PjBL can improve students' critical thinking skills through the activity stages of learning. Pan & Allison (2010) stated that the PjBL learning environment could enhance students' critical thinking skills. Starting with

an authentic problem can provide a way for students to learn deeply in response to real-world events. Kurubacak (2007) stated that contextual learning materials and near to daily life can improve students' critical thinking skills. Students who have critical thinking skills are able to acquire intellectual resources such as basic knowledge, operational knowledge, concept knowledge, and certain habits of mind (Bailin et al., 1999).

Today we live in an information-driven and knowledge-driven world. Therefore, critical thinking skills are needed to prepare students. PjBL can assist students in practising the skills used to live in a knowledge-based and high-tech society. PjBL brings real-life context and technology into learning, so students are encouraged to be independent and think critically. Ministry of Education Malaysia (2006) stated that if students learn to take responsibility for their own learning, then they can develop the ability to work together with others.

Problem solving activities that are close to students' daily lives make learning not only transfer content, but also teach important skills that students must have to function as adults in social life. Wang (2022) stated that the skills that can be developed through PjBL are communication and presentation skills, time management skills, skills in investigating, the ability to reflect and self-assess, leadership and participating in teams, and critical thinking.

PjBL has characteristics such as directing students in investigating important questions and ideas, students carry out the investigation process, differentiated according to student needs, encouraging student productivity, requiring critical thinking skills, creativity, and skills to investigate information, make conclusions and content, and connect students with the real world and authentic problems and issues (Klein et al., 2009). The characteristics of PjBL can help students develop their critical thinking skills (Chen et al., 2022; Shukla et al., 2024).

Critical thinking skills are important to have both in classroom learning and in the world of work. With critical thinking skills, students are expected to become future teachers who are able to provide the right digital nurturing for their students. Bassham (2010) argues that critical thinking skills can help avoid making wrong decisions. Critical thinking skills lead a person to make important decisions more carefully, clearly, and logically.

Conclusion

Based on the research results and discussion that have been presented, it can be concluded that the PjBL model is effective for improving students' critical thinking skills.

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