

Improving 4C Skills Through the Application of Gamification-Based Interactive Evaluation Media Using Flipped Classroom Integrated Project Based Learning Model

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Abstract

This study sought to ascertain how well students' 4C skills were improved by utilizing gamification-based interactive evaluation materials in conjunction with a flipped classroom and project-based learning approach. Pre-experimental research with a quantitative approach and one sample class was the methodology employed in this study. Students enrolled in the Jambi University Chemistry Education Study Program's course on chemistry learning curriculum creation served as the study's samples. A questionnaire was used to collect data on the 4C competencies of the pupils. The normalcy of the variation in the students' 4C skills outcomes was examined. The data from the sample class is normally distributed and parametric tests can be performed if the significance value is higher than 0.05. In this study, one sample t-test was employed for hypothesis testing. To find out how well gamification-based interactive evaluation materials combined with a flipped classroom and project-based learning approach improve 4C abilities, hypothesis testing was done. The study's conclusion is that students' 4C skills can be effectively improved by implementing gamification-based interactive evaluation materials in conjunction with a flipped classroom and project-based learning approach.

Keywords: Flipped Classroom; Media; Project Based Learning.

1. Introduction

Learning assessment is an evaluation process used to determine the level of students' understanding of the material presented and the level of achievement of learning objectives. The implementation of this assessment activity can be carried out with various tools and methods used. Some of the objectives of assessment activities include: measuring the achievement of learning objectives, providing feedback, identifying strengths and weaknesses of learning implementation, measuring teaching effectiveness, supporting decision making. Outcome-oriented feedback rubrics are useful in supporting performance outcomes and improving the quality of learning conducted (Wei et al., 2021).

The results of observations made in the field show that students' views on the chemistry learning curriculum development course are difficult. Low student involvement in lecture activities makes students' critical thinking skills low and has an impact on the low level of student understanding of chemistry learning curriculum development lecture material. Material concepts that are not maximally understood can lead to misconceptions of the actual material (Dewi et al., 2022).

The results of interviews with several students who have taken the chemistry learning curriculum development course mentioned that the existence of assessment or examination activities makes the learning atmosphere, especially exams, tense, so that it can make students feel depressed and overwhelmed by an unpleasant atmosphere. The demands that arise in exam activities cause pressure due to fears of not being able to meet the standards given (Khafifah et al., 2023). Conventional learning assessment requires a long time in correcting students' answers which makes the evaluation of learning activities that have been carried out not run optimally. Students are unable to know the level of achievement of material understanding due to the length of the test results given by the teacher. The strengths and weaknesses of each student are difficult to measure because assessment activities are still carried out

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conventionally which results in students with low levels of motivation being less accommodated. Therefore, teachers need to improve their competence in conducting an interesting, fair, flexible, and relevant assessment process to better suit the needs of modern students. The ability of teachers to adapt to technological advances is very important (Falah et al., 2023). The ability of teachers and students to utilize technology-based media can create a meaningful learning atmosphere (Haryanto et al., 2023).

Assessment activities can be carried out easily and without stress by incorporating gamification elements assisted by computer applications. Gamification-based assessment is one of the efforts that can be made to improve the quality of learning. Gamification-based assessment is an approach in evaluating learners' progress by using game elements or elements that are usually found in games. The use of gamification-based media makes learning more fun, enables diverse learning styles, increases learner confidence and cooperation, and can be applied to project and problem-based learning models (Ekaputra et al., 2024).

Another problem found from interview activities in the chemistry learning curriculum development course is the low 4C skills of students. 4C skills are often referred to as 21st century skills which include critical thinking, creativity, collaboration, and communication. 21st century skills need to be given to students as a provision in facing changing times. 4C skills need to be provided to students in facing the rapidly changing times (Ekaputra & Widarwati, 2023). Learning the 4C skills is seen to be possible when using the project-based learning approach. According to studies, using the project-based learning model can help students become more proficient in the 4C skills (Ekaputra, 2024). With the project-based learning paradigm combined with the flipped classroom, the study's goal is to analyze students' 4C skills through the use of gamification-based interactive evaluation materials.

2. Literature Review

2.1. Project Based Learning

In order to improve students' problem-solving skills, the project based learning learning model actively incorporates students in learning activities to complete and generate a learning project (Apriany et al., 2020). Students can engage in learning activities using the Project Based Learning approach, which helps them hone their critical thinking, creativity, and productivity skills (Widiarini et al., 2021). Because students have more latitude to complete the assigned project, project-based learning has been shown to boost student creativity (Nugraha et al., 2023).

2.2. Flipped Classroom

The flipped classroom model is learning with activities that are usually carried out in the classroom can be done from home and activities at home can be done in the classroom (Fakhri et al., 2023). Flipped classroom learning model is a flipped classroom learning model that can make students active and independent in the learning process (Kurniawati et al., 2019). The application of flipped classroom in learning can train students, so that they are more active during learning because in constructing concepts, students will learn through discussion activities in class (Clarisa et al., 2020).

2.3. Gamification

Gamification is learning by involving game elements that aim to reduce students' boredom in learning (Salsabila et al., 2022). This approach aims to increase learners' motivation, engagement and interest in the learning process. Some of the key characteristics of gamification-based assessment involve the use of elements such as points, levels, challenges and rewards to encourage learners to actively participate and achieve learning objectives. Assessment media that are often used in learning are quizizz and quizwhizzer, wordwall. Quizizz is a flexible and narrative educational game-based application (Sari & Yarza, 2021). The use of gamification-based games has a positive impact on learning success (Yu et al., 2021). The advantage of the quizizz application is that it presents exam questions in an interesting and easy-to-use way to develop educational games (Agustina & Rusmana, 2019). Student learning concentration can be increased through the use of quizizz applications in learning evaluation (Purba, 2019).

3. Research Methods

Pre-experimental research with a quantitative approach and one sample class was the methodology employed in this study. Students in the Jambi University Chemical Education Study Program's chemistry learning curriculum development course served as the study's sample. The Quizizz app was used in this study as an interactive assessment tool with a gamification theme. Students used a project-based learning approach combined with a flipped classroom for the research activities. This research used a project-based learning approach combined with a flipped classroom to assess students' 4C skills both before and after learning through the use of gamification-based interactive assessment materials. A questionnaire was used to collect data on the 4C competencies of the pupils. The normalcy of the variation in the students' 4C skills outcomes was examined. The data from the sample class is normally distributed and parametric tests can be performed if the significance value is higher than 0.05. In this study, one sample t-test was employed for hypothesis testing. To find out how well gamification-based interactive evaluation materials combined with a flipped classroom and project-based learning approach improve 4C abilities, hypothesis testing was done.

4. Results and Discussion

Before the implementation of project-based learning model integrated with flipped classroom in the sample class. Students were first asked to fill out an initial 4C skills questionnaire. Filling out the questionnaire before learning aims to determine the level of initial 4C skills. The results of students' initial 4C skills questionnaire in the chemistry learning curriculum development course are presented in Table 1.

Table 1. Initial 4C Skills Data

4C Skills	Score
Critical Thinking	67,60
Communication	68.00
Collaboration	69.50
Creativity	69.40
Average	68.63

Based on the results of the initial 4C skills questionnaire presented in Table 1, the average 4C skills of students was 68.63. The results of these skills indicate the need for efforts to improve students' 4C skills. This research focuses on the application of gamification-based interactive evaluation media using a project-based learning model integrated with a flipped classroom on students' 4C skills. The project-based learning model can improve students' 4C skills (Harizon & Ekaputra, 2023). The utilization of gamification-based interactive evaluation media in this research is expected to improve students' 4C skills.

After the initial 4C skills data is obtained, students are introduced to the learning methods that will be applied in the chemistry learning curriculum development course, projects that will be worked on during lecture activities, learning media used, and learning evaluations that will be carried out. At the implementation stage of the project-based learning model integrated with the flipclassroom model, students are divided into several small groups to complete a project that will be given and agreed upon. Learning with projects to be carried out includes the formation of small groups, selection of projects to be worked on, data collection and document creation, and portfolios regarding project implementation.

The implementation of the project-based learning model integrated with the flipclassroom model begins with an analysis of the scope of material and projects in the chemistry learning curriculum development lecture, designing the completion of the project given. In completing the project, students look for relevant sources or references related to the tasks assigned to each group. Through the application of the project-based learning model, students can explore in making steps or ways to complete the project with their group members. After the given project is successfully completed, students in each group present the results of the project discussion. Other group members are allowed to ask, evaluate, or complement each project given for the perfection of the project that has been developed.

The implementation of the project-based learning model makes students active in following the learning carried out, as evidenced by the high enthusiasm of students in the discussion and presentation activities carried out. The application of the project-based learning model can make students active because students are directly involved in

learning (Ekaputra, 2023). Learning that also applies the flipclassroom model in this study makes students more prepared in the lectures conducted, because students have prepared the material provided in advance before learning in class. Learning using the flipped classroom model can make students more prepared, because they have studied the material before the implementation of classroom learning (Widodo et al., 2021). At the end of the material, students are given evaluation questions using gamification-based interactive evaluation media, which in this study used the quizizz application. The use of the quizizz application for evaluation activities makes students happy because it contains various game elements and the assessment results can be done quickly, so that students and lecturers immediately know the level of student understanding of the material provided. The advantages of the quizizz application include easy to use, there are data and statistical calculations of student performance, so that it can measure student understanding of learning material (Rahmawati et al., 2022).

The results of the evaluation carried out after the implementation of learning by using the application of gamification-based interactive evaluation media using the project-based learning model integrated with the flipped classroom can increase knowledge and develop student skills in a deep and meaningful way through those built through authentic tasks and projects. This is in accordance with research conducted by Huda & Ekaputra (2023) which states that the application of the project-based learning model can improve student learning achievement.

Through projects that they are assigned and finish, students can increase their knowledge by utilizing project-based learning in conjunction with the flipped classroom paradigm. Students share ideas with one another during the discussion process, which raises student participation. Learning through discussion activities and giving students access to books and journals as references can help students gain information through continuous experience and positively impact their ability to collaborate and communicate. In the chemistry learning curriculum development course, the presence of project result presentation activities and discussions on the delivery of project results can enhance and educate students' critical and creative thinking abilities indirectly by having them carry out a full analysis process.

After the application of gamification-based interactive evaluation media using the project-based learning model integrated with the flipped classroom, students again fill in the 4C skills which aims to determine whether there is an increase in 4C skills after the application of the project-based learning model integrated with the student's flipped classroom. The results of 4C skills are presented in Table 2.

Table 2. 4C Skills Data

4C Skills	Pretest	Posttest	Gain Score
Critical Thinking	67,60	83,60	16,00
Communication	68.00	86.50	18.50
Collaboration	69.50	86.25	16.75
Creativity	69.40	84.00	14.60
Average	68.63	85.09	16.46

Based on the 4C skills data in Table 2, it shows that all skills have improved. The highest increase was in communication skills by 18.50. These results are in accordance with research conducted by Melinda & Zainil (2020) which states that the application of the project-based learning model can improve students' communication skills. The difference in initial and final skill data is then tested for normality to determine whether the data distribution in the sample class is normally distributed or not. The results of the normality test are presented in Table 3.

Table 3. Normality and Hypothesis Test

Test	Significance Value
Normality	0.200
One sample t-test	0.000

The significance value, as determined by the normalcy test, is 0.200. It may be concluded that the data in the sample class in this study are normally distributed because the normality test findings for the sample class indicate a significance value larger than 0.05. Given that the data in the sample class is normally distributed, parametric tests can be performed in this investigation. One sample t-test is used for hypothesis testing once the research data have been determined to be normal. Table 3's one sample t-test findings indicate a significance value less than 0.05. Based on

these findings, the study demonstrates that gamification-based interactive evaluation materials that combine flipped classroom instruction and project-based learning are useful for enhancing 4C abilities. According to research by Rahayu et al. (2023) using a project-based learning model integrated with a flipped classroom, there is an increase in 4C skills through the application of gamification-based interactive evaluation media. This is consistent with the idea that applying a project-based learning model with a flipped classroom can enhance creative thinking skills. This study came to the conclusion that gamification-based interactive evaluation materials combined with a flipped classroom and project-based learning models are a useful tool for enhancing 4C abilities.

5. Conclusion

Through projects that they are assigned and finish, students can increase their knowledge by utilizing project-based learning in conjunction with the flipped classroom paradigm. Students share ideas with one another during the discussion process, which raises student participation. Learning through discussion activities and giving students access to books and journals as references can help students gain information through continuous experience and positively impact their ability to collaborate and communicate. In the chemistry learning curriculum development course, the presence of project result presentation activities and discussions on the delivery of project results can enhance and educate students' critical and creative thinking abilities indirectly by having them carry out a full analysis process. The study's conclusions are based on these findings, which show that gamification-based interactive evaluation materials combined with a flipped classroom and project-based learning are useful for enhancing 4C abilities.

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