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Implementation of E-Module with Flipped Classroom Model on Reproductive System Material to Improve Creative Thinking Skills and Learning Outcomes of Students

Wirda Hari Yani[1], Safrida[2*], Muhubbudin M[2], M. Ali[2], Cut N[2]

[1] Master of Biology Education Department, Universitas Syiah Kuala, Banda Aceh, Indonesia.
[2] Biology Education Department, Universitas Syiah Kuala, Banda Aceh, Indonesia.

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Corresponding Author:
Safrida
safrida@usk.ac.id

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Abstract: This research aims to determine the differences in creative thinking abilities and learning outcomes improvement of students using an e-module with the flipped classroom model. The method employed in this research is experimental research. The research design is pretest-posttest group control design. The population of this study consists of eleventh-grade science students at MAN 2 Banda Aceh. Data collection on creative thinking abilities and learning outcomes is conducted using test instruments. Data analysis employs N-gain test and Mann Whitney test with a significance level of 0.05. The results of the data analysis indicate a significant difference between the experimental and control groups. The conclusion of this study is that there is a difference in creative thinking abilities and improvement in learning outcomes of students using an e-module with the flipped classroom model.

Keywords: Creative thinking ability; E-module; Learning outcomes

Introduction

Creative thinking ability can reveal the originality of students' thoughts (St-Jean et al., 2022). Students' creative thinking ability is a factor that encourages efforts to enhance learning at school, as it significantly influences both directly and indirectly on students' learning outcomes. Students who have high creative thinking abilities in learning will be able to carry out learning activities with higher responsibility and full confidence compared to students with low creative thinking abilities, thus the learning outcomes achieved may not be optimal (Ashish, 2020).

Students with high creative thinking skills in learning will be able to carry out learning activities with greater responsibility and full confidence compared to students with lower creative thinking skills, resulting in learning outcomes that are not yet optimally achieved (Ashish, 2020). Students with high creative thinking abilities are likely to obtain high learning outcomes as well, meaning that the higher the creative thinking ability, the greater the intensity of effort and endeavor, and thus, the higher the learning achievements attained. Learning outcomes refer to the abilities acquired by an individual after the learning process, which can lead to changes in behavior, including improvements in knowledge, understanding, attitudes, and skills, making them better than before (Danuri et al., 2022). The behavioral changes mentioned are where students have understood the taught material and are able to achieve the competency standards and minimum completeness criteria (KKM) that have been set.

Based on the observation conducted at MAN 2 Lamtemen, it was found that students' creative thinking abilities in biology subjects at both schools are still relatively low. The low creative thinking abilities

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indicate that some students are unable to articulate original ideas and theories effectively. Teachers tend to provide a lot of information in delivering the material, and students have not been trained to discover knowledge on their own. Students are less active in expressing abstract ideas and experiences in solving problems, and the blended learning model with innovative media that stimulates students' creative thinking abilities to be more interested in participating in the learning process is not utilized. The learning resources used in both schools only include biology textbooks which do not adequately facilitate students' understanding of abstract concepts.

One of the biology learning materials in the even semester that students find difficult is the reproductive system topic. The reproductive system topic is considered challenging because students need to grasp the abstract concepts of its organs, structures, and functions during their learning process. Difficulties in understanding this material contribute to the students' low creative thinking abilities during learning activities, consequently affecting their learning outcomes (Doyan et al., 2023; Evendi et al., 2021). This is supported by the findings of students' learning outcomes in both schools, which show that the average scores in biology subjects are still below the school's set standard passing grade (KKM) of 80.

Issues in learning are typically classic problems, including lack of learning resources support, methods that do not sufficiently encourage students' creativity, inadequate media support for learning activities, and students' difficulty in understanding purchased materials (Azizah et al., 2024; Bowo, 2022; Susilawati et al., 2023). These factors suggest that an innovative and non-monotonous learning media model is crucial to facilitate understanding of the reproductive system material, thereby enhancing students' creative thinking abilities and learning outcomes. One learning media that can be utilized to improve students' creative thinking abilities and learning outcomes is electronic modules (e-modules).

E-module is a learning resource that contains materials, methods, limitations, and evaluation procedures designed in an engaging and systematic manner to achieve competencies according to the curriculum used by the school (Nurhamidah et al., 2022). E-module is an innovative digital version of printed modules formatted electronically for access via computers and Android devices integrated with supporting software (Laili et al., 2019). The advantages of e-modules include the ability for students to learn anywhere and anytime, enabling independent learning (Fatmawati et al., 2021). They are interactive, allowing for the inclusion of images, videos, audio, and animations (Muliyadi et al., 2023; Zulkarnaen et al., 2022).

Flipped classroom is an approach that combines learning technology and active learning by utilizing technology to access knowledge and information easily in an online format for students (Danuri et al., 2022; Suryana et al., 2021). Additionally, flipped classroom allocates time outside of class, such as at home, for students to discover and study the material beforehand (Fatmawati et al., 2021). Classroom learning time is maximized for students to collaborate with peers, practice, and receive feedback on their learning progress. Therefore, during classroom sessions, students find it easier to build upon their knowledge.

The indicators of students' creative thinking skills can be seen from the aspects of fluency, flexibility, originality, and elaboration. Creative thinking in science aims to foster creativity by combining objects and ideas in new ways, as well as solving problems or generating unusual ideas (Pimdee et al., 2024; Wang et al., 2024). The development of creative thinking skills in biology education aims to solve problems, generate new ideas, and make decisions in contexts related to biological learning. This process enhances creative thinking by encouraging students to engage deeply with the subject matter and explore innovative solutions (Li et al., 2024; Tang et al., 2024).

In addition to media, effective learning strategies remain the most important factor in enhancing creative thinking skills (Naf'atuzzahrah et al., 2024; Permana et al., 2023). Students' creative thinking abilities can be stimulated by using strategies that capture their attention, present the relevance of learning material to their needs, provide confidence-building stimuli for success, and a sense of satisfaction with their performance (Schmid et al., 2023). An effective learning model that allows students to study both at home and at school is a suitable approach to be utilized. E-modules combined with the flipped classroom model are considered highly effective in enhancing students' creative thinking skills and learning outcomes, especially with abstract material.

Method

The research method employed in this study is experimental research, utilizing a Pretest-Posttest Control-Group Design. This experimental design aims to test independent and dependent variables across both control and experimental groups. The research design used in the study is specifically a Pretest-Posttest Control Group Design.

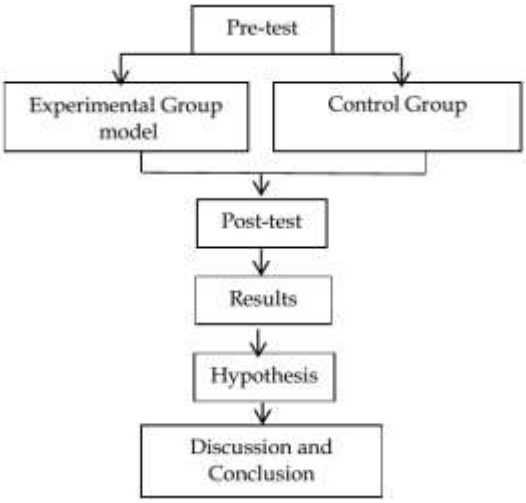

Figure 1. Research methodology flow

Result and Discussion

Overall, students' creative thinking abilities show a difference. The average scores of students' creative thinking abilities between the control and experimental groups differ. This difference occurs because of the distinct treatment in the experimental class, where implementing e-modules with the flipped classroom model enhances students' creative thinking abilities compared to the control class. The percentage difference in the change of creative thinking abilities between the experimental class and the control class can be seen in Figure 2.

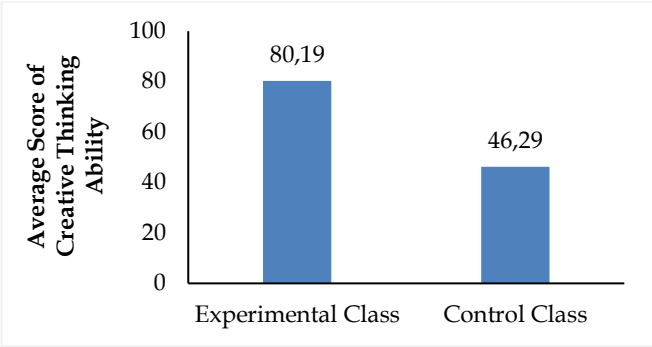

Figure 2. The average score of creative thinking ability

The average score of creative thinking abilities is low in every control class. This is because in the control classes, only conventional learning is used, namely the scientific approach and using textbooks, with not all students having access to textbooks during the learning process. This results in suboptimal outcomes, unlike the experimental group where each student has an e-module on the reproductive system accessible via smartphones. Study indicates that e-modules are an innovative teaching material that is effective and easily accessible in the learning process, including Biology (Birkness-Gartman et al., 2022; Hardiansyah et al., 2022). The average score of each student's creative thinking ability indicators is shown in Figure 2.

The average score of creative thinking ability indicators is shown in Figure 2, indicating a difference in average scores between the experimental and control classes. The experimental class demonstrates higher average scores, achieving a criteria of excellence with an average above 80%, compared to the control class with a low score criterion of 40%. This disparity is attributed to the treatment in the experimental class, where e-modules are utilized with a flipped classroom model, that e-modules enhance students' creative thinking abilities (Sjafei, 2022; Widiana et al., 2021).

The first indicator, fluency, achieved a score of 81.66%, indicating students' ability to generate leading ideas to solve problems. The second indicator, flexibility, scored 83.14%, the highest among the indicators, showing students' capability to provide variations in expressing ideas for any given problem. The third indicator, originality, scored 82%, showcasing students' ability to offer unique combinations of answers. The fourth indicator, elaboration, scored 81%, where students provide solutions based on their own ideas and understood theories. The fifth indicator, complexity, scored 82.29%, demonstrating students' ability to integrate new concepts while adhering to previously learned concepts (Aji et al., 2024; Febrianingsih, 2022).

Table 1. The Average Score of Creative Thinking Ability in the Experimental Group and the Control Group

Class	Average Score	Normality	Homogeneity
Eksperiment	80.19	Sig. < α 0.000< 0.05 (Not Normal)	0.000>α 0.05 (Not homogeneous)
Control	46.29	Sig. < α 0.000< 0.05 (Not Normal)	

The analysis results of creative thinking skills in the experimental group are shown in Table 1. Based on Table 1, the average score of high creative thinking skills in the experimental group was higher compared to the control group, which still showed low abilities. Both groups exhibited a non-normal distribution. The homogeneity test indicated a difference between the experimental and control groups due to the different treatments. The high scores in creative thinking skills occurred because the experimental class was provided with the application of e-modules using the flipped classroom model. Learning with e-modules and the flipped classroom model starts with students first understanding the teaching materials at home, which encourages students to actively engage in discovering

the concepts being studied (Wulandari et al., 2021). This learning activity, employing e-modules with a flipped classroom model, allows students to apply acquired concepts independently before classroom sessions begin, thereby fostering logical reasoning in the learning process and addressing theories not fully understood, thus enhancing students' creative thinking abilities (Chen et al., 2023; Pimdee et al., 2024; Walsh, 2024).

The achievement of creative thinking abilities in the experimental group, taught with e-modules and a flipped classroom model, encourages active and responsive student engagement. The use of e-modules trains students to comprehend theories before class begins (Sureni et al., 2023). The attainment of creative thinking abilities is evident when students tackle assigned problems. Implementing e-modules with a flipped classroom model in the experimental group aids students in exploration, discussions, and minimizes difficulties in finding references during learning processes. Statistical tests and improvements in creative thinking abilities in the experimental class validate that e-modules are effective in enhancing learning experiences (Irmawati et al., 2023). Regarding the use of e-modules with a flipped classroom model in providing answers higher education learning processes should involve activities that communication skills, and creative thinking (Susanti et al., 2019).

The average scores of creative thinking abilities in the experimental class, employing e-modules with a flipped classroom model, are significantly higher compared to those in the control class. The average score for creative thinking abilities in the experimental class is 80.19, whereas in the control class it is 46.29. The experimental class demonstrates higher levels of creative thinking abilities across fluency, flexibility, originality, elaboration, and complexity, as described by the average scores obtained in the descriptive analysis. The average scores of the creative thinking ability indicators can be seen in Figure 3.

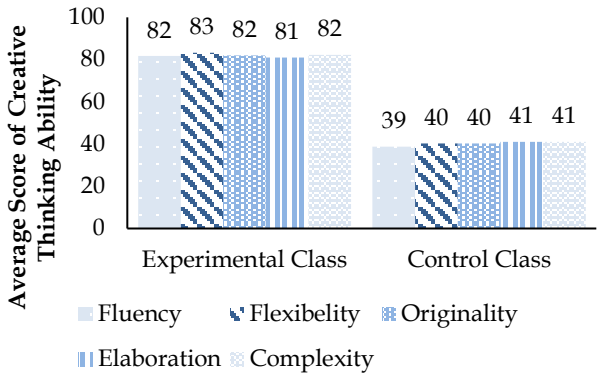

Figure 3. The average scores of the creative thinking ability indicators

On average, the scores of creative thinking ability indicators show that there is a difference in average scores between the experimental class and the control class. The experimental class exhibits higher average indicators of creative thinking ability, specifically above 80%, compared to the control class which shows lower criteria, specifically at 40%. This difference is attributed to the treatment in the experimental class using an e-module with a flipped classroom model. Which is capable of enhancing students' creative thinking skills.

The first indicator, seen in fluency, scores 81%. Students demonstrate the ability to generate prominent ideas in problem-solving. The second indicator, flexibility, scores 83%, which is the highest among the indicators. Students exhibit the capability to provide various ideas in addressing given problems. The third indicator, originality, scores 82%. Students possess the ability to offer different combinations of answers. The fourth indicator, elaboration, scores 81%. Students provide solutions to problems based on their own ideas and understood theories. The fifth indicator, complexity, scores 82%. E-modules with a flipped classroom model enhance creative thinking skills (Lastri, 2023).

The achievement of creative thinking skills in the experimental group, which was taught using e-modules with the flipped classroom model, made students more active and responsive. This is because the use of e-modules trains students to understand theories before the learning begins (Farida et al., 2019). The attainment of students' creative thinking abilities can be observed when they solve the problems provided. This learning activity, which uses e-modules with the flipped classroom model, provides students the opportunity to apply the concepts they have gained through independent learning to solve problems before class begins. This approach encourages reasoning skills in the learning process conducted in the classroom, helping to address theories that are not yet understood and training to enhance students' creative thinking abilities.

This learning activity utilizes e-modules with a flipped classroom model, providing students with the opportunity to apply concepts acquired through self-directed learning to solve problems before class begins. This approach enhances their reasoning abilities during classroom learning sessions, enabling them to tackle previously unclear theories and training them to enhance their creative thinking skills. The achievement of creative thinking skills among the experimental group taught using e-modules with the flipped classroom model makes students more active and responsive. The use of e-modules trains students to grasp theories before class starts (Chrismawati et al., 2021). The attainment of creative thinking skills in students can be observed when they solve given problems.

The average score for creative thinking skills in the experimental class, which applied e-modules with the flipped classroom model, is higher compared to the average score in the control class. The average score for creative thinking skills in the experimental class is 80.19, while the control class has an average score of 46.29. In the experimental class, there is a noticeable level of creative thinking skills across components such as fluency, flexibility, originality, elaboration, and complexity. This can be described based on the average scores obtained from the descriptive analysis. The average scores of students' learning outcomes can be seen in Figure 4.

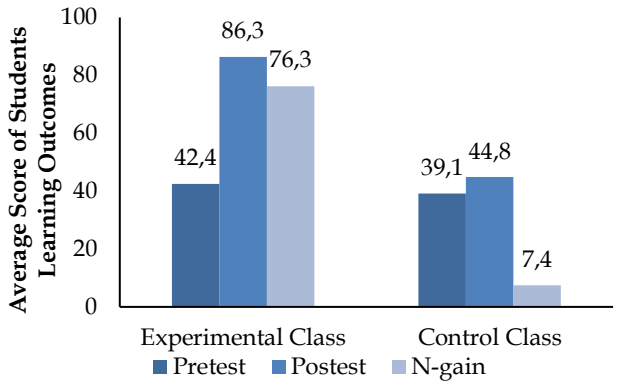

Figure 4. The average scores of students' learning outcomes

The average scores of student learning outcomes indicate that overall, there was no initial difference in the students' understanding. The average scores of the initial abilities of students between the control class and the experimental class were the same. After being treated using e-modules with a flipped classroom model in the experimental group, the post-test scores increased more compared to the control group. The comparison of the average N-Gain in learning outcomes between the experimental and control groups can be seen in Table 1.

Table 2. Analysis of Students' Learning Outcomes

Class	Average Score	Normality	Homogeneity
Eksperiment	86.29	Sig. > α 0.059> 0.05 (Normal)	0.000>α 0.05 (Not homogeneous)
Control	44.80	Sig. > α 0.076> 0.05 (Normal)	

The analysis of students' final learning outcomes (posttest) in the experimental and control groups is presented in Table 1. The average N-Gain scores of students in the experimental and control groups show a significant difference Table 2. Statistical analysis indicates that the data is significant or significantly different between the experimental and control groups. The N-Gain scores obtained in the experimental group are higher compared to the control group, indicating an improvement in students' learning outcomes using the e-module with flipped classroom model. The difference in learning outcomes between the experimental group and the control group is due to the different teaching methods applied to the two groups. The use of e-modules with the flipped classroom model, implemented in the experimental group, has had an impact on improving students' learning outcomes.

The data obtained from the study show that there is a difference in the improvement of learning outcomes between the experimental and control classes. In the experimental class, which applied e-modules using the flipped classroom model, students were encouraged to build their own understanding, be independent, creative, and active. In this approach, the teacher acts primarily as a facilitator rather than providing all the knowledge. Instead, the teacher stimulates students to discover concepts through the instructional materials provided in the modules, communicate their findings with other students, and understand the material before the classroom instruction begins.

The learning activity using e-modules with the flipped classroom model facilitates questions, discussions, and assessments regarding the learning process that has been conducted at home. This is because students have already gained an initial understanding of concepts through self-learning at home, and the e-modules serve as a reference source for learning. According to the characteristics of the module, it integrates learning before school instruction begins by encompassing all materials into the e-modules, including theories and videos. In contrast, the control class uses a scientific approach and does not utilize e-modules or the flipped classroom model. As a result, students in the control class lack an initial understanding before school instruction begins, and their tasks and discussions are based solely on the textbook and instruction from the teacher.

The implementation of e-modules using the flipped classroom model involves teaching students to understand concepts by reading and exploring learning materials beforehand, which are provided in the form of e-modules. E-modules are considered effective resources because they are easily accessible and can include theories and videos that help students develop creative thinking skills (Faridah et al., 2021). This approach demonstrates that e-modules with the flipped classroom model can assist students in deepening their understanding of the material and make learning comprehensive and enjoyable. The use of e-modules with the flipped classroom model enhances the learning process and fosters the development of students'

creative thinking abilities (Permana et al., 2023; Wahab et al., 2023).

The data obtained from the research indicates that there is a difference in learning outcome improvement between the experimental and control classes. In the experimental class, the implementation of e-modules using the flipped classroom model emphasizes on students building self-directed, creative, and active understanding. Here, the teacher acts primarily as a facilitator rather than providing comprehensive knowledge. Students are encouraged to explore concepts independently through module-based learning before class, and then communicate their findings to peers to deepen understanding before formal instruction begins.

The learning activities using e-modules in the flipped classroom model promote questioning, discourse, and assessment of the learning process conducted at home. This is because students gain initial concept comprehension independently at home through pre-learning stages, utilizing e-modules as a reference source during instruction. Modules integrate pre-class learning with all instructional materials including theories and videos.

In contrast, the control class employs a scientific approach without utilizing e-modules or the flipped classroom model. Consequently, students lack initial understanding before school-based learning begins, relying solely on textbooks and teacher-led instruction during tasks and discussions.

Previous research Mutmainnah et al. (2021) explains that learning achievement results from the activities carried out during learning. Using e-modules, for instance, has been shown to enhance student learning outcomes with increased average grades. This finding is consistent with Arriany et al. (2020) study, which highlights that improving learning outcomes isn't solely about correct theories, but also about instructional materials and methods that engage students effectively in the learning process. This underscores the effectiveness of e-modules with the flipped classroom model in significantly improving student learning outcomes.

Conclusion

There is a difference in using e-modules with the flipped classroom model in enhancing creative thinking abilities in high school students, particularly in the topic of reproductive systems. There is an improvement in learning outcomes using e-modules with the flipped classroom model among high school students in the topic of reproductive systems.

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Author Contributions

Conceptualization, W. H.; methodology, W. H.; software, S. W. H.; validation, S. and W. H.; formal analysis, W. H.; investigation, W. H.; resources, S.; data curation, W. H.; writing—original draft preparation, W. H.; writing review and editing, W. H.; visualization, W. H.; supervision, W. H.; project administration, W. H.; funding acquisition, W. H.

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Conflicts of interest

The authors declare no conflict of interest.

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