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The Impact of Escape Room Based Learning Method on Problem Solving Ability of High School Students

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ABSTRACT

Background. Challenge-based learning such as escape rooms is increasingly popular as an alternative in education. This method is seen as improving students' critical thinking and collaboration skills. However, there has not been much research exploring its impact on students' problem-solving abilities at the secondary education level.

Purpose. This study aims to investigate the impact of escape room-based learning methods on the problem-solving ability of high school students. The focus of the research is to evaluate the change in students' problem solving skills after participating in escape room-based learning.

Method. This study used an experimental design with two groups: the experimental group that used the escape room method and the control group that followed the conventional learning method. Data was collected through pretest and posttest to measure changes in students' problem-solving abilities. Data analysis was carried out using a t-test to compare the results between the two groups.

Results. The results showed that the experimental group that used the escape room experienced a significant improvement in problem-solving ability compared to the control group. Students in the experimental group showed higher engagement and better critical thinking skills after following this method.

Conclusion. This study concludes that escape room-based learning methods are effective in improving the problem-solving skills of high school students. This research also provides evidence that challenge-based learning can improve students' engagement and their ability to deal with problems creatively and collaboratively.

KEYWORDS

Challenge-Based Learning, Escape Room, Problem-Solving, Student Engagement

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INTRODUCTION

21st century education emphasizes the importance of critical thinking skills, creativity, collaboration, and communication . Problem-solving skills are an integral part of the competencies that students must have to deal with real-world complexities. Learning environments designed to stimulate analytical and reflective thinking skills are becoming increasingly needed (Hanafi dkk., 2021).

Conventional learning systems tend to still be oriented towards memorization and literal comprehension, so they do not support the development of complex problem-solving skills (Duran dkk., 2024).

Many students have difficulty applying the concepts they learn to solve new problems that require reasoning (Calderon dkk., 2024). The gap between conceptual knowledge and applicability is a challenge in secondary education (Kurni dkk., 2023).

Several innovative approaches have begun to be developed to overcome these obstacles, one of which is the game-based learning method (Fortunato dkk., 2022). This method is believed to increase student motivation while practicing high-level thinking skills. An interactively designed and challenging learning experience is able to create an environment that encourages students' exploration and creativity (Wu dkk., 2023).

Escape rooms as a form of game-based learning have been applied in various educational contexts in developed countries (Abbasi dkk., 2019). These activities involve elements of puzzles, teamwork, and time constraints, which naturally encourage students to think quickly, analyze information, and find solutions together. The escape room can also be adapted according to the learning objectives and characteristics of the students (Chen dkk., 2024).

Previous studies have shown that the use of escape room methods in education has a positive impact on increasing student motivation and engagement (Alves dkk., 2022). Some reports mention an increase in critical thinking skills and teamwork after students engage in these activities (Zhang dkk., 2025). The use of immersive learning media makes the learning experience more meaningful and contextual (González-Gómez & Jeong, 2022).

The theory of social constructivism put forward by Vygotsky became an important foothold in the development of escape room methods in learning (Udjaja dkk., 2019). According to this theory, knowledge is built through social interaction and meaningful learning experiences (Akram, 2019). Escape room-based learning provides a space for collaboration, reflection, and exploration, which supports the process of actively internalizing concepts by learners. This theory emphasizes that direct involvement in problem-solving situations is an important part of the development of students' cognitive abilities (Russo dkk., 2023).

Research on escape room-based learning is still limited in number, especially in the context of secondary education in Indonesia (Manzano-León dkk., 2021). Although it has been widely applied abroad, the effectiveness of this method in improving the problem-solving skills of high school students has not been studied systematically (Gur & Turel, 2025). This gap shows the need for further exploration of the application of escape rooms as a structured instructional method (Jankauskaitė-Jurevičienė, 2023).

Most of the available studies still focus on the motivational aspects and student engagement in game-based learning (Dikilitaş dkk., 2025). Cognitive aspects such as critical thinking and problem solving skills have not been thoroughly evaluated, especially within the framework of the national curriculum-based learning design. Empirical data on the impact of this method on learning outcomes is still very limited (Sejalkumar dkk., 2023).

The context of the implementation of escape rooms in Indonesia has also not been widely discussed in educational research (Grande-de-Prado dkk., 2020). Differences in learning culture, infrastructure readiness, and teacher and student perceptions of unconventional methods are important factors that have not been revealed in depth. Research relevant to the local situation will provide a more comprehensive understanding (Veldkamp dkk., 2022).

The lack of studies that combine quantitative analysis and qualitative case studies in evaluating the impact of escape room methods on problem solving makes understanding of the effectiveness of this method still partial (Bester dkk., 2023). An approach that is able to capture both numerical data and the dynamics of the learning process is needed to describe the potential of this method more completely (Romero & Barma, 2024).

David Kolb's Experiential Learning Theory explains that effective learning occurs when students experience first-hand challenging real-life situations, reflect on those experiences, and construct new understandings (Fontes dkk., 2024). Escape rooms as a learning method provide a cycle of concrete experience, active reflection, conceptual understanding, and active experimentation in accordance with the experiential learning framework (RASTEIRO dkk., 2023). The absence of real, contextual learning experiences in traditional methods is a compelling reason to adopt this experiential approach (Fitria, 2022).

Filling the research gap is important to answer the current educational challenges that demand the integration of high-level thinking skills in the learning process (Maryana dkk., 2024). Problem solving as a key competency in the 21st century requires a learning model that not only conveys information, but also challenges students to think critically and collaborate in complex situations. The escape room method provides an active learning framework that is able to facilitate this (Lane & D'Mello, 2019).

The purpose of this study is to test the extent to which the active learning-based escape room method has an impact on the problem-solving ability of high school students (Ashley, 2025). The hypothesis developed in this study is that there is a significant difference in the increase in problem solving between students who study with the escape room method and students who learn with the conventional method (Rosário & Raimundo, 2024).

The Cognitive Apprenticeship theory of Collins, Brown, and Newman became the basis for designing escape room-based learning (Ashley, 2025). This theory emphasizes the importance of learning through real practice, mentoring, and modeling of thinking strategies. Escape rooms support this strategy by placing students in problematic situations that must be resolved through exploration, discussion, and reflection in groups. This process encourages students to internalize problem-solving strategies gradually (Parthasarathy dkk., 2023).

RESEARCH METHODOLOGY

The research design used was a quasi-experiment with a pretest-posttest control group design approach (Feng dkk., 2024). This approach was chosen to directly measure the impact of using the escape room learning method on students' problem-solving skills . Two groups were used in this study, namely the experimental group that was treated with the escape room method and the control group that used conventional learning methods (Gill dkk., 2025).

The population in this study is all grade XI students in one of the public high schools in a big city in Indonesia. The sample was taken purposively by considering the equality of academic ability between classes and the willingness of teachers to be involved in research. Two classes were selected as samples with a total of 30 students each in the experimental group and 30 students in the control group (Houghton & Paniagua-Avila, 2023).

The instrument used in this study is a problem solving ability test consisting of questions in the form of descriptions with indicators of critical thinking and problem-solving skills based on Bloom's taxonomy. The validity of the instrument was tested through expert judgment and limited trials, while its reliability was tested with the Alpha Cronbach coefficient. In addition, student activity observation sheets and field notes are used to support qualitative data (Craig, 2021).

The procedure for conducting research began with giving a pretest to both groups to find out the initial ability of students. The experimental group then followed escape room-based learning for four meetings, with game scenarios tailored to the basic competencies of the subjects. The control group followed the learning with lecture and discussion methods. After treatment, a posttest was

given to both groups to measure changes in students' problem-solving abilities. Data were analyzed using descriptive and inferential statistical tests (Kim, 2019; Park, 2021).

RESULT AND DISCUSSION

The results of the descriptive analysis showed an increase in problem solving scores in the experimental and control groups. The mean pretest score in the experimental group was 62.3 and increased to 84.5 after treatment. The control group also saw an increase from 63.1 to 70.8 although the increase was not as large as the experimental group.

The standard deviation in the experimental group showed a decrease from 8.7 in the pretest to 7.3 in the posttest. This decrease indicates a more even distribution of grades after learning using the escape room method. In the control group, the standard deviation decreased slightly from 9.1 to 8.5 which means that the distribution of fixed values was quite variable.

The sample size used in this study was 30 students for each group. This number is considered sufficient to provide an initial idea of the influence of methods on student learning outcomes in the context of limited quasi-experimental studies.

Group	Rat-rata Pretest	Rate-Rate Posttest	Standard Pretest Deviation	Standard Posttest Deviation	N
Eksperimen	62,3	84,5	8,7	7,3	30
Control	63,1	70,8	9,1	8,5	30

Table1. Average Results and Standard Deviation of Pretest and Posttest

The difference in scores between the pretest and posttest in the experimental group showed a significant increase of 22.2 points. This figure is much larger compared to the control group, which only increased by 7.7 points. This difference in improvement indicates the real influence of the escape room method on students' problem-solving skills.

The use of challenge-based games in learning triggers students to think fast, strategize, and collaborate. These activities strengthen the ability to think logically and creatively in solving problems. These results are in line with the method's main goal, which is to create a meaningful and interactive learning experience.

The difference in standard deviation before and after learning also showed the influence of methods on uniformity of understanding improvement. The narrowing of the distribution of grades in the experimental group showed that this method not only benefited students who excelled academically, but also improved student achievement more evenly.

The posttest results showed that most of the students in the experimental group were in the 80–90 grade range. Previously, the distribution of pretest scores was more widespread and dominated by scores of 55–70. In contrast, the control group still showed a fairly random spread of values, despite the increase.

There were five students in the experimental group who scored above 90, while in the control group only one student achieved it. This fact shows that the escape room method is able to encourage student achievement at a higher level. The lowest score in the experimental group also rose from 48 to 68, indicating a minimum increase in achievement.

The final value distribution showed a narrower curve and tended to be normal in the experimental group, while the control group showed a still wide spread. This distribution is an indication that learning with an immersive approach can balance student learning outcomes from various initial abilities.

Improved performance in the experimental group showed that involvement in challenging educational games triggered an increase in students' analytical power and creativity. The challenges presented in the escape room encourage students to apply the knowledge they already have in different and unstructured situations.

Students are not only required to answer questions, but also have to strategize, divide roles, and make decisions within a certain time limit. This dynamic creates a learning situation that demands active and collaborative problem-solving. These activities form a reflective and flexible mindset in dealing with new situations.

The contribution of this method to improving learning outcomes can be seen not only from the numbers, but also from the quality of students' responses in the learning process. The teachers involved said that students became more active, communicative, and confident during the learning session with the escape room.

The data showed a correlation between active involvement in game-based learning and improved problem-solving skills. Activities in escape rooms require students to understand problems, seek clues, analyze information, and devise effective solutions. All of these stages are part of the problem solving indicator.

The experimental group experienced a greater improvement than the control group, suggesting that conventional learning methods were not effective enough in developing these skills. The high interaction between students during the escape room also strengthens understanding through discussion and teamwork.

The relationship between quantitative and qualitative data supports each other that escape room as a learning strategy is able to develop students' cognitive potential in a more dynamic and directed manner. The increase in grades consistent with the teacher's observation reinforces the conclusion that this method should be considered as an innovative alternative in education.

A student with the initials A from the previous experimental group was known to have difficulty solving analysis-based problems. After participating in the escape room session, the students showed significant changes in the way they thought and solved problems. The posttest score of student A increased from 58 to 88.

In the teacher's observation, student A is actively involved in group discussions, dares to propose hypotheses, and is able to break down problems into small parts to manage. This thought process was previously not seen in conventional learning activities. His confidence also increased during the process.

Student A said that the challenges in the escape room made him feel challenged to solve problems because there was time pressure and encouragement from group friends. This is one indication that this method is effective in stimulating students' emotional and cognitive involvement in learning.

Changes in behavior and improved student outcomes such as in case study A provide concrete evidence that the escape room method is able to create an impactful learning experience. Students experience the critical thinking process for themselves in a fun and challenging context. An active learning process is the key to the success of this method.

The student experience is not only limited to cognitive improvement, but also builds character such as tenacity, decision-making ability, and teamwork. Activities in the escape room provide space for students to learn from mistakes and try new approaches firsthand.

The teacher states that this method allows students who are usually passive to stand out more and take on roles. Students learn by relying on their own potential, without completely depending

on the teacher's direction. This suggests that game-based learning contributes to learning independence.

All the data obtained showed consistency between the increase in quantitative scores, qualitative student involvement, and teachers' recognition of changes in learning behavior. The application of escape rooms creates a holistic learning experience by combining cognitive, affective, and social aspects.

The relationship between learning components shows that this method does not work in isolation, but rather reinforces each other between elements in the learning process. Challenges, collaboration, and limited time are the main triggers for the creation of a high-level thinking process.

The results of the study provide an understanding that success in learning is not only determined by the content of the material, but also depends heavily on how students experience the learning process. Escape room as a learning method has been proven to be able to answer the needs of today's education that requires mastery of problem solving skills thoroughly.

This study shows that escape room-based learning methods have a positive impact on students' problem-solving skills. The experimental group that used the escape room experienced a greater average increase in posttest results than the control group that used conventional learning methods. The significant increase in the experimental group reflects a clear difference in the effectiveness of the two methods.

Students in the experimental group not only experienced improved scores, but also showed improvements in critical thinking skills, collaboration, and the ability to devise problem-solving strategies more creatively. These results show that escape rooms not only improve cognitive outcomes, but also affect student engagement in the overall learning process.

A significant increase in the standard deviation of the experimental group indicates that this method can reduce the gap in learning outcomes between students with different academic abilities. This shows that escape room-based learning can bring benefits to students with a wide range of ability backgrounds.

The results of this study are in line with several previous studies that show the success of game-based learning methods in improving students' problem-solving skills. Research by Soria and Diedrich (2017) revealed that gamification in education can improve students' critical thinking skills, similar to the findings of this study that show the role of escape rooms in improving problem-solving skills.

However, the study also found differences compared to studies conducted by Meyer (2018), which showed that game-based learning methods do not always provide better results compared to conventional learning in some contexts. The results of this study indicate that the success of the escape room method may be highly dependent on the way of implementation, context, and motivation of students in participating.

The two studies have similarities in showing that educational games, when applied in the right way, can improve students' cognitive and social abilities. However, this study makes an additional contribution by showing that escape rooms can be more effective compared to conventional learning methods in the context of developing students' problem-solving skills at the high school level.

The results of this study are a sign that more interactive and challenge-based learning methods can encourage more in-depth student involvement. Escape rooms, with their immersive approach, not only prioritize the cognitive aspect but also motivate students to think creatively, work together,

and solve problems in teams. This suggests that a fun and challenging education can be the key to improving important skills such as problem-solving.

This research also indicates the importance of a variety of learning methods in supporting the diversity of students' learning methods. Some students may be better suited to conventional methods, but many students will respond more positively to challenge- and game-based learning. This opens up opportunities for a more inclusive and adaptive approach to education, which can meet the needs of different students.

The main conclusion that can be drawn from the results of this study is that innovations in learning methods, such as the use of escape rooms, can have a great impact on the development of much-needed 21st century skills, especially in terms of problem-solving and social skills.

The implication of the results of this study is that schools and educators should consider the use of game-based learning methods, particularly escape rooms, to improve students' problem-solving skills. This method not only improves academic outcomes, but also enriches students' learning experience in a fun and challenging way.

The use of escape rooms in learning can help students develop critical thinking and collaboration skills, which are especially important in this digital age. It can also be an alternative to overcome the saturation in traditional learning methods that tend to be less appealing to students, thereby increasing their motivation to learn.

This research provides the basis for the development of innovative learning methods that can be applied at various levels of education, from primary to secondary education. Therefore, the results of this study have the potential to influence broader education policies regarding more adaptive and technology-based teaching methods.

The results of this study can be explained by the active interaction between students and learning materials in a challenging context. Escape rooms combine elements of play with problem-based learning that require students to use analytical and critical thinking skills in a limited amount of time. This approach creates a more engaging learning experience and provides room for students to thrive in an atmosphere that supports collaboration.

In addition, the positive influence of the escape room method on learning outcomes can also be explained by the theory of constructivism, which states that the most effective learning occurs when students are actively involved in the learning process through hands-on experience. In this context, escape rooms provide an immersive learning experience, which requires students to solve problems independently and in groups.

Significant improvements in results in the experimental group may also be due to higher motivational factors. These challenge-based games provide competitive elements and excitement that increase students' intrinsic motivation to participate more actively in learning.

The next step is to expand the application of the escape room method in various subjects and other levels of education. The use of escape rooms in learning can be extended to other fields, such as natural sciences, mathematics, or history, to test the extent to which these methods can be applied more widely.

Further research is also needed to explore other factors that may affect the effectiveness of this method, such as motivational variables, differences in learning styles, or students' social contexts. Further research can develop a more flexible escape room model that can be adapted to various learning needs.

The implementation of escape rooms on a larger scale also requires ongoing evaluation to identify challenges and opportunities in adapting these methods in various educational settings. Special attention needs to be paid to the development of supporting resources, training for teachers,

and the integration of technology in designing a more interactive and engaging escape room experience.

CONCLUSION

This study found that escape room-based learning methods significantly improved the problem-solving skills of high school students. The main finding that distinguishes this study is the effectiveness of the escape room method in improving collaboration and creative problem-solving skills, which not only impacts academic test scores but also on students' ability to work together in solving challenges. This shows that escape rooms can be a more comprehensive tool in educating students in 21st century skills.

This research contributes a new understanding of the application of game-based methods in education, particularly at the secondary education level. The main contribution lies in the use of escape rooms as an innovative learning method that not only focuses on mastering the material but also on developing students' problem-solving skills. This approach provides a new perspective in learning methods that involve active student engagement, while encouraging effective experiential learning.

This study has limitations in terms of relatively small sample size and the application of the escape room method in only one subject. For follow-up research, it is recommended to expand the sample and test the effectiveness of this method on a wide range of subjects and in more diverse contexts. Further research also needs to consider other variables that may affect the effectiveness of escape rooms, such as differences in student motivation, parental involvement, and other social factors that may affect learning outcomes.

AUTHORS' CONTRIBUTION

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.
Author 2: Conceptualization; Data curation; In-vestigation.

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