THE EFFECT OF GAMIFICATION IMPLEMENTATION ON COLLABORATION SKILLS, ENGAGEMENT, AND LEARNING ACHIEVEMENT OF STUDENTS IN CLASS X SMA XYZ

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ABSTRACT

This study explores the impact of gamification on students' collaboration skills, engagement, and learning achievement in the context of 21st-century education. Utilizing an experimental method, the research was conducted to observe the effects of implementing gamification, particularly through the Quizizz application, in classroom learning. The findings revealed that students in the experimental group, who experienced gamified learning, showed significant improvement in collaboration skills, engagement, and academic achievement compared to the control group. The application of gamification provided an interactive and engaging learning environment that promoted active participation and collaboration among students. The use of gamification as a learning strategy not only enhances students' soft skills but also contributes positively to their overall academic performance. These results suggest that gamification is an effective tool in modern educational settings, providing valuable insights for educators and policymakers to enhance learning outcomes.

KEYWORDS	*gamification, collaboration skills, student engagement, learning achievement*

INTRODUCTION

21st century skills called the 4Cs, namely Critical thinking, Communication, Collaboration, Creativity, are important elements in education. These four skills are essential for students' success in school and the world of work later. This is in accordance with what Voogt and Roblin (2012) said that Critical Thinking, Communication, Collaboration, and Creativity are core learning and innovation

skills that must be processed by 21st century learners (Voogt & Roblin, 2012). In addition, education must be in accordance with the Society 5.0 era which solves various problems by using various innovations born in the 4.0 era (Nurlaila & Rigianti, 2024). The innovations in question are the internet for everything (Internet of Things), big data (Big Data) and artificial intelligence (artificial intelligence). In the process of civilizing which is more dominated by the results of technology applied in terms of gaining knowledge, school children as the main object of learning are directed to be active in learning. This is a challenge and opportunity for students to improve soft skills and academic quality in preparing for the future. This is a challenge for teachers to create classroom learning that focuses on practicing 21st century skills and the use of technology in learning in accordance with the Society 5.0 process.

Collaboration skills are very important because they can help students understand how to deal with problems, overcome problems, and determine what actions to take. It can also be an exercise to know that everyone doesn't always have the same opinion as each other. Collaboration skills are key in facing challenges in the modern era that demand teamwork and effective social interaction. From the perspective of the development of the world of work and daily life, it shows the increasing need for the ability to collaborate. Collaboration is increasingly attracting attention as an important educational outcome and as a key to educational success; This is important not only for school but also for career and life success in the future. This ability is very important so that students can work effectively with others and to facilitate team formation and team-based work, in line with what Zubaidah (2016) explained that this is a study or research material to develop a variety of learning applications to prepare students' competencies and skills in the 21st century.

Furthermore, students must be trained to be able to participate constructively in society and the economy locally, nationally, and globally (Cambridge Assessment International Education, 2021, 3). This means that students need to be prepared to be able to play an active role by increasing the attitude of involvement, which is the effort made by students in learning activities to participate independently and together with others, and equipped with the values of a constructive learning approach. This can be done in classroom learning activities.

Students study at school to achieve learning goals, namely learning success which is the final result of learning over a certain period of time (Serin, 2023). Astini (2022) in Nurlaila and Regianti (2024, 171) stated that increasing the value of human resources through knowledge tracks, ranging from basic, intermediate, to advanced knowledge, is the main basis for continuing the development of Society 5.0. This indicates that learning achievement is an important element and one of the ultimate goals of learning in school.

According to Gredler in Muzakkir et al. (2019), learning is a process carried out by a person to acquire various competencies, skills, and attitudes. The acquisition of abilities, skills, and attitudes is acquired gradually and continuously. The learning process will not be free from problems, there are many problems that occur both from the internal and external of students, namely from the family,

social, and school environments. According to Soesilo in Muzakkir et al. (2019, 102), students' learning problems occur not because students do not carry out learning, but because the learning activities carried out by students experience obstacles so that the goals or results achieved are not optimal. Furthermore, Prayitno in Muzakkir (2019, 102) mentioned indicators that can cause learning problems in schools, namely the prerequisites for mastery of subject matter, learning skills, learning facilities, learning environment, and socio-emotional students. This means that learning, which is a continuous process to achieve abilities, skills, and attitudes, can be hampered by various problems related to willingness, skills, and attitudes.

The change in learning paradigm occurs along with technological advances. The use of technology and innovative learning methods is becoming increasingly relevant to improve the quality of the educational process. Educational technology is essentially the application of knowledge that has been organized as a product and process in overcoming students' learning problems (Sekarini, 2019).

Conventional learning models now tend to transform into more interactive and engaging models. Conventional learning methods may no longer be adequate to meet today's educational challenges, so gamification emerges as an innovative solution that can motivate learners, provide a more dynamic learning experience, and integrate elements of play into the learning context. The application of gamification is a strategy that is considered to increase student engagement in learning, utilizing game elements to create a more engaging learning experience.

Gamification is a strategy that utilizes elements of the game, such as awarding points, levels, and awards, to increase the motivation and engagement of learners. In recent years, the application of gamification has gained significant attention at various levels of education, from primary school to tertiary level. Gamification incorporates game elements such as mechanics and dynamics into the teaching-learning process. The use of gamification in education is also seen as an innovative and impactful strategy that encourages the empowerment of experiences through play Game, without losing academic achievement, while developing the skills necessary to become a 21st century workforce (Murillo-Zamorano et al., 2021). Gamification is about making activities in a non-game context more game-like by using game design elements (Deterding et al., 2011; Sailer et al., 2017).

Games are very important in actively involving students in all learning activities. The game will also transform a teacher-centered classroom into a student-centered classroom. In addition, according to Glover (2013, 2005), adding game elements to learning can increase students' involvement in learning and their interactions with peers. Gamification can create cooperation and sharing, and foster a willingness of learners to be willing to do further tasks compared to conventional methods (Glover, 2013).

In the context of education and learning, gamification has great potential for student learning achievement, especially in building 21st century skills (Harismayanti et al., 2020). Collaboration involves social interaction (Lee et al., 2023). Through verbal exchanges and opportunities to build, discuss, monitor, improve, and combine ideas and knowledge, conceptual understanding becomes

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clear while individuals can share different perspectives and knowledge to achieve common goals (Lee et al., 2023). Furthermore, gamification has become a popular practice used in education (Deterding et al., 2011; Uz Bilgin & Gul, 2020). Thus, the use of gamification as an improvement in students' learning skills and achievement deserves to be investigated.

Technology-based gamification is a strategy to create students' interest in learning. Making student learning activities a game can be done through various applications, such as Quizizz, which is an educational technology tool and an emerging online learning platform (Manipatruni et al., 2023). Quizizz is one of the learning strategies that uses collaboration, and creates a learning environment where students can discuss collaboratively.

Quizizz can provide motivational contributions, provide space for group interaction, provide instant feedback, and thus save time. This is in accordance with the minimum number of lesson hours owned by teachers in the classroom, because of the number of subjects that must be studied by class X students in the 2013 curriculum, namely 17 subjects.

Based on this explanation, the application of gamification using Quizizz was chosen in this study to try to overcome learning problems related to collaboration skills, engagement, and learning achievement. Gamification is believed to be able to train students' collaboration and involvement skills, but also has a positive effect on students' learning achievement. The application of gamification is expected to contribute significantly to improving students' ability to cooperate and collaborate, presenting learning experiences that are not only academic, but also include social and interactive aspects in the form of involvement in learning, and improve learning achievement.

Although the concept of gamification has been widely applied in learning, it has never been done in schools. So that this research is expected to have the potential to make a significant contribution to the development of innovative and sustainable learning approaches, especially at the school level, and can be used as a reference to be applied in schools or other institutions.

Thus, this research is expected to provide valuable insights for authors, schools, education practitioners and society in general to improve learning effectiveness in the context of collaboration skills, engagement and learning achievement.

RESEARCH METHOD

Sugiyono (2018) said that research methods are scientific, rational, empirical and systematic steps to obtain data with specific goals and functions. This study uses an experimental method. Experimental research methods are defined as research methods used to find the effect of a certain treatment on others under controlled conditions (Sugiyono, 2019). In addition, Ruminingsih et al. (2020, 38) define experimental research as one of the quantitative studies in which the researcher manipulates one or more independent variables, and controls the other variables accordingly, then observes the effect of manipulation on the bound variables. Creswell (2017) also explained that an experiment is a study to test an idea, practice, or procedure to determine the influence of results or bound

variables. Thus, the experimental research method is used to find out the results that appear after the existence of treatment (treatment) given to the research subject.

RESULT AND DISCUSSION

Testing Requirements Analysis
   Normality Test
   To find out the type of analysis to be used, whether parametric or nonparametric analysis, it is necessary to conduct a normality test. Parametric statistical analysis assumes that the research data is normally distributed. Meanwhile, non-parametric statistical analysis is used if the test results of the data are proven to be not normally distributed.
   By using the normality test Chi Square, obtained a score Pre-test and post-test collaboration skills, engagement, learning achievement from both research classes as shown in Tables.

Table 1. Pre-test Data Normality Test

Variable	Class	Chi Square	X2 Table	Conclusion
Collaboration Skills	Experiment	2,28	12,83	normal
	Control	6,67	12,83	normal
Involvement	Experiment	13,53	12,83	abnormal
	Control	8,85	12,83	normal
Learning Achievement	Experiment	6,83	12,83	normal
	Control	6,64	12,83	normal

Table 2. Post-test Data Normality Test

Variable	Class	Chi Square	X2 Table	Conclusion
Collaboration Skills	Experiment	8,47	12,83	normal
	Control	0,91	12,83	normal
Involvement	Experiment	3,29	12,83	normal
	Control	6,05	12,83	normal
Learning Achievement	Experiment	66,18	12,83	abnormal
	Control	85,06	12,83	abnormal

Information:
If the result of the chi square calculation is < from X2 Table, then the data is distributed normally.
If the result of the chi square calculation is > from X2 Table, then the data is not distributed normally.

   Based on Tables, it can be concluded that the collaboration skills data are normally distributed, the engagement data is not normally distributed, and the learning achievement data is not normally distributed.

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Homogeneity Test

To test the distribution of data, it is to conduct a homogeneity test to find out whether the variance of the two classes is the same or not. By data processing using Microsoft Excel Data Analysis with a significance level of 0.05, data was obtained as shown in Table.

Table 3. Data Homogeneity Test Pre-test and Post-test Experimental and Control Class

Variable	Pre-test	Conclusion	Post-test	Conclusion
Collaboration Skills	0,29	Homogeneous	0,06	Homogeneous
Involvement	0,50	Homogeneous	0,06	Homogeneous
Learning Achievement	0,24	Homogeneous	0,07	Homogeneous

Information:
If the significance > 0.05, then the data is homogeneous.

Based on Table results Output Homogeneity test using Data Analysis Microsoft Excel Significance values were obtained Pre-test collaboration skills $0.29 > 0.05$, post-test collaboration skills $0.06 > 0.05$, Pre-test $0.50 > 0.05$ engagement, post-test involvement $0.06 > 0.05$, Pre-test learning achievement $0.24 > 0.05$, and post-test learning achievement $0.07 > 0.05$. Thus, it can be concluded that the experimental and control classes have the same variance (homogeneous).

Hypothesis Testing and Discussion

This study aims to find out whether the application of gamification learning methods can improve students' collaboration skills, engagement, and learning achievement in Class X United Kingdom learning at XYZ High School compared to conventional learning. The analysis used was to compare the mean of the research sample using the test of two free samples if both data samples were normally and homogeneously distributed, and using the Mann-Whitney test if one or both samples were not normally distributed. Because this study has two classes that are compared and test *the pre-test* and *post-test* in both classes, the mean test uses *N-Gain data*.

Based on the results of data processing described in the prerequisites section of the hypothesis test, it was concluded that for the hypothesis test of collaboration skills using the T-test, the involvement hypothesis test using the Mann-Whitney test, and the learning achievement hypothesis test using the Mann-Whitney test.

Collaboration Skills Hypothesis Test

The results of the collaboration skill hypothesis test using the T-test to determine the average increase in collaboration skills in the experimental class compared to the control class with parametric data can be seen in Table. The hypothesis decision making is if Symp. sign. (1-tailed) < 0.05, it can be concluded that there is an improvement in students' collaboration skills in the experimental class.

Table 4. Collaboration Skills T-Test Results

	Experimental Class-Control Class
Symp. Sig. (1-tailed)	0,02

The hypothesis for improving students' collaboration skills is as follows:

H_0 : There was no improvement in students' collaboration skills after the application of the gamification method

H_1 : There is an increase in students' collaboration skills after the application of the gamification method

Based on Table 4, the T-test count using Microsoft Excel Data Analysis obtained a significance value of $0.02 < 0.05$ so that it can be stated that there is an increase in the average of the experimental class compared to the control class. So it can be concluded that H0 is rejected and H1 is accepted.

Test the Engagement Hypothesis

The results of the Mann-Whitney test were used to test the engagement hypothesis, to determine the average increase in the aspect of involvement in the experimental class compared to the control class with non-parametric data as seen in Table. The hypothesis decision making is if Symp. sign. (1-tailed) < 0.05, it can be concluded that there is an increase in student involvement in the experimental class.

Table 5. Mann-Whitney Engagement Test Results

	Experimental Class-Control Class
Symp. Sig. (1-tailed)	0,03

The hypotheses for increasing student engagement are as follows:

H_0 : There was no increase in learner engagement after the application of the gamification method

H_1 : There is an increase in student involvement after the application of the gamification method

Based on Table 4.41, the Mann-Whitney test calculation using Microsoft Excel obtained a significance value of $0.03 < 0.05$ so that it can be stated that there is an increase in the average of the experimental class compared to the control class. So it can be concluded that H0 is rejected and H1 is accepted.

Learning Achievement Hypothesis Testing

The results of the Mann-Whitney test were used to determine the average increase in learning achievement aspects in the experimental class compared to the control class with non-parametric data. This test is used to determine whether there is an increase in students' learning achievement in the experimental classroom after gamification is applied. The hypothesis decision making is if Sym. sign. (1-tailed) < 0.05, it can be concluded that there is an increase in students' learning achievement in the experimental class.

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Table 6. Mann-Whitney Test Results for Learning Achievement	
	Experimental Class-Control Class
Symp. Sig. (1-tailed)	0,04

The hypothesis for improving student learning achievement is as follows:

H_0 : No increase in learning achievement after the implementation of gamification

H_1 : There is an increase in learning achievement after the implementation of gamification

Based on Table, the Mann-Whitney test calculation using Microsoft Excel obtained a significance value of 0.04 < 0.05 so that it can be stated that there is an increase in the average of the experimental class compared to the control class. So it can be concluded that H0 is rejected and H1 is accepted.

Discussion

The Effect of Gamification Implementation on Collaboration Skills

Based on the descriptive statistical test, data was obtained that the average score of the pre-test class of the experimental and control classes was almost the same, namely the experimental class (112.29) and the control class (111.71), and for the average post-test score of the experimental class (126.79), it means that the average post-test of the experimental class was more than the average post-test value control class (118.65). From the collaboration skill categorization data, the experimental class was in the medium collaboration skill category (50%), and the control class was in the medium category (42%).

As the function of the inferential statistical test is to draw hypothetical conclusions from the data obtained, N-gain calculations are carried out to test the hypothesis of the T-test. From the results of the calculation, it was concluded that the increase in N-gain in the experimental class, (0.44) was higher than the N-gain of the control class (0.22). The t-test result was 0.02 < out of 0.05 so it can be concluded that there is an improvement in collaboration skills after the application of gamification.

From the results of the descriptive statistical test and the inferential test on the variables of collaboration skills, it can be concluded that the experimental class has a higher level of collaboration skills than the control class. This is in accordance with the results of research by Wiyono, et al. in Rahma et al., (2023, 209), which states that the application of gamification in learning shows that the use of technology in learning can be used to train student collaboration so that it becomes an attractive force between group members and leads to higher commitment and better learning.

The Effect of Gamification Implementation on Engagement

Based on the descriptive statistical test, the average pre-test scores of the experimental and control classes were relatively the same, namely the experimental class (128.09) and the control class (128.74). The average post-test of the experimental class was 150.03, which means that it was higher than that of

the control class (143.94). After all the engagement data was categorized into five categories based on the average value and standard deviation, it was concluded that the number of students in the experimental class had a level of involvement in the medium category (38%), while the control class in the medium category (45%).

As the function of the inferential statistical test is to draw hypothetical conclusions from the data obtained, the results of the N-gain calculation are carried out as the basis for conducting the Mann-Whitney hypothesis test. From the results of the N-gain calculation, it was concluded that the increase in N-gain in the experimental class, (0.49) was higher than the N-gain of the control class (0.30). The results of the Mann-Whitney Test from N-gain obtained a result of $0.03 < 0.05$ so that it can be concluded that there is an increase in student involvement after the implementation of gamification.

From the results of the descriptive statistical test and the inferential test on the involvement variable, it can be concluded that the experimental class has a higher level of involvement than the control class. This is in accordance with the results of research by Anggraeni and Sujatmiko (2021) which stated that gamification in learning can have an influence on learning activities, so that they can become more active in participating in the learning process so that they can increase engagement, besides that they are also more motivated to learn. In addition, research conducted by Zhao (2019, 42) showed a positive influence on student engagement and learning outcomes in classes conducted by gamification experiments using Quizizz.

The Effect of the Implementation of Gamification on Learning Achievement

Based on the descriptive statistical test, the average pre-test score of the experimental class was 6.38, lower than the control class, which was 6.81. For post-test, the average of the experimental class (8.62) was higher than that of the control class (8.10). After all learning achievement data were categorized into five categories based on average values and standard deviations, it was concluded that the number of students in the experimental class had a learning achievement level in the medium category (44%) and a control class in the medium category (35%).

As the function of the inferential statistical test is to draw hypothetical conclusions from the data obtained, the N-gain calculation is carried out for the basis of the Mann-Whitney hypothesis test. From the results of the N-gain calculation, it was concluded that the increase in N-gain in the experimental class, (0.62) was greater than the N-gain of the control class (0.40). The results of the Mann-Whitney hypothesis test obtained a result of $0.04 < 0.05$ so that it can be concluded that there is an increase in learning achievement after the application of gamification.

From the results of the descriptive statistical test and the inferential test on the learning achievement variables, it can be concluded that the experimental class has a higher increase in learning achievement than the control class. This is in accordance with the results of research by Bilgin and Gul (2019, 132) on the

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application of gamification in a collaborative learning environment to improve learning achievement.

In addition to the three conclusions of the hypothesis test results, the author also obtained information from the results of interviews with three students of the experimental class about the application of gamification in the classroom that has been implemented. This interview was conducted as a reinforcement of the research results. Students showed a positive response and felt enthusiastic during learning. They said that the application of gamification allowed them to understand the text and find answers to questions quickly and better, and were happy with the results of the post-test. The ability to answer text questions quickly and accurately will be very useful when students take the next test both at the school level and the college entrance test later. In addition, students also said that the application of gamification allows them to practice discussions effectively, better understand their friends and each other's roles, and make everyone more involved in learning activities.

Research Limitations

There were obstacles faced during this study which then became a limitation in its implementation, that the application of gamification in the experimental classroom was carried out in two meetings only, adjusting to the number of meetings that could be used in completing the learning plan according to the school program. If the application of gamification is carried out more, the achievement of improving collaboration skills, engagement, and learning achievement of students can be higher than the results obtained from this study.

CONCLUSION

The conclusions that can be drawn from the previous explanation of this study are: 1. There is an increase in students' collaboration skills after the implementation of gamification. This is supported by the average post-test score of collaboration skills of the experimental class is higher than that of the control class. Then, from the calculation of the N-gain of collaboration skills, the average N-gain of the experimental class was higher than that of the control class. The results of the Mann-Whitney hypothesis test of the N-gain average obtained a value of less than 0.05. Thus, it can be concluded that the improvement of collaboration skills in the experimental class is higher than in the control class. This is because in the experimental class the application of gamification is used in learning while the contraband class does not. The application of gamification improves the collaboration skills of students in the experimental class because students actively and collaboratively participate in learning in completing their group assignments using the Quizizz application as a form of gamification application. So it can be concluded that the application of gamification can improve students' collaboration skills. 2. There was an increase in the involvement of class students after the implementation of gamification. This is supported by the average post-test score of the experimental class's involvement higher than that of the control class. Then, from the calculation of N-gain involvement, the average N-gain of the experimental class was higher than that of the control class.

The results of the Mann-Whitney hypothesis test of the N-gain average obtained a value of less than 0.05. Thus, it can be concluded that the increase in engagement in the experimental class is higher compared to the control class. This is because in the experimental class the application of gamification is used in learning while the control class does not. The application of this gamification increases the involvement of students in the experimental class because students actively participate in learning and are involved in completing their group assignments using the Quizizz application as a form of gamification application. Therefore, it can be concluded that the application of gamification can increase student engagement. 3. There was an increase in student learning achievement after the implementation of gamification. This is supported by the average post-test score of the experimental class's learning achievement higher than that of the control class. Then, from the calculation of the N-gain of collaboration skills, the average N-gain of the experimental class was higher than that of the control class. The results of the Mann-Whitney hypothesis test of the N-gain average obtained a value of less than 0.05. Thus, it can be concluded that the increase in learning achievement in the experimental class is higher than in the control class. This is because in the experimental class the application of gamification is used in learning while the control class does not. The application of gamification increases the learning achievement of students in the experimental class because students actively and cooperatively participate in learning in completing their group assignments using the Quizizz application as a form of gamification application. So it can be concluded that the application of gamification can improve student learning achievement.

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