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Game On for Chemistry: How Kahoot Transforms Learning Outcomes and Student Interest

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ABSTRACT

Purpose of the study: This study aims to determine the effect of Kahoot game media on students' interest and learning outcomes in chemistry lessons.

Methodology: The method used is an experimental method with a quantitative approach to determine the level of interest and learning outcomes of students and to compare the level of interest and learning outcomes of students in the control class and the experimental class.

Main Findings: The results of the t-test show a significance value of 0.000, then Sig. < 0.05 so that there is an influence between the Kahoot game media and students' interest in learning. These results are supported by observation data with a significance value of 0.015, then Sig. < 0.05. So it can be concluded that there is an influence between the Kahoot game media and students' interest in learning. The results of the Mann-Whitney test show a significance value of 0.749, then Sig. > 0.05 so that it can be concluded that there is no significant influence between the use of Kahoot game media and students' learning outcomes.

Novelty/Originality of this study: The novelty of this study lies in the use of Kahoot game media as an interactive approach to improve students' interest and learning outcomes in abstract and complex Chemistry lessons. This study is also relevant in the context of post-pandemic digital learning that demands technology-based innovation.

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1. INTRODUCTION

Education is an important aspect in supporting students' future, one of which is through guidance and training activities. The quality of education can be seen from how the education system provides relevant and quality learning experiences [1]-[3]. This quality includes various components such as learning outcomes, skills, curriculum, learning methods, and the availability of educational resources. The learning process in schools is the core of the entire education system. Therefore, improving the quality of learning must be a primary concern for all parties involved [4], [5].

Success in the learning process is determined by many factors, including students' interest in learning. Interest in learning is a strong internal drive in students to follow and understand the subject matter [6]-[8]. Students who have a high interest in learning tend to be more active and able to achieve optimal learning outcomes

[6], [9], [10]. Conversely, a lack of interest in learning can be a serious obstacle in the education process. Therefore, teachers need to recognize the importance of interest in learning as an important indicator of learning success [11]-[13].

Student interest in learning is not only determined by internal factors, but is also greatly influenced by the way teachers teach [14]-[16]. Teachers play an important role in generating and maintaining students' interest in learning through a fun and motivating approach [17]-[19]. Low interest in learning is often caused by uninteresting teaching methods, inappropriate learning media, and ineffective teacher-student relationships. To overcome this, teachers are required to be more creative in designing learning. Teacher creativity in using appropriate media can increase students' enthusiasm for learning [20]-[22].

In addition to interest in learning, learning outcomes are also an important benchmark in assessing the effectiveness of learning. Learning outcomes reflect changes in student behavior, knowledge, and skills after participating in the learning process [23]-[25]. Low chemistry learning outcomes are caused by a lack of student interest, low understanding of concepts, and ineffective teaching methods [26]-[28]. Therefore, innovation in learning is needed, especially in subjects that are considered difficult such as chemistry [29]-[31]. An interesting and interactive approach can help students understand the material better.

Along with the development of the times, technology has become an important part of the world of education. The lecture method that used to be dominant is now starting to be abandoned because it makes students passive and bored. Technology provides a great opportunity to create a more enjoyable and interactive learning atmosphere [32]-[34]. One of the main functions of technology in education is to support the learning process to be more effective [35], [36]. Thus, the use of appropriate technology can help improve student learning outcomes significantly.

One of the technology-based media that can be used is the Kahoot game. Kahoot is an interactive internet-based quiz application designed for learning and can be accessed for free [37]-[39]. The use of Kahoot in learning can create an active, fun, and competitive atmosphere [40]-[42]. Students become more enthusiastic and do not get bored quickly when using Kahoot [43]-[45]. However, the implementation of this media is still limited due to the lack of knowledge and motivation of teachers in utilizing learning technology. Several previous studies have shown that Kahoot has a significant influence on increasing student interest and learning outcomes [46]-[48]. Students become more enthusiastic and active in participating in learning when Kahoot is used as a medium [49], [50]. In addition, the level of learning completion also increases significantly. With this background, researchers are interested in studying further through this study.

Although various studies have proven that the use of interactive media can improve learning effectiveness, most studies still focus on conventional presentation- or video-based approaches in chemistry learning. There are not many studies that specifically explore the effect of online game-based quiz media such as Kahoot on students' learning interest and learning outcomes in chemistry subjects, especially at the secondary level. In fact, chemistry is known as an abstract and complex subject, which requires a more fun and competitive approach to actively engage students. Therefore, there is a research gap in examining how educational game media such as Kahoot can facilitate students' cognitive and emotional engagement in chemistry learning.

This study presents novelty by integrating interactive digital game media Kahoot as a learning strategy to improve students' interest and learning outcomes in chemistry material. Not only measuring the increase in learning outcomes quantitatively, this study also observes the relationship between the affective dimension in the form of learning interest and the use of gamification platforms. Different from previous studies that focused more on cognitive aspects alone, this study emphasizes the importance of building emotional engagement through competitive, fun, and real-time technology-based learning experiences.

The urgency of this research lies in the need for learning innovations that can address the low interest of students in chemistry subjects and the challenges of the limitations of boring teaching methods in the digital era. In the context of the industrial revolution 4.0 and the digital-native generation, the use of Kahoot as an interactive learning media is considered relevant to increase active student participation and improve academic achievement. The results of this study can provide concrete recommendations for teachers and schools to utilize educational technology as part of a strategy to improve the quality of science learning.

2. RESEARCH METHOD

2.1. Types of Research

This study uses a quasi-experimental method with a quantitative approach to examine the effect of using Kahoot game media on students' interest and learning outcomes in chemistry lessons and to compare the level of interest and learning outcomes of students in the experimental class and the control class. The quasi-experimental method is a form of design using two groups [51], [52]. One group as the experimental group and the other group as the control group. The experimental group is given treatment with a learning strategy that will be tested for its effectiveness and the control class is given treatment with an existing learning strategy [53], [54]. The quasi-experimental design uses a nonequivalent control group design to compare the experimental group with the control

group. The experimental group and the control group are given a pre-test then given treatment and finally given a post-test.

This study groups respondents into two parts, namely the first group as an experimental group that was given treatment using Kahoot game media and the second group as a control group that was given treatment using conventional learning. The design of this study, namely:

Table 1. Research Design

Group	Pre-test	Treatment	Post-test
Experiment	O_1	X_e	O_2
Control	O_2	X_c	O_4

Information:
O_1 = Pre-test (Experimental Group)
O_2 = Post-test (Experimental Group)
O_3 = Pre-test (Control Group)
O_4 = Post-test (Control Group)
X_e = Using Kahoot game media
X_c = Using conventional learning

2.2. Population and Sample

Population is a generalization area that contains subjects that have certain characteristics that have been determined by researchers to be studied and concluded [55], [56]. In this study, the population is students of State Senior High School majoring in Science. In this study, the sample taken was 67 students of class Science. The sampling technique used in this study was purposive sampling. The purposive sampling technique is a technique for taking samples of data sources with certain considerations [57]. The purposive sampling technique is used for taking samples in small numbers.

2.3. Instruments and Data Collection Techniques

The instrument used in this study was a questionnaire containing specially arranged statements that collect or dig up information or information that is appropriate for analysis. The scale used in this research questionnaire is the Likert scale [58], [59]. The Likert scale is used to measure a person's attitude or perception. This scale assesses the attitude desired by researchers with questions-statements for respondents. The answer weights are 1, 2, 3, 4 for four negative statement choices, while the answer weights are 4, 3, 2, 1 for positive statements. The data collection technique in this study was to distribute a questionnaire. A questionnaire is a data collection technique by distributing a complete list of statements and according to the research variables aimed at respondents to obtain the information needed by researchers [60], [61]. The type of questionnaire used is a closed questionnaire so that respondents can choose the appropriate statement. The questionnaire given to students is a questionnaire on student learning interests before using the Kahoot game media and after using the Kahoot game. The student learning interest questionnaire was distributed via Google Form. The Likert scale and questionnaire grid used in this study can be seen in the table below:

Table 2. Scoring of Questionnaire Scale

No.	Alternative Answers	Positive Statement	Negative Statement
		Score	Score
1.	Strongly Agree	4	1
2.	Agree	3	2
3.	Disagree	2	3
4.	Strongly Disagree	1	4

Table 3. Student Learning Interest Questionnaire Grid

No.	Indicator Statement	Number of Statements	No. Question	
			Positive	Negative
1.	Student interest in learning	7	1,2,3,4	5,6,7
2.	Student pleasure in participating in learning	5	8,9,12	10,11
3.	Student involvement in learning	5	13,14,16,17	15
4.	Student attention to learning	5	18,20,21,22	19
5.	Student motivation towards learning	3	23	24,25
	Total	25	16	9

2.4. Data Analysis Techniques

The type of data used in this study is quantitative data. Data analysis in quantitative research is research that is analyzed statistically to obtain quantities on a problem and build research numerically through statements (questionnaires) or questions [62], [63]. The data analyzed are student learning interest questionnaires, student learning observation results, and student learning outcomes. After the research data is collected, the data is analyzed using descriptive statistics and inferential statistics. Where for the inferential statistical test, an assumption test is carried out in the form of a normality and homogeneity test first, then continued with a hypothesis test in the form of a Mann-Whitney test.

3. RESULTS AND DISCUSSION

3.1. Descriptive Statistical Analysis

3.1.1. Descriptive Analysis of Learning Interest

3.1.1.1 General Descriptive Analysis of Learning Interest

The results of the descriptive analysis of learning interests in the experimental class and control class using a questionnaire with 25 statements are presented in table 4 as follows:

Table 4. General Description of Learning Interests in Experimental Class

No.	Data	Experimental Class	Control Class
		Statistic (%)	Statistic (%)
1.	Number of Samples	33	34
2.	Lowest Score	72	58
3.	Highest Score	100	97
4.	Average	87.85	72.50

Based on table 4, the results of the descriptive analysis of students' learning interest in the experimental class obtained an average value of 87.85, so that students' learning interest in the experimental class was very high. The results of the descriptive analysis of students' learning interest in the control class obtained an average value of 72.50, so that students' learning interest in the control class was high. Thus, students' learning interest in the experimental class was higher than in the control class.

3.1.1.2. Specific Descriptive Analysis of Learning Interests

The results of the specific descriptive analysis of learning interests of the experimental class and control class are presented in Table 5.

Table 5. Specific Descriptive Learning Interests

No.	Indicator	Experimental Class		Control Class	
		Percentage	Category	Percentage	Category
1.	Student interest in learning	91.13	Very High	72.37	High
2.	Students' feelings of pleasure in participating in learning	89.10	Very High	72.65	High
3.	Student involvement in learning	80.91	Very High	70.44	High
4.	Student attention to learning	88.64	Very High	75.59	High
5.	Student motivation towards learning	88.38	Very High	70.83	High

Based on table 5, the learning interest of the experimental class has a higher value compared to the learning interest of the control class.

3.1.2. Descriptive Analysis of Learning Interest Observations

3.1.2.1. General Descriptive Analysis of Learning Interest Observations

The results of the descriptive analysis of learning interests in the experimental class and control class using a questionnaire with 16 statements are presented in table 6 as follows.

Table 6. General Description of Learning Interests in the Experimental Class

No.	Data	Experimental Class	Control Class
		Statistic (%)	Statistic (%)
1.	Number of Samples	33	34
2.	Lowest Score	75	75
3.	Highest Score	100	92
4.	Average	88.12	83.59

Based on table 6, the results of the descriptive analysis of students' learning interest in the experimental class obtained an average value of 88.12 so that students' learning interest in the experimental class was very high, while the results of the descriptive analysis of students' learning interest in the control class obtained an average value of 83.59 so that students' learning interest in the control class was also very high. Thus, students' learning interest in the experimental class is higher than in the control class.

3.1.2.2. Specific Descriptive Analysis of Learning Interest Observations

The results of the specific descriptive analysis of observations of learning interests in the experimental and control classes are presented in Table 7.

Table 7. Deskriptif Spesifik Observasi Minat Belajar

No.	Indicator	Experimental Class		Control Class	
		Percentage	Category	Percentage	Category
1.	Student interest in learning	86.03	Very High	80.48	High
2.	Students' feelings of pleasure in participating in learning	85.29	Very High	82.14	High
3.	Student involvement in learning	84.56	Very High	79.11	High
4.	Student attention to learning	86.28	Very High	83.57	High
5.	Student motivation towards learning	85.78	Very High	81.43	High

Based on table 7, observations of learning interest in the experimental class have higher values compared to the learning interest in the control class.

3.1.3. Descriptive Analysis of Learning Outcomes

3.1.3.1. Descriptive Analysis of Pre-Test Learning Outcome Data

Descriptive analysis of learning outcome data using a pre-test with 18 questions. The following are the results of the descriptive analysis of pre-test learning outcome data in the experimental class and control class presented in table 8 as follows.

Table 8. Descriptive Data of Pre-Test Learning Outcomes

	Data	Experimental Class	Control Class
Pre-test	N	33	34
	Lowest Value	11	11
	Highest Value	61	50
	Mean	32.30	27.18
	Standard Deviation	13.84	12.59
	Variance	191.66	158.39

Based on the descriptive table 8 of the pre-test learning outcome data, the experimental class obtained a higher average score compared to the control class, namely 32.30, while the control class obtained an average score of 27.18.

3.1.3.2. Descriptive Analysis of Post-Test Learning Outcome Data

Descriptive analysis of learning outcome data using a post-test with 18 questions. The following are the results of the descriptive analysis of post-test learning outcome data in the experimental class and control class presented in table 9 as follows.

Table 9. Descriptive Data of Post-Test Learning Outcomes

	Data	Experimental Class	Control Class
Pre-test	N	33	34
	Lowest Value	44	222
	Highest Value	100	94
	Mean	81.61	80.38
	Standard Deviation	11.36	15.75
	Variance	128.93	247.94

Based on the descriptive table 9 of post-test learning outcome data, the experimental class obtained a higher average score compared to the control class, namely 81.61, while the control class obtained an average score of 80.38.

3.2. Prerequisite Analysis Test

3.2.1. Normality Test

3.2.1.1. Normality Test of Learning Interest Questionnaire

Table 10. Results of the Normality Test of the Learning Interest Questionnaire

Data	Interest in Learning
α	0.05
Sig.	0.086
Conclusion	Sig. > (α) (0.05) The population of learning interest variable values is normally distributed

Based on table 10, the results of the normality test of the learning interest questionnaire obtained a significance value of 0.086. So it can be concluded that the population of learning interest variable values is normally distributed.

3.2.1.2. Normality Test of Learning Interest Observations

Table 11. Results of the Normality Test for Observations of Learning Interest

Data	Interest in Learning
α	0.05
Sig.	0.200
Conclusion	Sig. > (α) (0.05) The population of learning interest variable values is normally distributed

Based on table 11, the results of the normality test of the learning interest observation obtained a significance value of 0.200. So it can be concluded that the population of learning interest variable values is normally distributed.

3.2.1.3. Normality Test of Learning Outcomes

Table 12. Results of the Normality Test of Learning Outcomes

Data	Learning outcomes			
	Experimental Class		Control Class	
	Pre-Test	Post-Test	Pre-Test	Post-Test
α	0.05			
Sig.	0.002	0.006	0.003	0.000
Conclusion	Sig. < (α) (0.05) The population of learning outcome variable values is not normally distributed			

Based on table 12, the results of the normality test of learning outcomes, the significance value in the experimental class pre-test is 0.002, then 0.002 < 0.05 so that the value of the learning outcome variable is not normally distributed, and the post-test is 0.006, then 0.006 < 0.05 so that the value of the learning outcome variable is not normally distributed. The significance value in the control class pre-test is 0.003, then 0.003 < 0.05 so that the value of the learning outcome variable is not normally distributed, and the post-test is 0.000, then 0.000 < 0.05 so that the value of the learning outcome variable is also not normally distributed. The statistical test that will be used for the hypothesis test is a nonparametric test with the Mann-Whitney test.

3.2.2. Homogeneity Test

3.2.2.1. Homogeneity Test of Learning Interest Questionnaire

Table 13. Results of the Homogeneity Test of the Learning Interest Questionnaire

Data	Interest in Learning
α	0.05
Sig.	0.340
Conclusion	Sig. > (α) (0.05) Data comes from a homogeneous group

Based on table 13, the results of the homogeneity test of the learning interest questionnaire obtained a significance value of 0.340, so 0.340 > 0.05, so it can be concluded that the data comes from a homogeneous group.

3.2.2.2. Homogeneity Test of Learning Interest Observations

Table 14. Results of the Homogeneity Test of Learning Interest Observations

Data	Interest in Learning
α	0.05
Sig.	0.005
Conclusion	Sig. < (α) (0.05) Data comes from non-homogeneous groups

Based on table 14, the results of the homogeneity test of the learning interest questionnaire obtained a significance value of 0.005, so 0.005 < 0.05, so it can be concluded that the data comes from a group that is not homogeneous or heterogeneous.

3.2.2.3. Homogeneity Test of Learning Outcomes

Table 15. Results of the Homogeneity Test of Learning Outcomes

Data	Interest in Learning
α	0.05
Sig.	0.354
Conclusion	Sig. > (α) (0.05) Data comes from a homogeneous group

Based on table 15, the results of the homogeneity test of learning outcomes obtained a significance value, namely 0.354, so 0.354 > 0.05, so it can be concluded that the data comes from a homogeneous group.

3.3. Hypothesis Testing

3.3.1. Hypothesis Test of Learning Interest Questionnaire

Table 16. Results of the Hypothesis Test of the Learning Interest Questionnaire

Data	Interest in Learning
T_{count}	7.014
T_{table}	1.997
Sig. 2-tailed	0.000
α	0.05
Conclusion	Sig. < (α) (0,05) There is an influence between the Kahoot game media on interest in learning

Based on table 16, the results of the hypothesis test of the learning interest questionnaire obtained a Tcount value of 7,014 and a Ttable of 1,997. The significance value obtained is 0.000, so 0.000 < 0.05 so it can be concluded that there is an influence between the Kahoot game media on students' learning interest.

3.3.2. Hypothesis Testing of Learning Interest Observation

Table 17. Results of the Hypothesis Test of Learning Interest Observations

Data	Interest in Learning
T_{count}	2.488
T_{table}	1.997
Sig. 2-tailed	0.015
α	0.05

Conclusion	Sig. < (α) (0,05) There is an influence between the Kahoot game media on interest in learning

Based on table 17, the results of the observation hypothesis test of learning interest obtained a Tcount value of 2,488 and a Ttable of 1,997. The significance value obtained is 0.015, so 0.015 < 0.05 so it can be concluded that there is an influence between the Kahoot game media on students' learning interest.

3.3.3. Hypothesis Testing of Learning Outcomes

Table 18. Results of Learning Outcome Hypothesis

Data	Learning outcomes	
	Pre-Test	Post-Test
α	0.05	
Asymp.Sig. 2 tailed	0.113	0.749
Conclusion	Sig. > (α) (0,05) There is no influence between the Kahoot game media on learning outcomes	

Based on table 19, the results of the hypothesis test of learning outcomes, the significance value obtained is 0.749, so 0.749 > 0.05. The decision criteria are, Ho is accepted if the significance value is > 0.05, so it can be concluded that there is no significant influence between the use of Kahoot game media on student learning outcomes.

The implementation of interactive game-based learning media such as Kahoot has a positive contribution to increasing students' interest in learning. These results strengthen the view in constructivist theory which states that meaningful learning occurs when students are actively involved and motivated in the learning process. In this context, Kahoot is not only a fun evaluation tool, but is also able to create a competitive and collaborative learning atmosphere, which ultimately increases students' interest and enthusiasm [64], [65].

The dominance of the “very high” category in the learning interest indicator in the experimental class shows that the digital game-based approach provides a different learning experience compared to conventional methods. Active student involvement, full attention during the learning process, and the emergence of a strong sense of pleasure and internal motivation are signs that Kahoot is able to fulfill important elements in student-oriented learning.

However, although the increase in learning interest was quite significant, the implementation of Kahoot did not show an equally strong influence on student learning outcomes, especially in the hypothesis test for post-test data. This can be explained from the perspective of Bloom's taxonomy, where the use of Kahoot is more dominant in activating the affective domain and some low-level cognitive domains such as remembering and understanding, but has not fully reached high-level thinking skills such as analyzing and evaluating.

The mismatch between the increase in learning interest and learning outcomes can also be caused by external factors such as the duration of media use, teacher readiness in managing technology-based activities, or the limitations of test instruments that do not reflect the achievement of competencies as a whole. In this case, Kahoot functions effectively as a motivation trigger, but needs to be integrated with other learning strategies to encourage the achievement of more optimal learning outcomes.

In terms of prerequisite analysis, the varying results of normality and homogeneity tests indicate the importance of choosing the right statistical method. The use of non-parametric tests such as Mann-Whitney is an appropriate choice considering the non-normal distribution of learning outcome data. This confirms that the validity of decision making in quantitative research is highly dependent on the fulfillment of statistical assumptions. Overall, this study provides empirical evidence that the use of digital game-based media can improve the affective aspect of learning, especially in terms of learning interest. However, to obtain optimal learning outcomes, this approach needs to be combined with pedagogical methods that emphasize material in-depth study and critical thinking skills. Thus, media such as Kahoot can play a strategic role as a complement in modern learning designs that are both fun and effective.

This study shows a positive impact on increasing students' interest in learning through the use of interactive and fun game-based learning media. Kahoot is able to create a competitive and participatory learning atmosphere, thus encouraging students' active involvement in the chemistry learning process which has been considered difficult and boring. However, this study has several limitations, including the relatively short intervention time, limited material coverage, and has not touched on high-level cognitive domains in depth. In addition, external variables such as teacher readiness, technology support, and students' psychological conditions also have the potential to influence the results, but have not been analyzed comprehensively. These findings open up opportunities for further research with a wider scope and a mixed approach to more thoroughly examine the effectiveness of game-based learning in improving student learning outcomes and competencies.

4. CONCLUSION

There is an influence of Kahoot game media on students' interest in learning with a very high category of 87.85%. The percentage level of interest in learning based on indicators, namely student interest in learning of 91.13 (very high), students' feelings of pleasure in participating in learning of 89.10 (very high), student involvement in learning of 80.91 (very high), student attention to learning of 88.64 (very high), and student motivation towards learning of 88.38 (very high). There is no significant influence between Kahoot game media on learning outcomes, because the significance value obtained is 0.749 so that the sig. value < (α) (0.05).

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AUTHOR CONTRIBUTIONS

Conceptualization, I.S.A.-F. and R.D.; Methodology, I.S.A.-F. and K.C.B.; Software, I.S.A.-F.; Validation, I.S.A.-F., K.C.B., and R.D.; Formal Analysis, I.S.A.-F.; Investigation, I.S.A.-F. and K.C.B.; Resources, R.D.; Data Curation, I.S.A.-F.; Writing – Original Draft Preparation, I.S.A.-F.; Writing – Review & Editing, I.S.A.-F., K.C.B., and R.D.; Visualization, I.S.A.-F.; Supervision, R.D.; Project Administration, I.S.A.-F.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the generation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried out entirely by the authors without the assistance of AI-based technologies.

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