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The Influence Of The Brain-Based Learning Model Assisted With Quizizz Media On Students' Creative Thinking In History Learning

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Abstract: *Education in the 21st century has given rise to a new paradigm in learning. This is implemented through technology, information, and communication-based learning. As times progress, teachers and students must have 21st-century skills, including communication, collaboration, creative thinking, and critical thinking, or what is commonly known as 4C. This research aims to determine the effect of the brain-based learning model assisted by quiziz media on students' creative thinking skills. This research method uses a quasi-experiment type of research consisting of an experimental class and a control class. The data analysis method used includes the ANCOVA test and a further test in the form of LSD (Least Significant Difference) to see which of the two classes, namely the experimental class and the control class, has a more significant influence on students' creative thinking skills. The results of this research show a significance value for the ANCOVA test of 0.000 (0.000 > 0.05), which means there is a positive influence of the brain-based learning model assisted by quiziz media on students' creative thinking skills. In contrast, the LSD test shows a significance value of 0.000 with a mean difference of -14.560 in the pretest and posttest columns for the experimental class. In contrast, in the pretest and posttest, the control class obtained a significance value of 0.000 with a mean difference of -10.889. So, it can be concluded that the experimental class taught using the brain-based learning model significantly influenced students' creative thinking skills more than the control class taught using the problem-based learning model.*

Keywords: Learning models, Brain-Based Learning, Creative Thinking, Quizizz Media

1. INTRODUCTION

Education in the growing technology era raises a new paradigm affecting all learning aspects. Welcoming the Industrial Revolution 4.0 in the 21st century, technological developments are increasingly sophisticated, which can affect the way of thinking, behaving, and changing the character of students (Boulhrir, 2017). To deal with changes in the 21st century, seven skills are needed: critical thinking, creativity and innovation, collaboration and leadership, cross-cultural understanding, literacy, information, media and communication, computer and ICT literacy, and life and career skills (Serdyukov, 2017). One of the 21st-century skills that is a reference in the implementation of the new curriculum in Indonesia, namely the Merdeka Curriculum, is thinking skills. According to experts, creative thinking is one of the keys to success in life (Joynes et al., 2019). As a form of response to the times, the teacher as a learning facilitator plays a role in developing *creative thinking skills and being* innovative in learning (Muhtar & Rahayu, 2022), for example, through the application of learning models and social activities that are by students' thinking patterns (Andayani *et al.*, 2020). Therefore, teacher efforts are needed to apply a suitable learning model to support the success of learning objectives.

Creative Thinking Skills are one of the 21st-century skills that emphasize the students' thinking process in expressing new ideas in teaching and learning activities. Developing *creative thinking skills is* essential for students to fulfill 21st-century skills (Wechsler, *et.al.* 2018). *Creative thinking skills* train students to create new ideas (Weisberg, 2015; Putri, *et al.*, 2022). Creative thinking is not a fixed ability that someone has or does not have, but it needs to be taught and developed in a person (Saavedra, *et.al.* 2019). Previous research revealed that students' creative thinking ability is still in the low category; this is caused by teachers who need to hone students' thinking competencies; they tend to memorize instead of understanding concepts (Hidayat & Widjajanti, 2018). According to Dewi *et.al* (2019), their research revealed that creative thinking skills in Indonesia are still relatively low based on the results of *The Global Creativity Index in* 2015, which states that Indonesia is ranked 115 out of 139 countries, research by Leasa *et.al* (2021) also revealed that low *creative thinking skills* require better learning efforts comprehensively to improve students' *creative thinking skills*. So overcoming this problem involves applying specific learning models whose steps can train students to think creatively (Saregar, *et.al.* 2021). One of the learning models that has proven effective in improving students' *creative thinking skills* is the *Brain-Based Learning model*.

Brain-based *learning* is learning based on the brain's performance that works naturally. *Brain-based learning is* a concept that creates learning that is oriented to maximize the potential of students' brains (Jensen, 2011). The *brain-based learning* model is a learning model that reviews the workings of the brain in retrieving, processing, and interpreting absorbed information sources (Wiantara, *et.al.* 2020). BBL is based on the idea that every part of the brain can function optimally in learning (Siercks, 2012; Handayani *et al.*, 2021). One of the characteristics of the *Brain-based learning* model

is creativity, which means that every teacher must motivate students to create something or be able to solve a problem with methods, techniques, or ways that students master through the learning process (Immanuel, et al., 2022). *Brain-based learning* provides space for students to think freely without pressure, a supportive learning environment, and can stimulate creative thinking (Supeno, *et.al.,* 2022). Therefore, *brain-based learning is* the right choice for teachers when implementing learning models to develop students' *creative thinking skills*.

Previous research has revealed that the *brain-based learning* model affects students' *creative thinking skills*, showing that using *brain-based learning* in teaching and learning activities positively influences students' *creative thinking skills* (Purwanto *et al.,* 2018). *Brain-based learning* models in learning have proven effective in improving students' *creative thinking skills* (Immanuel *et al.,* 2021). In addition, research by Maknuna (2022) reveals that students taught using a *brain-based learning model* have better creative thinking skills than those taught using a *problem-based learning* model.

Brain-based learning develops three primary strategies in its application: realizing a learning atmosphere that can hone students' *creative thinking skills* and realizing a learning atmosphere that is fun, active, and meaningful for students. (Rahmatin & Suyanto, 2019). In the *brain-based learning* model, students can increase their learning potential (Santoso et al., 2019). *Brain-based learning* provides guidelines based on the principles and work of the brain to improve the best way of learning, improve academic achievement, and provide equal opportunities for individual differences (Duman, 2010). *Brain-Based Learning* (BBL) is a learning model based on the brain's structure that works naturally. According to Jensen (2011), the steps of *brain-based learning* include preexposure, preparation, initiation and acquisition, incubation and memory encoding, verification and checking, celebration, and integration.

The use of appropriate media and learning resources certainly supports the application of the learning model. Learning that uses media can make it easier for teachers to present learning materials and something new for students (Magdalena, 2021). One of the factors determining the success of learning in the classroom is the use of learning media (Ramadhani, *et.al*., 2023). The learning media used can be teaching aids or technology-based media (Rahman, *et.al.*, 2023). Technology can be used in diverse ways in the classroom, depending on teacher planning and creativity (Junior, J.B., 2020). Research shows that students who learn using interactive media such as videos, simulations, and games can better understand concepts and are more involved in learning than learning through text or presentations (Courts & Tucker, 2012; Damanik & Saragih, 2020). One example of interactive learning media is *quiz* media. *Quiziz* is a game or software application that combines digital games with education (Sitorus & Santoso, 2022). Through this application, learning activities in the classroom are more interactive and fun (Susilaningsih, *et.al*. 2020). Unlike other educational applications, *quiziz* has various characteristics, including avatars, themes, memes, and music that can entertain students in the learning process (Purba, 2019). Therefore, *quizizz* media is an alternative teachers can use to develop students' thinking potential and can be used as a learning evaluation.

Teachers need the application of appropriate learning models and media to create a more varied learning atmosphere and, of course, improve 4C abilities according to the demands of 21st-century learning. Teachers applying appropriate models and media will motivate students to improve learning outcomes. Of course, students will be impressed with the learning carried out by the teacher (Sukmawan *et al.,* 2023). So, based on the problems that arise in the field, the *brain-based learning model* is suitable for the classroom to improve students' thinking skills and learning outcomes. The *brain-based learning* model is learning that is packaged through a more interactive discussion, meaning that students are invited to exchange ideas or opinions and are free to express their opinions and exchange ideas with other students to find the right problem solution. The *brain-based learning* model prioritizes students to maximize brain function, especially the right brain, which tends to be used to hone creative thinking skills. Based on the explanation described above, the researcher is interested in conducting an experimental study entitled **"The Effect of *Brain-Based Learning* Model Assisted by *Quiziz* Media on *Creative Thinking Skills* and Learning Outcomes of Students in History Learning."**

II. Research Methods

1. Research Instruments

Instruments related to creative thinking skills are obtained through performance tests, which are assessed using a questionnaire containing written statements accompanied by creative thinking skills indicators, namely (1) *fluency, (*2) *flexibility,* (3) *originality, and (*4) *elaboration*. Each of the four indicators has a sub-indicator, which will then be arranged as an instrument used to measure students' *creative thinking skills*. The *creative thinking skills* questionnaire uses a Likert scale model with answer choices, namely Very Creative (SK), Creative (K), Creative Enough (CK), Less Creative (KK), and Not Creative (TK).

2. Research Design

This study used a *quasi-experiment* research design type of *nonequivalent control group design*. This design has a control group but cannot function fully to control external variables that affect the implementation of the experiment (Sugiyono, 2018). In this study, there is a control class and an experimental class. The experimental class will be treated with the *brain-based learning* model applied by the teacher, and the control class will be given the *problem-based learning* model.

3. Prerequisite Test Analysis

The prerequisite test fulfills the requirements before hypothesis testing is carried out. The prerequisite test analysis is used to carry out normality tests, homogeneity

tests, linearity tests, validity tests, and instrument reliability tests.

a) Normality Test

Data	Type III Sum of Squares	df	Mean Square	F	Sig.
Class * Pretest	103.618	7	14.803	0,974	0,468

Implementing the normality test aims to prove whether the sample data comes from a normally distributed population. The normality test was carried out based on the test results of student's *creative thinking skills* from experimental and control classes. It was calculated using Kolmogrov-Smirnov on SPSS version 25 for Windows.

b) Regression Homogeneity Test

The regression homogeneity test aims to determine whether there is a relationship between covariates and independent variables. If there is, the slope of the regression line is declared homogeneous. The regression homogeneity test was carried out using SPSS version 25 *for Windows.*

c) Linearity Test

The linearity test is the last assumption test before the ANCOVA test. It aims to determine whether the relationship between covariates and the dependent variable is significant. Covariates are said to have a linear relationship with the dependent variable if their significance value is less than 0.05. They have no significant linear relationship if their significance value is more than 0.05.

A. Hypothesis Test

This study applied hypothesis testing using ANCOVA (analysis of covariance) and the LSD/BNT test. Hypothesis testing in data analysis was carried out using the SPSS 26 for Windows software program.

a) ANCOVA Test

The ANCOVA test was conducted to test the effect of the *brain-based learning* model assisted by *Quizizz* media on students' *creative thinking skills* in history learning with *pretest* scores as covariates. Before conducting the ANCOVA test, first, carry out the prerequisite test and assumption test that was described in the previous subchapter. The following is the basis for decision-making on the ANCOVA test:

a. If the significance value > 0.05, then Ha is accepted
b. If the significance value is <0.05, then H0 is rejected.

b) LSD (*Least Significant Different*) Test

The LSD test was first introduced by Fisher (1935) and is commonly known as Fisher's LSD or *Least Significant Difference* method. The LSD test aims to determine the effect between the average of two treatments and which one has a more significant effect. The LSD value becomes the benchmark in determining the average difference between two treatments statistically.

III. Results and Discussion

1) Research Results

a) Normality Test

The normality test in this study was measured from the *pretest-posttest* results of the two samples, namely the control class (XI 8), which was given the *problem-based learning* model *treatment,* and the experimental class (XI 9), which was given the *brain-based learning* model *treatment* assisted by *quiz* media. The normality test used the Kolmogorov-Smirnov formula assisted by *SPSS for Windows software* version 25. The decision-making criteria using a significance level of 5% are as follows:

a. If the sig value> 0.05, then H0 is accepted (normally distributed)
b. If the sig value <0.05, then H0 is rejected, or Ha is accepted (not normally distributed)

Table 1. Normality Test Results of *Creative Thinking Skills*

	Class	**Kolmogorov-Smirnov[a]**		
		Statistic	**df**	**Sig.**
Creative Thinking	Control Pretest	0,156	27	0,089
	Control Posttest	0,131	27	0,200
	Experiment Pretest	0,108	25	0,200
	Experiment Posttest	0,149	25	0,158

Table 1 shows the results of the normality test *output* using the *Kolmogrov-Smirnov* technique, which shows that the significance value for the experimental class on *pretest* data is 0.200 and the *posttest value is* 0.158, which means that the *pretest* and *posttest* data in the experimental class are normally distributed. The significance value of the control class on the *pretest* data is 0.089, and the *posttest value is* 0.200. So, based on the decision-making criteria that the normality test results for *pretest* and *posttest* data in both classes, both experimental and control, show a significance value above 0.05 (Sig. > 0.05), so it can be concluded that the *pretest* and *posttest* data in these classes are typically distributed.

b) Regression Homogeneity Test

The regression homogeneity test aims to determine whether there is a relationship between covariates and independent variables. The slope of the regression line is declared homogeneous if the significance value between the covariate and the independent variable is more than 0.05 (sig. > 0.05).

Table 2. *Creative Thinking Skills* Regression Homogeneity Test Results

Table 2 produces a significance value *output of* 0.468 in the class and pretest tables. So, by decision-making, it can be concluded that there is a relationship between the covariate (pretest) and the independent variable (class) for both experimental and control classes because the significance value is more than 0.468 (sig. > 0.05).

c) Linearity Test

The linearity test is the last assumption test before the ANCOVA test. The linearity test aims to determine whether the relationship between covariates and the dependent variable has a significant linear relationship. The linearity test was carried out with the help of SPSS version 25 *for Windows*. The following are the decision-making criteria for the linearity test:

a. If the sig. If the value is> 0.05, there is no significant linear relationship between the covariates and the dependent variable.
b. If the sig. Value <0.05, then there is a significant linear relationship between the covariate and the dependent variable.

Table 3. Linearity Test Results of *Creative Thinking Skills*

Dependent Variable: Posttest					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Pretest	975.556	14	69.683	4.585	.000

Table 8 shows the results of the linearity test for *creative thinking skills* derived from *pretest* scores as covariates and class as the dependent variable. In the table, the significance value shows a 0.000 (0.000 <0.05) result. So, based on the decision-making criteria, it can be concluded that there is a significant linear relationship between the covariate and the dependent variable.

2) Hypothesis Test

Research involves hypothesis testing to answer the problem formulation. This study will use the ANCOVA (*Analysis of covariance*) test and the LSD (*Least Significant Differen*ce) test.

1. ANCOVA Test

ANCOVA testing aims to determine whether there is an influence on *creative thinking skills* and learning outcomes of students who are taught using the *brain-based learning* model assisted by *quiziz* media in the experimental class and the *problem-based learning* model assisted by PowerPoint using *Canva in* the control class. In this study, *pretest* as a covariate. In this study, *pretest* and *posttest* data from control and experimental classes that have met the requirements of normality, homogeneity, and linearity tests will be tested with the help of *SPSS* version 25 *for Windows*. The following are the decision-making criteria in the ANCOVA test:

a. If the Sig. Value is <0.05, then H0 is rejected, and Ha is accepted.
b. If the Sig. value > 0.05, then H0 is accepted, and Ha is rejected

Tabel 4. Test of Between-Subject Effects Results on *Creative Thinking Skills*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1337.627[a]	2	668.813	41.388	.000
Intercept	645.236	1	645.236	39.929	.000
Pretest	709.085	1	709.085	43.880	.000
Class	299.079	1	299.079	18.508	.000
Error	791.815	49	16.159		
Total	350303.000	52			
Corrected Total	2129.442	51			

Based on table 4 shows the results of the *test of between subject effects* for students' *creative thinking skills*. In the *Corrected Model* column, a significance value of 0.000 (0.000 <0.05) is obtained, which means that simultaneously, the *pretest* and learning model affect students' *creative thinking skills*. Then, in the learning model column, a significance value of 0.000 (0.000 <0.05) is obtained, which means that there is a difference in the effect of applying the learning model, namely the *brain-based learning model* assisted by *quiziz* media in the experimental class and the *problem-based learning* model assisted by PowerPoint using *canvas in* the control class. So, the conclusion is that H01 is rejected, meaning that applying the brain-based *learning* model, which is assisted by *quiz* media, significantly affects students' creative thinking skills.

2. LSD (*Least Significant Different*) Test

The next step is to conduct further tests using LSD (*Least Significant Differen*ce), which aims to determine the effect between the averages of the experimental and control classes, which one has a more significant influence. LSD test was conducted using *SPSS* version 25 *for Windows*.

Table 5. Results of LSD Test for *Creative Thinking Skills*

Table 5 presents the LSD test results for *creative thinking skills for* both control and experimental classes derived from pretest and posttest data. In the control pretest column (I), the control posttest (J) shows a significance value of 0.000 (0.000 <0.05), which means

Multiple Comparisons				
Dependent Variable: Creative Thinking Skills				
(I) Class	(J) Class	Mean Difference (I-J)	Std. Error	Sig.
experimental pretest	experimental posttest	-14.560*	1.659	.000
control pretest	control posttest	-10.889*	1.596	.000

there is an influence, with a *mean difference of* -10.889. As for the experimental class, the pretest and posttest data have a significance value of 0.000 (0.000 <0.05), which means there is an influence, with a *mean difference of* -14.560. So, it can be concluded that the experimental class taught using the *brain-based learning* model assisted by *quiz* media has a better *creative thinking skills* effect than the control class taught using the *problem-based learning* model assisted by PowerPoint using *Canva*.

2) Discussion

This study used the experimental classes (XI 9) and control classes (XI 8) to apply different learning models. The experimental class applied *a brain-based learning* model assisted by *Quiziz* media, while the control class applied a *problem-based learning* model assisted by PowerPoint using *Canva. The* application of the *brain-based learning* model consists of 6 stages, namely: (1) preexposure, (2) preparation, (3) Initiation and Acquisition, (4) elaboration, (5) Incubation, (6) verification and checking. In contrast, the steps of the *problem-based learning* model include (1) orienting students to the problem, (2) organizing students, (3) guiding individual and group investigations, (4) developing and presenting work, and (5) analyzing and evaluating the problem-solving process. Both models are innovative learning models integrating technology through learning media, such as *quizzes* for experimental classes and *Canva* for control classes.

The next step is to conduct prerequisite tests, including a normality test, homogeneity test, regression homogeneity test, and linearity test. This study has met the prerequisite test, so hypothesis testing can be done using the ANCOVA test and the LSD (*Least Significant Difference*) test.

Hypothesis testing in this study used ANCOVA test and further test in the form of LSD assisted by *SPSS* version 25 *for Windows*. The ANCOVA test results for the value of *creative thinking skills* in the learning model column have a significance value of 0.000 (0.000 <0.05), which means that there is a significant effect of applying the *brain-based* learning model assisted by *quiziz* media on students' *creative thinking skills* in history learning so that H01 is rejected. So, it can be concluded that applying a *brain-based learning* model assisted by *quiz media* affects students' *creative thinking skills* after the pretest *covariate is* controlled.

Furthermore, to determine the difference in influence between the experimental class and the control class through the average value (*mean*) of the class to see which one has a greater impact, further testing using LSD (*Least Significant Difference*) is carried out. The LSD test results for *creative thinking skills* in the control pretest column (I) and control posttest (J) show a significance value of 0.000 (0.000 <0.05) which means there is an influence, with a *mean difference of* -10,889, then in the pretest and posttest columns for the experimental class show a significance value of 0.000 (0.000 <0.05) which means there is an influence, with a *mean difference of* -14,560. So, it can be concluded that the experimental class taught using the *brain-based learning* model assisted by *quiz* media has a better *creative thinking skills* effect than the control class taught using the *problem-based learning* model assisted by PowerPoint using *Canva*.

The syntax and characteristics of *the brain-based learning* model reflect the indicators of *creative thinking skills* proposed by Guilford (1994): *fluency, flexibility, originality*, and *elaboration*. The four indicators are appropriate and in line with the syntax and indicators of *the brain-based learning* model, namely (1) creative thinking, (2) *active learning*, (3) collaborative, (4) problem solving, (5) elaboration, and (6) incubation. While the syntax of the *brain based learning* model is: (1) preexposure, at this stage the educator provides an overview of the material to be discussed through the provision of learning media, (2) preparation, at this stage the educator encourages students to formulate several questions about the material that has been given, the educator also provides an introduction or prefix before starting the topic of material to be discussed (3) Initiation and acquisition, at this stage the educator divides students into several small groups and is given the task of studying today's learning topic, (4) elaboration, (4) elaboration, students provide conclusions from the results of the study that has been discussed, (5) incubation and memory encoding, at this stage the educator invites students to stretch their brains for a moment with ice breaking or giving *mini quiz* to students, (6) verification and checking, this stage is the end of learning where the educator evaluates students about what has been learned today, the evaluation can be done through tests or performance or work (Jensen, 2020). Therefore, the *brain-based learning* model has been proven more effective in improving students' creative thinking skills and learning outcomes. The application of the *brain-based learning* model is also supported by relevant

learning media that integrate technological advances in learning, one of which is *quiz* media.

Quiz media is a learning media based on information and communication technology (ICT). *The quiz* can be accessed through a *website* or application. Teachers use quiz media to create interactive quizzes or presentations. In this research, *the quiz is* used to support the application of *the brain-based learning* model in an experimental class. As for its application in the classroom, *quiz* media is designed in the form of presentations and interactive quizzes. So, in each session of learning material, there is a *break session in the* form of questions or *mini quizzes* about the topic that has been studied. *Quiz* media is based on the characteristics of the *brain-based learning* model because, in practice, *quizzes* also provide *ice-breaking* features so that students do not feel bored in the learning process. *Quiz* encourages students to be more interactive and fun in class (Purba, 2019). Through *quizizz* media, students become more active and involved in classroom learning so that students and teachers can optimally develop their potential.

This study shows that the experimental class taught using the *brain-based learning* model assisted by *quiz* media has a better *creative thinking skills* effect than the control class taught using the *problem-based learning* model. This is due to several factors, including (1) the advantages of the *brain-based learning* model, which lie in its stages. The *brain-based learning model* stimulates students more naturally, as it relates to the diverse ways the brain works to access the learning process (Kilbane & Milman, 2014), (2). Milman, 2014), (2) the *brain-based learning model is* packaged through a more interactive discussion, thus bringing up students' ideas and creativity, (3) the selection of the suitable media to support the application of *brain-based learning* models in experimental classes is more effective and efficient, namely using *quiziz* media where in its application learning is more interactive. Students have high enthusiasm and are actively involved during the learning process, and this is because *Quizizz* has an *ice-breaking* feature that makes learning in the classroom manageable and engaging.

The results of this study strengthen theoretical studies and previous research, which states that the *brain-based learning* model assisted by *quiz* media can improve *creative thinking skills.* Among them is research by Widiana, *et al.* (2017), which states that students who are taught using a *brain-based learning* model have higher creative thinking skills than those who use conventional learning models. *The creative thinking skills of* students who are applied to *brain-based learning* models have improved better than students who are applied to conventional learning models (Gardenia, *et.al.* 2018). Research by Immanuel, et al. (2021) revealed that using the *brain-based learning* model improved students' *creative thinking skills*. Research by Farida, *et.al* (2021) reveals that using *brain-based learning* models can affect students' *creative thinking skills*. The study conducted by Adiansha & Sani (2021) shows that students with high creativity can achieve better results if given a *brain-based learning* model than a *problem-based* one.

Previous research also examines the effect of *quiz* media on students' *creative thinking* skills, including Faidah's study (2020), which shows that *quizizz* influences students' *creative thinking skills*. Implement*ing Quizizz* in learning has proven to be more effective in improving students' *creative thinking skills* (Nurwijaya, 2022). In addition, research by Mardliyah *et al.* (2022) reveals that using *quiz* media can develop students' creative thinking skills during the learning process.

The research results described above can be discussed, and it can be concluded that the *brain-based learning* model assisted by *quiz* media positively affects students' *creative thinking skills*.

IV. Conclusion

The study results show that applying the *brain-based learning* model assisted by *quiziz* media significantly affects students' *creative thinking skills*. The experimental class that used the *brain-based learn*ing model assisted by *quizizz* media had a better *creative thinking skills* effect than the control class that applied the *problem-based learning* model assisted by PowerPoint using *Canva*. This is due to several factors, including (1) the advantages of the *brain-based learning* model, which lie in its stages, the *brain-based learning model* stimulates students more naturally related to the diverse ways the brain works in accessing the learning process (Kilbane & Milman, 2014), (2) the *brain-based learning model is* packaged through more interactive discussions, thus bringing up students' ideas and creativity, (3) the selection of appropriate media to support the application of *brain-based learning* models in experimental classes is more effective and efficient, namely using *quiziz* media where in its application learning is more interactive and students have high enthusiasm and are actively involved during the learning process, this is because *quizizz* has an *ice-breaking* feature that makes learning in the classroom not saturated and boring. So, this study concludes that the *brain-based learning* model assisted by *quiziz* media affects students' *creative thinking skills* in learning history.

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