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The Effect of Wordwall-Based Word Card Media on Increasing Creativity and Cognitive Development in Kindergarten

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Abstract: The transition period to formal schooling begins at the kindergarten level. The word card media in this study uses Wordwall-based. The objectives of this research are: To determine the effect of Wordwall-based Word Card Media on the creativity of students at TK Kemala Bhayangkari 21, and to determine the effect of Wordwall-based Word Card Media on the cognitive development of children at TK Kemala Bhayangkari 21. In this study, a quantitative approach is applied. The method used is a quasi-experiment. The research results show data that the Asymp sig (2-tailed) value is 0.000 < 0.05. These results can be concluded that there is a difference in creativity before and after the implementation of Wordwall-based Word Card Media. Secondly, based on the output results in the regression test and its interpretation, a significance value of 0.000 < 0.05 will be obtained, which means that there is an influence of Wordwall-based Word Card Media on children's cognitive development. the questionnaire on the use of Wordwall-based card Media and the student creativity questionnaire. The basis for drawing conclusions is if the sig. linearity deviation value > 0.05.

Keywords: Cognitive development; Creativity; Development word card media; Wordwall

Introduction

Positive educational outcomes require student engagement in the classroom in accepting their peers (Lazic et al., 2025). The transition period to formal schooling begins at the kindergarten level (Johnson & Foster, 2005). Because the kindergarten level (TK) will serve as a marker for forming the foundation for interacting with peers in the future through formal education (Chow et al., 2022), specifically, active involvement in classroom behavior and peer acceptance is crucial for the early development of children at the initial stage of formal education (Lindström et al., 2021). The entire process is interconnected with the child's readiness to attend kindergarten and will yield long-term educational outcomes, such as academic achievement and a sense of belonging to their school (Wentzel et al., 2021).

The need to maintain the readiness of schools at the kindergarten level requires adequate facilities and infrastructure. One of them is educational media in the form of toys. Because in kindergarten, toys are valuable tools for early childhood education (Pandey, 2025). Because of the importance of studying the child's growth process, such as the ability to acquire mathematical skills and learning during kindergarten (Leyva et al., 2022). If learning facilities are not met, it can create a gap in acquiring skills for kindergarten students (Kleemans et al., 2012). According to Duhirwe et al. (2023), the use of libraries and the habit of reading can predict skills in kindergarten, but not for observing children's growth.

The learning process of kindergarten students does not solely use print-based media, as it is less effective

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and efficient when outside of school (Pradhana et al., 2023). Including, the advancement of developing technology can make humans demand that all aspects of life become easier, including learning media that keeps up with the times (Rohman & Susilo, 2019). Ultimately, learning media must be able to capture the attention of kindergarten students to optimize the delivery of information in order to shape children's cognition (Hafiz et al., 2021). One alternative form of learning media is card media for kindergarten students. The selection of learning media that aligns with the lesson material can make the learning process run effectively and efficiently (Widyastuti & Susiana, 2019). Card media has proven to be effective in providing understanding of the material for kindergarten students (Jihad, 2024). Because, through illustrated card media, children's cognition can be stimulated, one of which is in the form of words and pictures (Giah, 2022).

An alternative form of learning media is Wordwall. Through Wordwall, it can create an enjoyable classroom atmosphere and actively engage in the learning process (Nadhifa et al., 2024). Because Wordwall media can be recommended as one of the alternative learning media (Nesimnasi et al., 2024). Wordwall is an educational browser-based game that can serve as a learning resource, learning media, and an evaluation tool (Umah & Alam, 2024). Its advantages include that the Wordwall application can be created to help teachers provide learning media according to the learning material, suitable for various levels of education, including kindergarten, and does not require coding knowledge for beginners (Gandasari & Pramudiani, 2021).

The application of the Wordwall learning media will be implemented at the kindergarten level. The specificity of the research lies at TK Kemala Bhayangkari 21 Sumberasih Probolinggo. The main topics at the kindergarten level can be formulated as shown in Table 1.

Table 1. Kindergarten material description

Material	Material Description
Moral and religious values	Introducing the religions followed by each student, honesty, helping each other, politeness, sportsmanship, and mutual respect.
Motoric	Introducing gross motor skills, fine motor skills, healthy behavior, and physical fitness.
Cognitive	Learn problem solving, creativity, and logical thinking.
Language	Understanding language, expressions, and scripts.
Social emotional	Self-awareness, behaving pro-socially.
Art	Able to explore oneself in various activities appreciating works of art.

In this study, the focus is on language materials, namely word cards to understand literacy, which will be applied using Wordwall media. This study sought to examine the influence of Wordwall media on creativity and cognitive development. First, creativity is a process that synthesizes past knowledge and learning experiences to generate new concepts, ideas and solutions (Wang et al., 2024). In addition, through creativity, it becomes an important skill to compete globally for students (Kuo et al., 2024). Because learning that emphasizes creativity can be a major source in overcoming students who experience learning stress (Lucas, 2025). Because, it is expected that creativity can produce useful and original knowledge in solving learning problems, acting quickly, and being different from others (Verger et al., 2024). The indicators of creativity are: fluency, flexibility, originality, development, and reformulation (Gardner, 1993).

Next is cognitive development. As based on cognitive load theory, which emphasizes the limits of human cognition resources (Sweller, 2022). It will be a burden on student cognition, if in the process of learning assignments, the amount of information processed exceeds its capacity (Candido & Cattaneo, 2025). In contrast, there is a gap in the literature for research that can effectively test multimedia contexts (Augmented Reality) to enhance learning and cognition (Chappell et al., 2025). So, it would be interesting if this research focuses on testing the cognitive level of students in learning.

As for this research has the following objectives: Knowing the effect of Wordwall-Based Word Card Media on Increasing Children's Creativity at Kemala Bhayangkari 21 Kindergarten and Knowing the effect of Wordwall-Based Word Card Media on Increasing Children's Cognitive Development at Kemala Bhayangkari 21 Kindergarten. So, based on this background, a study was developed, namely "The Effect of Wordwall-Based Word Card Media on Increasing Creativity and Cognitive Development of Children at Kemala Bhayangkari 21 Kindergarten Sumberasih Probolinggo".

Method

This research applies the experimental method, with the basic research design used is pre-experimental design in the form of one group pretest-posttest design. The research sample was Kemala Bhayangkari 21 Kindergarten students. The following describes the relationship of variables in this study, can be explained in Figure 1.

So, in finding the magnitude of the relationship between X with Y1, and X with Y2, a simple linear regression analysis was carried out.

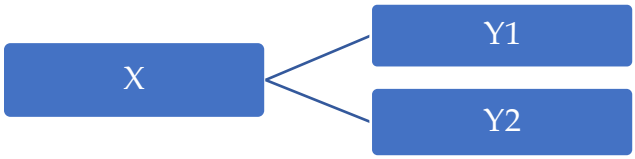

Figure 1. Procedures between quantitative variables

Result and Discussion

Prerequisite Test Analysis

Normality and Homogeneity Test on Creativity

Before conducting the hypothesis test, it is necessary to test that the data is normally distributed and homogeneous. Normality test, so that it can be continued with parametric statistics. In testing normality, it is conducted on two groups, namely the pre-test scores (initial scores) and post-test scores (final scores). If the number of test samples is small, the Liliefors normality test technique (L test) can be used with Microsoft Excel software. The basis for making a decision in the normality test is that if the calculated L < table L, then the data results are normally distributed (Noor, 2017).

This study is preceded by a prerequisite analysis test to examine the influence. In data analysis, it is necessary to test that the creativity data must be normally distributed and homogeneous. Based on the tests, the following data were obtained (See Table 2).

Table 2. Results of the normality test of creativity

Statistic	Creativity	
	Pre-test	Post-test
L Calculated value	0.7657	0.9245
L table value		0.1789
Conclusion	Data is not normally distributed	Data is not normally distributed

Table 3. Creativity homogeneity test results

Statistic	Creativity	
	Pre-test	Post-test
Variant Value	45.7389	22.8745
L Calculated value		1.9784
L table value		2.0144
Conclusion		Data is homogeneously distributed

The results of the normality test on the creativity variable indicate that the data is not normally distributed. Next, a homogeneity test was conducted to determine whether the research data on children's cognitive development is homogeneous or not (Noor, 2017). The homogeneity test regarding children's cognitive development was conducted on two groups of data, namely the initial scores before the treatment (pre-test) and the final scores after the treatment (post-test). In the process of the homogeneity test, the Fisher test (F-test) was used with Ms. Excel software (Mulyani, 2021). The basis for decision-making is that if the calculated F < table F, then the data is homogeneous. The homogeneity test for the creativity variable shows that the data is distributed homogeneously (See Table 3). Therefore, the linearity test on the creativity variable can proceed.

Normality Test and Homogeneity Test of Cognitive Development

The second variable is cognitive development, the results of the normal distribution test are 0.0684 < 0.1655 on the pretest, meaning that the data is normally distributed. Likewise, for the posttest, it has a value of 0.0897 < 0.1655, which means that the data is also normally distributed (See Table 4).

Table 4. Results of the normality test of cognitive development

Statistic	Cognitive Development	
	Pre-test	Post-test
L Calculated value	0.0684	0.0897
L table value		0.1655
Conclusion	Data is normally distributed	Data is normally distributed

Table 5. Results of the homogeneity test of cognitive development

Statistic	Cognitive Development	
	Pre-test	Post-test
Variant Value	0.0714	0.0878
L Calculated value		1.1548
L table value		2.0144
Conclusion		Data is homogeneously distributed

In the homogeneity test process for Cognitive Development, the Fisher test (F test) was used with Ms. Excel software. The basis for decision making is if F count < F table, then the data is homogeneous. So, the test data obtained data is 0.0714 < 2.0144 for pretest, then the data is homogeneous. Including for the posttest, the data obtained is 0.0878 < 2.0144, meaning that the data is also homogeneous (see Table 5).

Linearity Test on Variable X Against Variable Y1

Table 6. Results of the linearity test between variable X and Y1

	Sum of Squares	df	Mean square	F	Sig.
Flashcard Media * Creativity	379.2164	16	22.819	1.411	0.463
Linearity	198.749	1	197.947	9.597	0.019
Deviation of Linearity	172.382	15	11.462	0.858	0.831
Both Groups	142.238	7	20.899		
Total	513.427	23			

The linearity test is conducted to determine whether the relationship between variable X (Wordwall-based Flashcard Media) and variable Y1 (creativity) is linear or not. This linearity test is calculated by comparing the mean values from two groups of data, namely the questionnaire on the use of Wordwall-based Flashcard Media and the student creativity questionnaire. The basis for drawing conclusions is if the sig. linearity deviation value > 0.05, then it can be concluded that there is a linear relationship between variable X and variable Y1. Therefore, based on Table 5, the linearity significance value = 0.831 > 0.05, it can be concluded that there is a linear relationship between variable X and variable Y1.

Test of Linearity on Variable X Against Variable Y2

Second, the linearity test at this stage is carried out to determine the relationship between variable X (Wordwall-Based Word Card Media) and variable Y2 (cognitive development) will have linear properties or not. This linearity test is calculated by comparing the mean values derived from two groups of data, namely the questionnaire for the use of Wordwall-Based Word Card Media with the final score of students (post-test). The basis for taking the results if the sig value. linearity deviation > 0.05 then it can be concluded that there is a linear relationship between variable X and variable Y2. So, based on Table 6, the significance value of linearity = 0.587 > 0.05, it can be concluded that there is a linear relationship between variable X and variable Y2.

Table 7. Results of the linearity test between variable X and Y2

	Sum of Squares	df	Mean square	F	Sig.
Flashcard Media * cognitive development	122.597	16	7.189	1.169	0.457
Linearity	25.938	1	25.697	3.849	0.089
Deviation of Linearity	96.947	15	6.899	0.978	0.587
Both Groups	44.938	7	6.919		
Total	167.981	23			

Hypothesis Testing

After the prerequisite tests are completed, they are followed by hypothesis testing. The hypothesis is a temporary answer to the formulation of the problem in the research (Noor, 2017). The formulation of the problem tests statements in the form of relationships between two or more variables, comparisons, or independent variables (Sugiyono, 2019). This research aims to test two types of hypotheses, namely the null hypothesis (Ho) and the alternative hypothesis (Ha). The null hypothesis states "there is no," which means there will be no influence or relationship between one variable and another. The hypothesis that will be tested is the null hypothesis.

This research aims to conduct hypothesis testing to determine whether there is a significant effect of Wordwall-based Word Card Media (variable X) on creativity (Y1) and cognitive development (Y2) at the kindergarten level.

Hypothesis Testing of the Influence of Variable X on Y1

The independent variable in this study is the Wordwall-based Word Card Media, while the dependent variable Y1 is creativity. After conducting the prerequisite analysis test based on the post-test data, it was concluded that the data is not normally distributed, but homogeneous. Second, based on the linearity test, it can be concluded that there is a significant linear relationship between the variables. Seeing the condition of the data which is not normally distributed, the data analysis to test the hypothesis applies an alternative analysis, namely the Mann Whitney U Test. This type of test falls under non-parametric statistics, as an alternative to the t-test for data that is not normally distributed. The purpose of the Mann Whitney test is also to determine whether there is a difference in the means of two unpaired sample data. In its application, in this t-test, the samples used do not have to have the same number. Therefore, the hypothesis to be tested is stated as follow: Ho = There is no difference in creativity before and after the application of Wordwall-based Word Card Media; Ha = There is a difference in creativity between before and after the implementation of Wordwall-based Word Card Media.

Therefore, the basis for decision-making in the Mann Whitney statistical test is that if the Asymp sig value is less than the probability of 0.05 (Asymp sig < 0.05), then the result indicates that there is a difference in the mean between the two types (groups) that have been tested. Thus, the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted. Conversely, if the Asymp sig value is 0.05, it indicates that there is no difference in the mean, so Ho is accepted and Ha is rejected. Therefore, based on the statistical test results using SPSS software, the output of the Mann

Whitney U test shows the following creativity scores for kindergarten students.

Tabel 8. Mann-Whitney test results

Model	Group	N	Rank Mean Rank	Sum of Ranks
Value creativity	Pretest	24	13.89	334.50
	Posttest	24	34.97	835.50
	Total	48		

Table 9. Statistical data results from Mann Whitney

Test Statistics[a]	Value Creativity
Mann-Whitney U	34.500
Wilcoxon W	334.500
Z	-5.123
Asymp. Sig. (2-tailed)	0.000

a. Grouping Variable: Group

Based on the statistical test output table, it was found that the Asymp sig (2-tailed) value is 0.000 < 0.05. These results can be concluded that there is a difference in creativity before and after the implementation of Wordwall-based Flashcard Media. Since the data shows a significant difference, it can be interpreted that there is an influence of the implementation of Wordwall-based Flashcard Media on the creativity of TK Kemala Bhayangkari 21 Sumberasih Probolinggo students. Based on other sources, it is stated that students prefer communication that combines face-to-face interaction and text rather than audio (Oviedo & Tree, 2021). This is in line with the idea that students are not only able to acquire theoretical knowledge but also need to use creative approaches, one of which is through wordwall-based word cards (Lounek, 2015).

In fact, there is interesting evidence that creativity is generated by a balanced audio conversation alongside text interaction from videos, appealing visuals from the latest technology, and can create balance (Oviedo & Tree, 2021). However, if using video directly, such as through Zoom, it results in excessive close-up eye contact, increased cognitive load, reduced mobility, and heightened self-evaluation (Bailenson, 2021). In the end, through engaging media, one of which is through games that are designed to balance interaction and allow students to enjoy tasks more and enhance creativity (Guydish et al., 2021).

Hypothesis Testing of the Influence of Variable X on Y2

The variable X in the Wordwall-based Word Card Media with children's cognitive development, denoted as Y2. The hypothesis is tested using the following formula: Ho = there is no influence of Wordwall-based Word Card Media (variable X) on children's cognitive development (Y2); Ha = there is an influence of Wordwall-based Flashcard Media (variable X) on children's cognitive development (Y2).

After testing, data on children's cognitive development is needed, which has been tested for normality and homogeneity. Including the results of the linearity test, it can be concluded that the relationship between the variables is linear. Given these conditions, the analysis technique was performed for hypothesis testing using simple linear regression analysis in the form of the R Square (R2) test using SPSS software (Mulyani, 2021). The data is shown as follows (See Table 10).

Table 10. Correlation values and coefficient of determination R square

Model	Model Summary R	R^2	Adjusted R2	Standard Error of Estimation
1	.400[a]	0.827	0.113	2.43541

a. Predictors: (Constant), Wordwall-Based Word Card Media

Table 11. Significance value of the output from the simple linear regression test (R square)

Model	ANOVA[a] R^2 Result	df	R^2 Mean	F	Sig.
Regression	25.648	1	25.648	3.9	.058[b]
Residual	140.278	22	6.257	91	
Total	165.926	23			

a. Dependent variable: children's cognitive development

b. Predictors: (Constant), Wordwall-Based Word Card Media

Table 12. Output of regression coefficients from the results of simple linear regression test

Model	Coefficients[a]		Standardized Coefficients Beta	t	Sig.
(Constant)	68.795	5.578		13.79	.000
Flashcard Media	0.078	0.043	0.389	1.895	0.05

a. Dependent variable: children's cognitive development

The basis used to determine whether there is an influence of variable X on variable Y2 is by comparing the significance value (sig) with the probability value, which is 0.05. If the sig value < 0.05, it means variable X has an influence on Y2, and conversely, if the sig value > 0.05, it means variable X does not have an influence on variable Y2. Therefore, based on Table 12, a sig value of 0.000 < 0.05 is obtained. It can be concluded that variable X has an influence on variable Y2.

As for the coefficient of determination (R2), the coefficient of determination is used to determine the contribution value of variable X (Wordwall-based Word Card Media) to variable Y2 (children's cognitive development). From Table 10, it was found that the coefficient of determination (R square) value is 0.827, which means that the influence of variable X (Wordwall-

based Word Card Media) on children's cognitive development is 82.7%. The R correlation value describes the magnitude of the correlation between variable X and Y1. Based on the correlation value of 0.400. If related to the correlation category, then this correlation value is categorized as moderate.

In simple linear regression, it is formulated through the equation Y = a + (b.X). This means that a is the constant of the dependent variable, while b is the regression coefficient of the independent variable, X. Observing the output table, the constant value a is 68.795 and the value b is 0.078. Therefore, based on the values of a and b, the regression equation is Y = 68.795 + (0.078.X). The constant value a of 68.795 signifies a consistent value based on the creativity variable, which is 68.795. Meanwhile, the value b of 0.078 indicates that for every 1% increase in the value of Wordwall-based Media Card Words, the creativity value increases by 68.795. It can be concluded that the regression coefficient is positive.

Based on the output results of the regression test and its interpretation, a significance value of 0.000 < 0.00 will be obtained, which means that there is an influence of Wordwall-based Word Card Media on children's cognitive development. Also, the correlation value between variable X and Y2 is 0.400. It was decided that the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted. The results of this study are supported by the fact that there is effectiveness in fulfilling students' cognitive and creativity needs through game-based learning (Fang & Chiu, 2025). Because the game model can provide students with the opportunity to have meaningful and authentic learning experiences (Hakkarainen, 2011).

Through technology-based games, it can help students organize knowledge and strengthen their relationship with learning content (Ryan & Deci, 2020). In fact, currently, by creating learning materials assisted by artificial intelligence (AI), it contributes to the future trends of student pedagogy (Chiu, 2024). Because creating digital media gives meaning to positive learning outcomes for students, including enhancing creativity and collaboration (Lam & Yunus, 2023).

Conclusion

As for this research, after being conducted and through data analysis, it can be concluded that: The application of Wordwall-based Word Card Media has an influence on enhancing creativity and cognitive development in children at TK Kemala Bhayangkari 21 Sumberasih Probolinggo. The improvement in children's creativity and cognitive development can be evidenced by the following. First, the data shows that the Asymp sig (2-tailed) value is 0.000 < 0.05. These results can be concluded that there is a difference in creativity before and after the implementation of Wordwall-based Word Card Media. Since the data shows a significant difference, it can be interpreted that the implementation of Wordwall-based Word Card Media has an impact on the creativity of students at TK Kemala Bhayangkari 21 Sumberasih Probolinggo. Second, based on the output results in the regression test and its interpretation, a significance value of 0.000 < 0.05 will be obtained, which means that there is an influence of the Wordwall-based Word Card Media on the cognitive development of children. Also, the correlation value between variable X and Y2 is 0.400. It was decided that the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted.

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Author Contributions
Main author and article researcher, H: collecting information, making instruments to measure needs and responses, making material expert and media expert validation assessments, making evaluations, making and testing research products, data processing and writing the initial article, research and writing the second article; E.T. and K.: conducting instrument validation and initial product design before being submitted to media expert and material expert validators, supervisors who direct and guide the first author.

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