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Developing a Technology-Integrated Picture and Picture Model Assisted by Enuma and Wordwall for Early Reading and Learning Interest

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Abstract
This study aims to develop and test the effectiveness of the Picture and Picture learning model assisted by the Enuma and Wordwall application and to assess the level of feasibility and practicality based on expert validation and user responses, and the effect of its application on students' learning interest in first grade elementary school. The research method used is Research and Development (R&D) with the Borg and Gall stages which include ten product development steps. The research subjects consisted of two first grade classes at SD IT Insan Kamil and Bina Insan Cendekia as the experimental and control classes with a pretest-posttest design. Data collection techniques included reading ability tests, learning interest questionnaires, observations, and interviews. Statistical analyses were determined based on normality testing results, with parametric tests applied to normally distributed data and nonparametric alternatives used otherwise. This approach ensured methodological rigor and strengthened the validity of the findings and N-Gain calculations. The findings of this study indicate that the developed learning model has been assessed as very feasible and practical through validation by experts and practitioners. The application of the Picture and Picture model assisted by Enuma and Wordwall can significantly improve students' early reading ability, as reflected in the significant difference in posttest scores between groups, although the N-Gain improvement between classes was not statistically significant (Sig=0.216). Furthermore, students' learning interest also increased descriptively, reaching the moderate category. Thus, this learning model has proven effective as an innovative alternative for improving early literacy in elementary school students.

Keywords: Early Reading; Enuma; Interest in Learning; Picture and Picture; Wordwall

INTRODUCTION

Reading skills and elementary students' learning interest constitute an important foundation for achieving long-term academic success (Syajida & Ahyadi, 2024). Strong reading skills promote cross-disciplinary achievement (Wikanengsih et al., 2020) , while learning interest serves as an indicator of intrinsic motivation that contributes to student engagement in the learning process. In reality, low reading ability among elementary school students remains a significant challenge in Indonesia's education system. Likewise, reading comprehension skills among upper-grade elementary students are still low (Wikanengsih & Juhari, 2025). This issue presents a challenge to creating innovative and adaptive learning approaches that align with students' needs and characteristics in the digital era.

Reading ability is an essential skill greatly needed by learners, as it is used to understand various types of information they read. (Hidayat & Sukitman, 2020) state that "reading ability is a language function used as a tool or medium of communication among humans; therefore, the development of language skills also affects children's social and personal adjustment." Reading is one of the four fundamental language skills, along with listening, speaking, and writing (Sebayang et al., 2023). s stipulated in Law Number 02 of 1989 concerning the National Education System, reading is identified as one of the four core language skills that must be fostered and developed systematically (Umi Setyaningsih, 2022). Reading is defined as the process of recognizing, understanding, and interpreting symbols, which may take the form of written letters or visual forms such as maps, graphs, and diagrams. Thus, reading ability is a basic skill that students must master in order to understand all school subjects (Oktaviyanti et al., 2022). If students do not master basic reading skills, they tend to encounter obstacles in participating in learning activities, which ultimately can negatively affect their academic performance at higher grade levels. Indicators of successful mastery of early reading are determined by the formation of literacy practices and students' awareness to engage in meaningful reading activities. Early reading development is considered effective when reading habits grow as an intrinsic need and desire, rather than as a burdensome or challenging task. Nevertheless, various empirical findings in the field reveal that a large number of first-grade students still experience difficulties in reading, mainly due to low learning motivation, limited environmental support, and the use of conventional learning methods that are less engaging for young children. These conditions result in slow acquisition of early reading skills and hinder students' readiness to participate effectively in classroom learning.

In addition to early reading ability, students' learning interest is another important factor influencing the success of learning processes in early elementary grade sum (Pujiarti et al., 2024). Learning interest functions as an internal driver that encourages students to participate actively, stay focused, and show enthusiasm in learning activities (Hanif, 2025). Students' learning interest is important to enhance, considering that their academic success is influenced by the level of interest they demonstrate during the learning process (Wikanengsih & Ningrum, 2021). Students with high learning interest tend to absorb material more easily, dare to try, and demonstrate perseverance in completing learning tasks. Conversely, students with low learning interest often become passive, easily bored, and less motivated to practice reading, which in turn directly impacts the slow development of early literacy skills. Field findings indicate that conventional approaches, such as lectures and monotonous reading exercises, still dominate reading instruction in first grade. These methods do not actively involve students nor utilize engaging media. As a result, students quickly lose attention and their interest in lessons decreases (Putra, 2020). However, to attract students to reading activities at an early age, learning that is visual, interactive, and enjoyable is essential. Therefore, learning innovations are needed that not only improve students' low reading ability but also foster sustained learning interest.

One learning model with strong potential effectiveness is the Picture and Picture model. The Picture and Picture learning model is an instructional approach that places images as the main medium for gradually building conceptual understanding (Siregar et al., 2023). This method utilizes pictures as its core element, requiring students to arrange and match images in logical order. The process of arranging images trains students' concrete thinking skills while also supporting physical-motor development, an important component of overall child development. In line with this, (Wikarya & Yogiarni, 2025) state that the Picture and Picture model, supported by audiovisual media, encourages greater student activity, makes learning

more meaningful and engaging, and provides distinctive learning experiences. The Picture and Picture model uses paired or sequentially arranged images, such as ordering pictures, identifying images, providing descriptions, and explaining visual content (Hendriana, 2025). Based on this perspective, Picture and Picture can be concluded as an innovative instructional approach that utilizes structured images to support thinking processes, build conceptual understanding, and create creative and enjoyable learning experiences. This model emphasizes logical and systematic thinking, enabling students not only to observe images but also to construct meaning through visual sequencing.

When this visual-based model is integrated with digital applications such as Enuma and Wordwall, the learning experience becomes increasingly interactive and adaptive. Enuma provides activities for letter recognition, phonics practice, and literacy-based games, while Wordwall enables teachers to reinforce instructional steps through quizzes, animations, and image-based activities (Jaya et al., 2024). The integration of visual learning models with interactive technology has the potential to enhance students' early reading skills more effectively. Advances in educational technology offer opportunities for teachers to design more interactive and engaging learning experiences (Rosfiani et al., 2025). The Picture and Picture model, which emphasizes logically sequenced images, has been shown to foster systematic thinking skills and support students' visual understanding of concepts. When combined with digital media such as Enuma School and Wordwall, learning becomes more engaging, adaptive, and aligned with the characteristics of young children who tend to be visual and kinesthetic learners. These digital media provide educational games, reading exercises, and immediate feedback, thereby encouraging student engagement and learning motivation. The integration of both applications within the Picture and Picture model offers a more comprehensive approach to improving early reading ability and learning interest among elementary students. However, integrating Enuma and Wordwall presents opportunities to fill gaps in innovative elementary reading instruction.

Several researchers have investigated the implementation of the Picture and Picture learning model supported by Quizizz and its impact on students' cognitive learning outcomes (Fatria et al., 2025). Their findings indicate that using Picture and Picture as the primary instructional method helps students understand learning material more effectively, while Quizizz contributes positively to cognitive outcomes. These results align with previous studies (Fitriani & Putra, 2024) which explain that Picture and Picture assisted by material images positively affects students' conceptual understanding. This is supported by simple linear regression analysis, where the Picture and Picture model served as the independent variable influencing conceptual understanding as the dependent variable (Rahmawati & Muthi, 2025). Previous studies have shown that this image-based approach is effective in improving students' comprehension and retention of instructional material (Ahida Suci et al., 2018; Fitriawati, 2020; Nuryanti et al.,2020). Consistent with earlier research emphasizing the importance of positive habituation in shaping students' character and learning readiness, appropriate learning media and models can create a more conducive and motivating learning environment. Findings from civic literacy studies show that structured learning habits and supportive environments enhance discipline, learning readiness, and self-awareness. These principles are also relevant in early reading instruction, where consistency and visual stimulation play vital roles in building strong literacy foundations.

Although many national studies show that Picture and Picture effectively improve early reading skills, most focus on conventional visual media and have not systematically integrated digital technology. Internationally, research indicates that image-based and multimodal learning techniques effectively enhance decoding skills, student engagement, and reading comprehension among early learners (Mayer, 2024). Additionally, digital literacy studies emphasize that interactive applications can increase motivation and facilitate phonics instruction and word recognition among beginning readers (Wang, 2021). However, neither national nor international studies have specifically analyzed teachers' needs in developing a Picture and Picture model integrated with Enuma and Wordwall two platforms providing visual support, phonics instruction, and educational games. This integration represents the primary novelty of the study, as it systematically combines a structured visual learning model Picture and Picture with adaptive phonics

instruction through Enuma and interactive digital reinforcement via Wordwall within a unified pedagogical framework. This represents the novelty of the proposed solution. Enuma allows adaptive learning personalization based on each child's pace and ability, while Wordwall offers diverse interactive activities, opening great potential to enhance student engagement in reading instruction. Through Enuma, reading materials become more attractive for students. Proper, creative, and challenging material presentation serves as a stimulus to foster students' confidence during learning (Wikanengsih & Rostikawati, 2024).

On the other hand, Enuma also holds strong potential for strengthening foundational reading instruction. It allows children to learn at individualized rhythms and levels, making it highly suiFi for supporting literacy development (Fitriza et al., 2022). However, to date, no research has developed or integrated Enuma and Wordwall within a single Picture and Picture learning model to optimize reading outcomes and learning interest. Learning interest is crucial, as student success is influenced by high interest during learning (Wikanengsih & Ningrum, 2021). The Enuma application offers thousands of activities that can be tailored to students' ability levels. Wordwall has been shown to enhance students' learning interest and strengthen their understanding of the material in an engaging manner (Rezeki & Amelia, 2025; Syamsidar et al., 2023; Putri & Hamimah, 2023). It also fosters an active learning environment, increases participation, and encourages collaboration among students (Abd Al-Aziz et al., 2024; Nenohai et al., 2022; Aditya et al., 2022). The integration of these two applications within the Picture and Picture model provides a more comprehensive approach to improving elementary students' reading ability and learning interest. Therefore, developing a Picture and Picture model integrated with Enuma and Wordwall constitutes an important new contribution, offering solutions to challenges in improving early reading ability and learning interest at the elementary level.

Based on this background, the study aims to descriptively examine: (1) the development process of the Picture and Picture model assisted by Enuma and Wordwall for first-grade reading instruction; (2) feasibility and practicality based on expert validation and user responses; (3) effectiveness in improving early reading ability; and (4) the influence of the model on students' learning interest.

RESEARCH METHODS

This study employed a Research and Development (R&D) approach. According to Borg & Gall (1989), R&D is used to create and validate educational products. Development research not only produces instructional products but also addresses real educational problems. This study developed a Picture and Picture learning model assisted by Enuma and Wordwall to improve reading ability and learning interest among first-grade students. The R&D stages followed Borg & Gall (1989): (1) research and information gathering, (2) planning, (3) product development, (4) preliminary testing, (5) initial product revision, (6) field testing, (7) product revision, (8) operational field testing, (9) final product revision, and (10) dissemination and implementation.

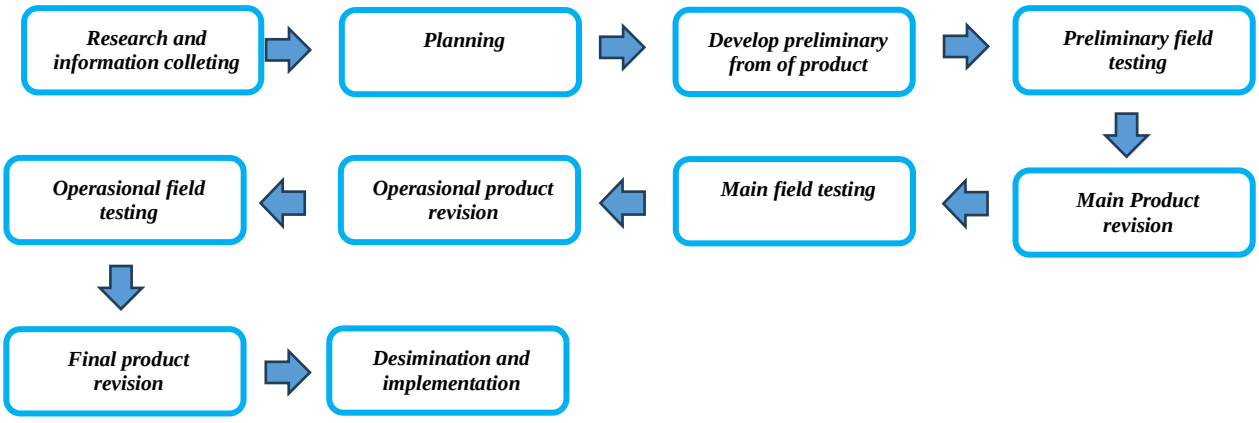

Figure 1. Borg and Gall R&D Measures

The subjects of this study were divided into several groups according to the stages of product testing conducted. In the limited trial stage, the research subjects consisted of 10 second-grade students from SD IT Insan Kamil, which is located on Jl. Ciseupan No. 33, Cibeureum Subdistrict, South Cimahi District, Kota Cimahi. Although the primary focus of this study was first-grade students and early reading ability in Grade I, the limited trial stage involved 10 second-grade students. The inclusion of second-grade students at this stage was intended to evaluate the technical aspects, clarity of instructions, and practicality of the learning model before its implementation with the main research subjects. Second-grade students were selected because they already possess more stable early reading skills, allowing technical refinements to be made without affecting the validity of the effectiveness testing conducted with first-grade students as the primary participants. Furthermore, in the large-scale trial stage, the research subjects involved 25 first-grade students from SD IT Bina Insan Cendekia, located on Jl. Cisalak No. 63, Leuwigajah Subdistrict, South Cimahi District, Cimahi City.

The subjects in the product testing stage were first-grade students of SD IT Insan Kamil, consisting of two classes, namely Class IA and Class IB, each comprising 30 students. This product testing aimed to determine the effectiveness of the developed product as well as students' responses to it, namely the learning system using the Picture and Picture learning model assisted by the Enuma and Wordwall applications. At this stage, an experimental method with a pretest–posttest design was employed, involving two learning groups: an experimental class and a control class. The experimental class received instruction using the model designed by the researcher, while the control class received conventional instruction.

Data analysis in this study included validity analysis, reliability analysis, discrimination index, and difficulty index of the developed test instruments. All analytical processes were conducted using SPSS version 26 and Microsoft Excel to obtain accurate and systematic results. The resulting instrument was an early reading ability test for first-grade elementary school students that had undergone empirical feasibility testing. Furthermore, to determine the effectiveness of the Picture and Picture learning model assisted by Enuma and Wordwall, a difference test analysis was conducted before and after treatment. A paired sample t-test was used when the data were normally distributed. However, when the data were not normally distributed, the nonparametric Mann–Whitney U test was applied. This testing aimed to examine the effectiveness of the given treatment, indicated by differences in students' average learning outcomes before and after implementation of the learning model (Rasmuin,2024). In addition, improvements in students' early reading ability were analyzed using N-gain calculations to determine the level of learning outcome improvement after participating in instruction using the developed model. Descriptive quantitative analysis was also used to describe students' learning interest during the learning process. Thus, all data analyses were conducted in an integrated manner to obtain an overview of instrument validity, learning model effectiveness, and students' responses to the implementation of the Picture and Picture learning model assisted by the Enuma and Wordwall applications.

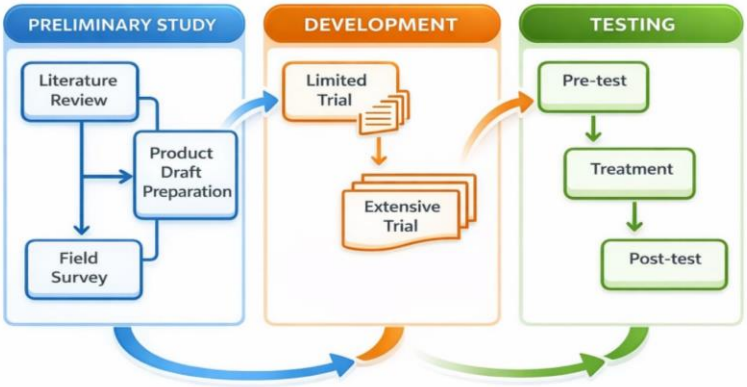

Figure 2. Steps for Research and Development of Learning Tools

RESULTS AND DISCUSSION

Results

1) Development Process of the Picture and Picture Learning Model Assisted by Enuma and Wordwall

In the first step of the study, namely Potential and Problems, the researcher observed students during a preliminary study at an elementary school in Cimahi City. The purpose of this observation was to identify problems in the learning process, especially in Grade 1. The researcher found that several students were still unable to read and showed little interest in learning.

In the second stage, data were collected through observations and interviews with first-grade teachers and students regarding early reading ability. The interview results indicated that the learning model used was still conventional, causing the learning process to be monotonous and less actively involving students. In addition, most students were found to be unable to read fluently and even experienced difficulties recognizing letters and forming simple words. These conditions caused students to struggle to follow lessons, particularly in understanding the material delivered by the teacher. This lack of early reading ability also affected students' low learning interest. Many students appeared less enthusiastic, easily bored, and unfocused during the learning process. This shows that limited reading ability is one of the main factors hindering student engagement in learning activities and reducing their motivation to participate optimally.

In the third stage, Product Design, the researcher developed a learning model design using the Picture and Picture learning steps and the Enuma and Wordwall applications. In the fourth stage, design validation was conducted by two lecturers as material and media experts from IKIP Siliwangi and one first-grade teacher as a practitioner expert. The validation results are presented in Table 1.

Table 1. Expert and practitioner validation summary results

No	Draft Picture and Picture Learning Model	Expert Validation	Practitioner Validation	Results	Category
	Revisi 1				
1.	Model Draft	75.44%	85.66%	86.55%	Usable with minor revisions
2.	Teaching Module	75.56%	84.36%	85.46%	Usable with minor revision
3.	Teaching Materials	76.46%	88.56%	87.51%	Usable with minor revisions
4.	Media	90.46%	88.56%	87.51%	Usable
5.	LKPD	92.56%	84.36%	85.46%	Usable
6.	Learning Evaluation	76.46%	88.56%	87.51%	Usable with minor revisions
7.	Interview Guidelines	90.00%	88.56%	87.51%	Usable
	Revisi 2				
1.	Teaching Materials	94.66%	92.36%	93.31%	Usable
2.	Media	96.00%	94.44%	95.22%	Usable
3.	LKPD	95.00%	92.00%	93.50%	Usable
4.	Learning Evaluation	95.00%	92.00%	93.50%	Usable
5.	Interview Guidelines	95.00%	92.00%	95.00%	Usable
6.	Teaching Materials	96.00%	94.44%	95.22%	Usable
7.	Media	95.00%	92.00%	93.50%	Usable

The fifth stage was a limited trial. The revised product was tested on students with a limited sample of 10 students per class. The trial was given to students who had received the developed material. aiming to measure the practicality of the Picture and Picture learning model draft assisted by Enuma and Wordwall based on student responses. Data were obtained from practicality questionnaires completed by teachers and students. After the limited trial. several revisions were made based on the evaluation results.

The sixth stage was conducted after revisions from the limited trial. followed by a wider trial. The wider trial was implemented at SD IT Bina Insan Cendekia for Grade 1 students. involving 30 participants.

This trial was conducted with students from another school that had not previously used the Picture and Picture learning model assisted by Enuma and Wordwall. The process continued with revising the draft model based on broader student feedback to obtain more effective teaching materials. Improvements included adjusting color contrast. adding clearer instructions. and organizing story text to enhance student comprehension. Further revisions were made based on student suggestions and followed by product testing to determine effectiveness.

In the final stage. after revisions from the wider trial. product testing was conducted. Two different classes were involved: an experimental class implementing the Picture and Picture learning materials assisted by Enuma and Wordwall. and a control class using conventional learning. At SD IT Insan Kamil. 30 students in Class 1A served as the experimental group. while 30 students in Class 1B served as the control group.

2) Feasibility of the Picture and Picture Learning Model Assisted by Enuma and Wordwall

After completing the potential–problem identification and data collection stages. the study proceeded to the product design stage in the form of a Picture and Picture learning model assisted by Enuma and Wordwall. The designed product was then validated by three validators: two expert lecturers and one expert teacher. Validation covered components including teaching modules. learning materials. learning media. student worksheets (LKPD). learning evaluation. and interview guidelines. The results of material expert validation are presented in Table 2.

Table 2. Results of material expert validation

No	Product Design	Percentage	Category
1.	Teaching Materials	90 %	Very Practical
2.	Media	90 %	Very Practical
3.	LKPD	91 %	Very Practical
4.	Learning Evaluation	91 %	Very Practical
5.	Interview Guidelines	90 %	Very Practical
6.	Teaching Materials	91 %	Very Practical
7.	Media	91 %	Very Practical

Based on Table 2. all developed product components fell into the “very practical” category with high feasibility percentages: model draft 90%. teaching module 90%. learning materials 91%. learning media 91%. LKPD 90%. learning evaluation 91%. and interview guidelines 91%. These results indicate that the developed learning product meets feasibility and practicality criteria for classroom implementation. Therefore. the Picture and Picture learning model assisted by Enuma and Wordwall is considered ready to be implemented as an effective instructional tool to support improvements in students’ reading ability.

The data collection instrument in this study was an early reading ability test. A test instrument may be biased if it does not undergo testing stages; thus. it may fail to accurately measure students’ abilities. Instrument quality was assessed in terms of validity. reliability. discrimination power. and difficulty index. Validity testing was conducted using Microsoft Excel. with results presented in Table 3

Table 3. Results of validity. reliability. level of difficulty and distinguishing power tests

Question Indicator	No. of Questions	Validity Test		Reliability Test		Discriminatory Power		Difficulty Index	
1	1	0.65	Valid	0.46	Sedang	0.37	good	0.68	moderate
	2	0.64	Valid			0.22	sufficient	0.76	moderate
2	3	0.53	Valid			0.35	good	0.40	moderate
	4	0.69	Valid			0.44	very good	0.52	moderate
3	5	0.60	Valid			0.35	good	0.72	moderate
	6	0.61	Valid			0.59	very good	0.36	moderate
4	7	0.57	Valid			0.35	good	0.60	moderate
	8	0.64	Valid			0.67	good	0.32	moderate
5	9	0.64	Valid			0.37	very good	0.32	moderate
	10	0.55	Valid			0.33	good	0.32	moderate

3) Effectiveness of the Picture and Picture Learning Model Assisted by Enuma and Wordwall on Early Reading Ability

Before product testing. a wider trial was conducted. The results of the wider trial using the Picture and Picture learning model assisted by Enuma and Wordwall are shown in Table 4.

Table 4. Area test results

Data	Pretest	Posttest
Number of Data	25	25
Minimum Value	50	75
Maximum Value	80	92
Mean	72	84
Normality	0.012 (Abnormal)	0.000 (Abnormal)
Paired Sample T-Test	0.000 (Significantly different)	
Ngain	0.31 (Quite effective category)	

Based on Table 4 (Results of the Extensive Trial). the findings indicate that the students' mean learning outcomes increased from 72 in the pretest to 84 in the posttest. In addition. the minimum score improved from 50 to 75. and the maximum score rose from 80 to 92. These results suggest an overall improvement in students' reading ability after the implementation of the Picture and Picture learning model supported by the Enuma and Wordwall applications. The normality test results revealed that the pretest data had a significance value of 0.012 and the posttest data had a significance value of 0.000. indicating that both datasets were not normally distributed. Furthermore. based on the Paired Sample T-Test results. the significance value (Sig. 2-tailed) was $0.000 < 0.05$. leading to the rejection of H_0. This indicates a statistically significant difference between the pretest and posttest results of students' reading ability following the implementation of the developed learning model. Moreover. the N-Gain analysis yielded a value of 0.31. which falls into the moderately effective category. This finding suggests that the implementation of the Picture and Picture learning model assisted by the Enuma and Wordwall applications was moderately effective in improving first-grade elementary students' reading skills.

The next stage was product testing. involving inferential statistical analysis of pretest and posttest data from the experimental and control classes. The hypothesis tested was: *Students' early reading ability using Picture and Picture learning materials assisted by Enuma and Wordwall is better than those using conventional learning.*

At this stage. pretest and posttest data were analyzed after students received different treatments. The experimental class used the Picture and Picture model assisted by Enuma and Wordwall. while the control class used conventional instruction.

The first step was conducting a normality test on pretest data using IBM SPSS 26 with the Shapiro–Wilk test at a significance level of 0.05.

Hypotheses:

H_0 : The sample comes from a normally distributed population.

H_1 : The sample does not come from a normally distributed population

Decision criteria:

If Sig > 0.05. H_0 is accepted.

If Sig < 0.05. H_0 is rejected

The next step was applying the nonparametric Mann–Whitney U test to pretest data using IBM SPSS 26 at a significance level of 0.05.

Hypotheses:

H_0 : There is no significant difference in early reading ability between students in the experimental class using the Picture and Picture model assisted by Enuma and Wordwall and those in the control class using conventional learning.

H_1 : There is a significant difference between the initial reading abilities of students in the experimental class that applies the Picture and Picture learning model with the help of the Enuma and Wordwall applications. compared to students in the control class that uses conventional learning.

Decision criteria:

If Sig > 0.05. H_0 is accepted.

If Sig < 0.05. H_0 is rejected

The results of the pretest normality tests for the experimental and control classes are presented in Table 5.

Table 5. Results of the normality test of the pretest of students' reading ability

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest Eksperimen	.222	30	.001	.895	30	.006
Pretest Kontrol	.124	30	.200	.963	30	.362

The following are the results of the Mann-Whitney pretest data for the experimental and control classes in Table 6.

Table 6. Results of the mann whitney pretest data analysis of students' reading ability

Test Statistics[a]

	Pretest
Mann-Whitney U	296.000
Wilcoxon W	761.000
Z	-2.294
Asymp. Sig. (2-tailed)	.022

The following are the results of the normality test data for the posttest for the experimental and control classes in Table 7.

Table 7. Results of the post-test normality test of students' reading ability

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Postest Eksperimen	.238	30	.000	.823	30	.000
Postest Kontrol	.202	30	.003	.935	30	.067

The following are the results of the Mann-Whitney posttest data for the experimental and control classes in Table 8.

Table 8. Results of data analysis of posttest mann whitney pretest of students' reading ability

Test Statistics[a]

	Pretest
Mann-Whitney U	.188
Wilcoxon W	.653
Z	-3.917
Asymp. Sig. (2-tailed)	.000

The N-gain test was conducted to determine the improvement of the experimental and control classes with different types of treatment. This was seen from the pretest and posttest completed by students. Calculations can be performed using the normalized gain as follows. The following are the test results from the N-gain data for the experimental and control classes' initial reading ability in Table 9

Table 9. Results of n-gain normality test of beginning reading ability

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
N-Gain Eksperimen	.090	30	.200[*]	.983	30	.888
N-Gain Kontrol	.150	30	.083	.890	30	.005

Below are the results of the Mann-Whitney test of the N-Gain scores for the experimental class and the control class in Table 10.

Table 10. Mann-Whitney N-gain Test results of students' beginning reading ability

Test Statistics[a]

	Pretest
Mann-Whitney U	.366
Wilcoxon W	.831
Z	-1.237
Asymp. Sig. (2-tailed)	.216

Based on the results of the normality test. the pretest and posttest data of students' reading ability in the experimental class did not show a normal distribution. while in the control class some of the data were normally distributed. Therefore. the analysis was continued using the Mann–Whitney U test. The Mann–Whitney test results for the pretest showed a significance value of 0.022 (< 0.05). indicating a difference in initial reading ability between the experimental and control classes. Furthermore. the posttest produced a significance value of 0.000 (< 0.05). indicating a significant difference in reading ability after the learning treatment. with the experimental class achieving better results than the control class. In addition. based on the N-Gain normality test results. the improvement data for reading ability in the experimental class were normally distributed. whereas those in the control class were not fully normally distributed; therefore. the

analysis was continued using the Mann–Whitney U test. The Mann–Whitney test on N-Gain scores showed a significance value of 0.216 (> 0.05). indicating that there was no statistically significant difference in reading ability improvement between the experimental and control classes. Nevertheless. descriptively. the N-Gain score of the experimental class fell into the moderate category and was higher than that of the control class. which was in the low category. This indicates that learning using the Picture and Picture model assisted by the Enuma and Wordwall applications was able to provide better improvement in reading ability compared to conventional learning.

4) The Effect of the Picture and Picture Learning Model Assisted by Enuma and Wordwall on Students' Learning Interest.

The second variable measured in this study was students' learning interest. Data on students' learning interest scale were obtained from students before and after learning in both the experimental and control classes. The results of the learning interest scale data from both classes are presented below. In processing the learning interest scale data. interval data were converted into ordinal data using the Method of Successive Interval (MSI) so that the data could be analyzed more appropriately according to the statistical techniques used.

The next stage involved inferential statistical calculations on the learning interest scale data from the experimental and control classes. The hypothesis tested was: Students' early reading ability using teaching materials based on the Picture and Picture learning model assisted by Enuma and Wordwall is better than those using conventional learning. The results of the inferential statistical calculations are presented below.

The first step was conducting a normality test on the pretest data using IBM SPSS 26 with the Shapiro–Wilk test at a significance level of 0.05.

The hypotheses were formulated as follows:

H_0 : The sample comes from a normally distributed population

H_1 : The sample does not come from a normally distributed population.

Decision criteria:

If the significance value > 0.05. H_0 is accepted.

If the significance value < 0.05. H_0 is rejected.

The next step was applying the nonparametric Mann–Whitney U test to the pretest data using IBM SPSS 26 with a significance level of 0.05.

The hypotheses were:

H_0 : There is no significant difference in early reading ability between students in the experimental class applying the Picture and Picture learning model assisted by Enuma and Wordwall and students in the control class using conventional learning.

H_1 : There is a significant difference in early reading ability between students in the experimental class applying the Picture and Picture learning model assisted by Enuma and Wordwall and students in the control class using conventional learning.

Decision criteria

If the significance value > 0.05. H_0 is accepted

If the significance value < 0.05. H_0 is rejected

The results of the pretest normality tests for the experimental and control classes are presented in Table 11.

Table 11. Results of the Normality Test of the Pretest of the student learning interest scale

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest Eksperimen	.192	30	.006	.917	30	.023
Pretest Kontrol	.152	30	.073	.921	30	.028

The following are the results of the Mann-Whitney pretest data analysis for the experimental and control classes on the student interest scale in Table 12.

Table 12. Pretest data analysis results: Mann-Whitney pretest: Student interest scale

Test Statistics[a]

	Pretest
Mann-Whitney U	.161
Wilcoxon W	.626
Z	-4.281
Asymp. Sig. (2-tailed)	.000

The following are the results of the posttest normality test data for the experimental and control classes on the student interest scale in Table 13.

Table 13. Posttest Normality Test Results: Student Interest Scale

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Postest Eksperimen	.139	30	.143	.920	30	.027
Postest Kontrol	.167	30	.032	.897	30	.007

The following are the test results from the Mann-Whitney post-test data for the experimental and control classes on the student learning interest scale in Table 14.

Table 14. Results of the Mann-Whitney Post-test Data Analysis for Student Learning Interest.

Test Statistics[a]

	Pretest
Mann-Whitney U	.445
Wilcoxon W	.910
Z	-.074
Asymp. Sig. (2-tailed)	.941

The N-gain test was conducted to determine the improvement of the experimental and control classes with different types of treatment. This was seen from the pretest and posttest completed by students. Calculations can be performed using the normalized gain as follows. The following are the test results from the N-gain data for the experimental and control classes. showing the student learning interest scale. in Table 15.

Table 15. Results of the N-gain Normality Test of the Student Learning Interest Scale.

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
N-gain Eksperimen	.171	30	.025	.912	30	.017
N-gain Kontrol	.194	30	.005	.830	30	.000

Below are the results of the Mann-Whitney test for the N-Gain scores of the experimental class and the control class for the student learning interest scale in table 16.

Table 16. Results of the Mann-Whitney N-gain Test of Students' Learning Interest Scale.

Test Statistics[a]

	Pretest
Mann-Whitney U	.295
Wilcoxon W	.760
Z	-2.295
Asymp. Sig. (2-tailed)	.022

Based on the results of the normality test. the data on the student learning interest scale were not fully normally distributed. so the analysis was continued using the Mann-Whitney U test. The Mann-Whitney results in the pretest showed a significance value of 0.941 (> 0.05). which means there was no difference in initial learning interest between the experimental class and the control class. In the posttest. a significance value of 0.544 (> 0.05) was obtained. so there was no significant difference in learning interest after the learning treatment. However. based on the results of the Mann-Whitney test on the N-Gain score. a significance value of 0.022 (< 0.05) was obtained. which indicates a significant difference in increasing student learning interest between the experimental class and the control class. where the experimental class experienced a better improvement than the control class.

Discussion

The results of the study show that the development of the Picture and Picture learning model assisted by the Enuma and Wordwall applications had a positive impact on the early reading abilities of first-grade elementary school students. The improvement in reading skills. indicated by a medium-category N-Gain score in the experimental class. suggests that the developed learning model is more effective than conventional instruction. These findings reinforce the view that systematically organized visual media can help students recognize letters. connect sounds with symbols. and gradually understand simple words and sentences.

Theoretically. the success of this model can be explained through the characteristics of Picture and Picture. which emphasize the logical sequencing of images. This process trains students' concrete thinking skills and helps them construct meaning from visual representations. This is consistent with the findings of Siregar et al. (2023) who stated that image-based learning can enhance conceptual understanding because students are actively involved in observing. sequencing. and interpreting visual information. In the context of early reading. these activities play an important role in helping students understand the relationship between letter symbols and their sounds. Studies on visual–graphic exposure also show that visual representations contribute to children's language development and skills. thus supporting the use of structured image media in early reading instruction (Vaknin-Nusbaum & Nevo. 2021).

The integration of Enuma and Wordwall further strengthens the effectiveness of the developed learning model. Enuma provides phonics exercises. letter recognition. and game-based literacy activities that align with the characteristics of early-grade learners. Meanwhile. Wordwall serves as a reinforcement medium through interactive quizzes and image-based activities. The combination of the Picture and Picture model with these digital applications creates a more interactive and adaptive learning environment. enabling students not only to receive information but also to actively participate in the learning process. This finding aligns with Wang (2021) who stated that the use of interactive digital tools in literacy learning can increase student engagement and support phonetic recognition in beginning readers.

The results of this study are also consistent with the systematic review conducted by (Wikarya & Yogiarni. 2025). which concluded that the Picture and Picture learning model improves student learning outcomes by combining visual elements. student activities. and meaningful learning experiences. When this model is used together with digital media. learning becomes more flexible and better suited to students' needs in the modern era.

In addition. these findings support the results of (Fitriani & Putra. 2024) who also showed that the Picture and Picture model assisted by image media has a significant effect on elementary students' conceptual understanding. In this study. students' early reading comprehension improved because they not only read text but also understood meaning through structured visual support and activities.

From the aspect of learning interest. although inferential statistical tests did not indicate a significant difference between the experimental and control classes. the N-Gain score in the experimental class was in the medium category and higher than that of the control class. This indicates that learning with the Picture and Picture model assisted by Enuma and Wordwall descriptively increased students' learning interest. This finding is in line with (Sebayang et al. 2023) who stated that information-technology-based learning media can enhance student motivation and engagement. The increase in learning interest can also be explained through early childhood developmental characteristics. (Setyaningsih & Indrawati. 2022) emphasized that early reading instruction should be designed to be engaging. enjoyable. and appropriate to children's developmental stages. The Picture and Picture model assisted by digital media in this study meets these principles by providing visual. interactive. and non-monotonous learning experiences. The increased learning interest among students in the experimental class can also be explained through the theory of game-based learning proposed by (Shernoff & Twersky. 2022). Their research states that challenging and interactive educational games can increase learning interest. focus. and active student participation. Games designed with elements of challenge and immediate feedback encourage students to engage cognitively and emotionally. In this study. the use of Wordwall as an interactive quiz medium and educational game provided enjoyable yet challenging learning experiences. making students more enthusiastic about early reading activities. This aligns with the medium-category N-Gain score for learning interest in the experimental class. indicating that integrating educational games into the Picture and Picture model positively contributes to student engagement and motivation. Thus. this discussion shows that the results not only align with previous studies but also strengthen empirical evidence that developing the Picture and Picture learning model assisted by Enuma and Wordwall is an effective and relevant instructional strategy for improving early reading skills and learning interest among first-grade elementary students

CONCLUSION

The results of this research and development indicate that the R&D stages of Borg and Gall successfully produced a Picture and Picture learning model assisted by Enuma and Wordwall. The findings show that this model can be used to teach early reading to first-grade elementary students. Expert and practitioner validation results indicate that the learning model. instructional materials. learning media. and supporting tools are highly feasible and practical for classroom use.

The study demonstrates that the Picture and Picture learning model assisted by Enuma and Wordwall effectively improves students' early reading abilities. The posttest results between the experimental and control classes differed significantly. with the experimental class achieving a medium N-Gain and the control class a low N-Gain. These results indicate that students can understand reading concepts more systematically and meaningfully when visual-based instruction is combined with interactive digital media. The developed learning model also shows the potential to descriptively increase students' learning interest. N-Gain values indicate that the increase in learning interest in the experimental class falls within the medium category. although inferential statistical tests did not show a significant difference between the experimental and control classes. This suggests that learning using sequenced images and interactive applications can create a more engaging and enjoyable learning atmosphere for students.

Overall. the Picture and Picture learning model assisted by Enuma and Wordwall can serve as an innovative alternative for early reading instruction in elementary schools. This model effectively enhances students' reading abilities and learning interest. Despite some initial technical implementation challenges. these can be addressed through teacher support and instructional adjustments. Consequently. this learning model can be further developed and more widely implemented to support improvements in early literacy among elementary school students. This study has several limitations. First. the research subjects were

limited to two elementary schools with a relatively small sample size; therefore. the generalization of the findings should be made cautiously. Second. differences in initial reading ability between the experimental and control groups at the pretest stage may have influenced the interpretation of learning improvement. Third. students' learning interest was primarily measured using quantitative questionnaire data. which may not fully capture the depth of students' motivational dynamics. Future studies are recommended to involve larger samples. employ more rigorous experimental designs. and apply mixed-method approaches to obtain more comprehensive findings.

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