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SMART WINDOW PUZZLE AS AN INNOVATIVE LEARNING MEDIA: ITS IMPACT ON STUDENT LEARNING OUTCOMES IN VOCATIONAL HIGH SCHOOLS

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Keyword

Smart Windows Puzzle, Innovative Media, Learning Outcomes, Islamic Education,

Abstract

This study aims to examine the effectiveness of the Smart Windows Puzzle learning media in improving learning outcomes in Islamic Education at Al Basyariyah Vocational High School. The study is motivated by the monotonous learning models applied in the classroom, which focus only on cognitive outcomes and ignore affective and psychomotor domains, despite students' relatively good cognitive performance. A quantitative method was used with a True Experimental Design in the form of a Pretest-Posttest Control Group Design. The sample consisted of 50 eleventh-grade students, with 24 in the experimental group and 26 in the control group. Data were collected through posttests and analyzed using IBM SPSS v27.0. The Mann Whitney U Test was applied due to non-normal data distribution. The results showed that the experimental group scored higher (89.58) than the control group (78.85), with a significance value of 0.000 < 0.05, indicating a significant effect. Therefore, the Smart Windows Puzzle media is proven effective in enhancing Islamic Education learning outcomes. This research is expected to guide teachers in implementing innovative strategies and learning media in integrating Islamic values into vocational education.

INTRODUCTION

In the 21st century, education is directed toward development in response to the increasing demands of life. This era also follows the dynamic flow of change and progress. The current reality shows that numerous efforts must be made to address the demands of development across various aspects in preparation for the future. These include fostering critical thinking, creativity, innovation, communication, and collaboration skills that are systematically cultivated to enhance the quality of education today. This transformation requires a strong foundation in educational cognition.

The evolution of digital technology have brought about profound transformations across various domains of life, with education being one of the most significantly affected sectors. Islamic Education (PAI) in the digital era faces complex challenges, both from the educators, the students, and the available infrastructure. Technology should serve as a tool to enhance the effectiveness of learning; however, in reality, many obstacles still hinder its optimal implementation. One of the main challenges in teaching Islamic Education (PAI) in the digital era is the low level of digital literacy among both educators and students. Many PAI teachers struggle to utilize technology as a learning aid due to insufficient training on how to integrate technology into the teaching process. Consequently, PAI instruction in several schools is still conducted conventionally, without making full use of the significant opportunities provided by digital technology.(Prayetno, 2025).

Generation Z, who grew up with visual media such as videos, images, and infographics, tend to understand learning materials more easily through these formats. The presence of digital technology and social media has shaped their mindset and learning preferences, making them more responsive to information presented visually rather than through lengthy text. The use of visual media not only helps accelerate comprehension but also enhances creativity and memory retention. Furthermore, according to McKinsey & Company, Generation Z is often described as a generation that highly values flexibility. They are considered more adaptable to change compared to previous generations and are more open to trying new things and learning from their experiences. (Hayati, 2024).

It is crucial to use educational resources that complement the visual and flexible learning preferences of Generation Z. This emphasizes the necessity for creative media that encourage deeper comprehension and active interaction in addition to being aesthetically pleasing. Thus, it is essential for Islamic education (PAI) to provide engaging, technological, and interactive materials. A fresh strategy that combines digital innovations with Islamic principles is needed to meet this problem. This makes it possible to use cutting-edge resources like Smart Windows Puzzle, which was created to satisfy the demands of education in the twenty-first century. Digital puzzle media is a form of interactive, game-based media that effectively enhances students' active participation. It presents visual and logical challenges that stimulate thinking skills, exploration, and collaboration. (Alifah Nurfathiyyah, Yoyo Zakaria Ansori, 2025). Puzzle board media has great potential to enhance students' critical thinking skills. Research shows that students are actively engaged when using this media in the learning process. Although it effectively stimulates critical thinking, it has limitations in covering a wide range of material and may not fully suit all visual learning styles. Based on assessments by media experts (93.7%) and subject matter experts (90.6%), this media is considered highly valid. Positive responses from teachers (98.6%) and students (86.7%) also indicate that the media is practical and effective for use in elementary schools.(Ziliwu & Anas, 2024). The use of puzzle media in Islamic Education (PAI) helps train students' critical thinking skills, such as analyzing exemplary values, relating them to real-life situations, and solving related problems. This media also promotes collaboration, communication, digital literacy, and enhances student engagement and learning outcomes. Additionally, puzzles instill Character Education values such as cooperation and religious commitment, discipline and responsibility. (Purwaningrum & Iftitah, 2023).

Educational media refers to tools used to facilitate effective communication between teachers and students. Examples of educational media include images and diagrams related to Islamic education. Without the use of learning media, it is challenging to improve student learning outcomes. Students who aim to achieve good results in Islamic education may struggle to gain understanding and knowledge if the learning process lacks appropriate media and is not accompanied by a teacher’s effective instructional skills and mastery of teaching methods. This research was conducted in educational institutions with the aim of uncovering and solving existing problems, despite limitations related to the research subjects. The ultimate goal is to produce solutions, one of which is to improve the quality of education in Indonesia by enhancing the learning process both inside and outside the classroom. The effectiveness of the learning process and student outcomes can be improved through experimental research conducted in the target class, in this case, eleventh-grade students at Al Basyariyah Vocational High School (SMK). Essentially, teachers can use various learning during classroom instruction. However, problems often arise during practice sessions or exams, which are reflected in students' final scores. Many teachers fail to recognize the significant influence of certain factors that they do not fully understand yet.

Based on the phenomena described in the background, this study is essential to examine Smart Windows Puzzle as an innovative learning media offering a promising solution to challenges in Islamic Education (PAI), especially in meeting the needs of Generation Z students. Its interactive and visual design supports critical thinking, collaboration, and communication skills, while also aligning with value-based character education. With strong validation from media and subject experts, as well as positive feedback from educators and

students, Smart Windows Puzzle has proven effective and practical in improving learning outcomes. Therefore, this media holds great potential to transform PAI learning into a more engaging, meaningful, and future oriented experience.

METHOD

This study was conducted on 11th-grade students at SMK Al Basyariyah Caruban, East Java, during the odd semester of the 2024–2025 academic year. Using a quantitative approach, the research aims to analyze variable correlations and assess the impact of specific treatments through experimental methods. As for the use of a quantitative experimental research design using the quasi-experimental design method in the form of pre-test and Post-test control design, in this design there are two groups. The first group was given treatment and the other group was not given treatment. (Sugiyono, 2023).

The researcher uses the quasi-experimental method is because it offers a practical solution for measuring the effect of a treatment when random assignment of participants is not feasible.(Sugiyono, 2013). The research population consists of 81 students, the population is the entire set of subjects in a study. Meanwhile, the sample is a portion of the population that shares its characteristics.(Payadnya, I. P. A. A., & Jayantika, 2018).

The research sample consisted of 50 eleventh-grade Automotive students at SMK Al Basyariyah, comprising 24 students from Automotive class A (experimental group) and 26 students from Automotive class B (control group), using a Two-Group Pretest-Posttest Design without stratification. The experimental class was given treatment using Smart Windows Puzzle, while the control class used a conventional learning model. After the treatment, the researcher administered a posttest to both classes to measure and compare the pretest and posttest results in order to determine whether there was an effect on the learning outcomes of the Islamic Education (PAI) material.

The data collection technique was complemented by prerequisite analyses, which included a normality test using the Shapiro–Wilk method to ensure that the data were normally distributed. The Shapiro–Wilk test was chosen because it is more reliable and sensitive for a small samples, such as the 50 participants in this study.(Souza et al., 2023) Additionally, a homogeneity test using Levene's test was conducted to determine the equality of variances between the experimental and control groups. The hypothesis testing results based on the normality test indicated that the data were not normally distributed; therefore, the analysis was conducted using a non-parametric experimental test, specifically the Mann–Whitney U test, with the assistance of IBM SPSS version 27.

RESULTS

Validity and reliability of instruments.

Validity testing is a testing phase conducted on the content of an instrument, aiming to measure the accuracy or appropriateness of the instrument used in a study.(Ono, 2020).

Table 1 Question Validity Reference Criteria.

Coefficient Interval	*Relationship Level*
0.81 – 1.00	Very high
0.61 – 0.80	High
0.41 – 0.60	Good
0.21 – 0.40	Low
0.00 – 0.20	Very low

This validity test aims to assess the effectiveness of the *Smart Windows Puzzle* learning media as an educational tool, focusing on its accuracy and usability. The analysis was conducted using IBM SPSS for Windows on 31 Grade XI at SMK Al Basyariyah, alongside a reliability test of the instrument.

Table 2 Results of Validity Testing.

No	Question	r tabel	r value	Remarks
1	Question 1	0,355	0,845	Valid
2	Question 2	0,355	0,469	Valid
3	Question 3	0,355	0,661	Valid
4	Question 4	0,355	0,409	Valid
5	Question 5	0,355	0,845	Valid
6	Question 6	0,355	0,839	Valid
7	Question 7	0,355	0,742	Valid
8	Question 8	0,355	0,456	Valid
9	Question 9	0,355	0,621	Valid
10	Question 10	0,355	0,557	Valid

Based on the validity test of the descriptive question item test, with the final results in the table, the calculation results, there are 10 descriptive questions which are declared valid from number 1-10, so that all questions that have been tested for validity can be used for testing tests in the Experiment class and control class. Reliability testing was carried out using the IBM SPSS Alpha Cronbach program. Cronbach's alpha is that an instrument is declared reliable if it has a reliability coefficient of 0.60 or more. This calculation can also be done with the help of the SPSS computer package :

Table 3. Reliability Test Results Question Description

Case Processing Summary

		N	%
Cases	Valid	31	100.0
	Excluded[a]	0	.0
	Total	31	100.0

a. Listwise deletion based on all variables in the procedure.

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
U_1	34.19	71.295	.182	.795
U_2	33.29	76.946	.114	.787
U_3	32.48	69.191	.475	.747
U_4	33.13	69.183	.628	.737
U_5	33.35	61.170	.678	.715
U_6	33.06	65.662	.736	.721
U_7	33.58	61.185	.550	.733
U_8	32.61	73.045	.202	.782
U_9	32.32	68.892	.564	.740

U_10	32.94	61.662	.535	.736

Reliability Statistics

Cronbach's Alpha	N of Items
.770	10

Source: Primary data processed by the researcher

Based on the results of the reliability test on the multiple-choice questions, the table shows that the Cronbach's Alpha value of all items or Question Description items with the value obtained is 0.770 > 0.06. So it can be concluded that the reliability test on the question item description is declared reliable as a measuring tool for research tests.

Data Analysis

Result of Post-Test for Experimental and Control Classes

The post-test conducted in the control and experimental classes aimed to determine the initial abilities of students in both groups.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
kontrol	26	60	90	78.85	8.753
eksperiment	24	70	100	89.58	8.587
Valid N (listwise)	24				

Figure 1. Figure of Post-Test Score Data Results

Based on the data tested and analyzed, the post-test results for the experimental class, with a sample size of 24 students, showed a minimum score of 70 and a maximum score of 100. The mean score was 89.58, with a standard deviation of 8.587. Meanwhile, the post-test results for the control class, with a sample size of 26 students, showed a minimum score of 60 and a maximum score of 90. The mean score was 78.85, with a standard deviation of 8.753.

Test of Prerequisites for Analysis and Hypothesis Testing

Normality Test

The normality results for the post-test results for the experimental class and control class are as follows:

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	class	Statistic	df	Sig.	Statistic	df	Sig.
result	post test control	.206	26	.006	.896	26	.013
	post test eksperiment	.228	24	.002	.883	24	.010

a. Lilliefors Significance Correction

Figure 2. Normality Test with Kolmogorov-Smirnov on Posttest Results

Table 4 Normality Test with Kolmogorov-Smirnov on Posttest Results

Statistik	Eksperiment	Control
	Posttes	Posttes
L count	0,002	0,006
Explanation	Abnormal	Abnormal

A comparison of the normality test results for learning outcomes, calculated from the post-test scores of the experimental and control

classes, is shown in the table above. The normality test for the experimental class post-test yielded a value of 0.002, which is less than 0.05, while the control class post-test normality test resulted in 0.006, also less than 0.05. Therefore, the post-test data for both the experimental and control classes are not normally distributed.

Homogeneity Test

Below are the results presented as a summary of the homogeneity test for each data distribution in the experimental and control groups, as follows:

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Result	Based on Mean	.095	1	48	.759
	Based on Median	.031	1	48	.861
	Based on Median and with adjusted df	.031	1	47.998	.861
	Based on trimmed mean	.111	1	48	.741

Figure 2. Results of the Homogeneity Test of Learning Outcomes for the Experimental and Control Classes

Based on the output above, the significance value (Sig) is 0.741 > 0.05, so from these results it can be concluded that the variance of the experimental class and control class posttest data is homogeneous.

Hypothesis test results

Based on the normality test results, which showed that the data were not normally distributed, hypothesis testing was conducted using a non-parametric test, specifically the Mann-Whitney U test, with IBM SPSS Version 27, as follows:

Table 5. Posttest Hypothesis Test Results for Experiment Class and Control Class

Ranks

	class	N	Mean Rank	Sum of Ranks
result	posttest kontrol	26	17.85	464.00
	posttest eksperiment	24	33.79	811.00
	Total	50		

Test Statistics

	result
Mann-Whitney U	113.000
Wilcoxon W	464.000
Z	-3.912
Asymp. Sig. (2-tailed)	.000

Source: Primary Data Processed by Researchers

a. Grouping Variable: class

Based on the "Group Statistics" output table above, the total number of students in the control class group is 26, while the experimental class group has 24 students. The average (mean) learning outcome score for the control class group was 17.85, whereas for the experimental class group it was 33.79. From these descriptive statistics, it can be concluded that there is a difference in the average learning outcomes between the experimental and control class groups. This is supported by the Mann-Whitney test result of 0.000. It means

that if the p-value is less than 0.05, there is a significant effect between the experimental and control classes.

DISCUSSION

Education is a conscious and planned effort to create a learning environment and process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble morals, and the skills needed for themselves, society, nation, and state. Educational media are tools used to make communication effective between students and teachers. Educational media include pictures, diagrams, and other materials related to Islamic education learning. Without learning media, it is difficult to improve student learning outcomes. Likewise, students who want to achieve good results in Islamic education will face challenges if the learning process is not supported by appropriate media and if teachers lack the ability to teach and understand teaching methods well. This makes it difficult to gain good understanding, knowledge, and learning outcomes in Islamic education.(Anyelir & Depok, 2019)

Based on the results of hypothesis testing on the post-test data from the experimental and control groups using the Independent Samples U-Test (Mann-Whitney Test), with a significant two-tailed value of 0.000 (which is less than 0.05), the final conclusion is that the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted. Therefore, it can be concluded that the use of Smart Windows Puzzle learning media has a significant effect on student learning outcomes. Consequently, the use of Smart Windows Puzzle learning media is declared quite effective in improving student learning outcomes in Islamic education subjects.

According to Harfiani and Roziqin, as quoted in (Maulidah, M., Leksono, S. F., & Farhurohman, 2025), puzzle media is one of the learning tools that can encourage active participation and deepen students' understanding because it involves the process of assembling parts of the material into a unified whole. The results of this study are relevant to previous research (Putri, 2024) which showed that the development of interactive puzzle media is proven to be effective in improving the learning outcomes of fourth-grade elementary school students. The use of puzzles as a learning media offers various benefits, including increasing students' motivation, engagement, and conceptual understanding.

This media provides a more enjoyable and challenging learning experience, encouraging students to participate more actively in the learning process. Consistent with these findings, puzzle learning media is a more effective tool that can attract students' interest and make Islamic Education learning more enjoyable and effective. The puzzle, which is played by assembling and disassembling pieces and uses puzzle-solving techniques to stimulate the brain, aims to help students master the competencies that have been set. Thus, this media not only increases motivation and engagement but also deepens students' understanding, making them more active in the learning process.(Ermawati et al., 2022)

Puzzle media is one option that can be utilized to enhance student engagement and learning outcomes by applying a game-based paradigm, making learning activities more interesting and enjoyable. The advantages of using puzzle media include: (a) students can easily access learning materials; (b) students can think creatively and critically; (c) students can develop their skills; (d) it creates an effective learning environment with classroom interaction; (e) it can increase students' enthusiasm for learning; (f) it can be used in groups or individual. (Ratna Ayu & Sobri, 2024)

Based on various studies, the Smart Window Puzzle media is recommended for use in the learning process because it enhances students' active engagement. This increased active involvement positively impacts students' understanding of the material and overall learning outcomes. Puzzle media is an effective tool to enhance student engagement and learning outcomes through a play-based paradigm, making learning activities more interesting and enjoyable.

CONCLUSION

Based on the results of the research and implementation analysis of the Smart Windows Puzzle learning media, it can be concluded from the tested data that there is a significant improvement in student learning outcomes in Islamic education subjects when using this media. This is evident from the post-test scores of the two classes studied: the experimental group had an average score of 33.79, while the control group had an average score of 17.85.

The data clearly shows that the experimental group's average score is higher than that of the control group. Furthermore, hypothesis testing on the post-test data using the Independent Samples U-Test (Mann-Whitney Test) yielded a significant two-tailed p-value of 0.000, which is less than 0.05. Therefore, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_1) is accepted, indicating that the use of Smart Windows Puzzle learning media has a significant positive effect on student learning outcomes.

Consequently, the Smart Windows Puzzle learning media is considered effective in improving student learning outcomes in Islamic education subjects. In conclusion, integrating interactive and engaging learning media, such as the Smart Windows Puzzle, not only enhances students' academic performance but also increases their motivation, participation, and critical thinking skills. This study highlights the importance of innovative learning tools in modern education and recommends their broader implementation in Islamic education to foster more meaningful and effective learning experience.

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