

LEARNING IMPLEMENTATION USING TPACK WITH SCIENTIFIC APPROACH ASSISTED BY E-MODUL PAI

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Author(s):

Moh. Nawafil^{1*}
Luluk Maktumah²
Junaidi³
Moh. Hafid⁴

* Author's Email Correspondence:

nawafil@ibrahimiy.ac.id

Affiliation:

¹⁻⁴ Pendidikan Agama Islam,
Universitas Ibrahimiy, Jawa
Timur, 68374, Indonesia

Abstract

This study aims to analyze the differences in learning outcomes between students who apply scientific TPACK learning assisted by PAI (Islamic Religious Education) e-modules and students who apply scientific TPACK learning in grade IX on the subject of Islam's presence in reconciling the Indonesian archipelago. A quantitative approach with a quasi-experimental research design was used in this study. Data collection utilized testing techniques and observation techniques. The data analyzed were quantitative data obtained from pretest and posttest learning outcomes of students in the experimental and control groups. Based on the research results, at a significance level of 5% and a sig. (two-tailed) of 0,000, it was found that students who participated in TPACK learning using a scientific approach assisted by PAI e-modules in the ninth grade of junior high school achieved significantly higher learning outcomes than students who only participated in TPACK learning using a scientific approach. These results are also supported by previous studies that confirm the effectiveness of digital teaching materials in improving the quality of learning. Through this research, it is also proven that PAI learning, which was previously textual and abstract, resulting in a decline in student learning outcomes, has now become more concrete, interactive, and applicable, and has successfully improved student learning outcomes through the use of e-modules.

Keywords: *Student Learning Outcomes, Teaching Materials, Scientific Approach*



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INTRODUCTION

The development of information and communication technology has brought significant changes to the world of education, including PAI learning. However, the implementation of technology in PAI learning still faces various challenges. Among these challenges is the teachers' difficulty in effectively integrating technological, pedagogical, and content knowledge. Research Hariati (2022, p. 33) shows that many PAI teachers have struggled to apply the Technological Pedagogical Content Knowledge (TPACK) approach during and after the COVID-19 pandemic, particularly in determining appropriate learning models and the right technology to use.

Conversely, the scientific approach is one of the learning activities expected to improve the quality of education. This approach emphasizes the process of observing, questioning, reasoning,

experimenting, and communicating, which aligns with the objectives of PAI learning to shape character and understanding of Islamic values. However, the application of the scientific approach in PAI learning is still not optimal, especially in terms of integration with technology and appropriate learning media.

Recently, there has been much discussion about the decline in student learning outcomes in PAI. One of the reasons for this decline is the difficulty of understanding the teaching materials. Kadir et al., (2024, p. 514) emphasize that the use of additional teaching materials in schools has a significant impact on learning outcomes. Many students admit to feeling bored during lessons because the material is difficult to understand, causing them to lose interest in learning. Additionally, the absence of learning media, especially for topics like the history of Islam in Indonesia, further demotivates students. Aminingtyas dan Dwi Wardhani (2023, p. 591) assert that learning interest significantly determines learning outcomes; the higher the students' interest, the better their learning outcomes.

Low student learning outcomes are also caused by teachers dominating the learning process or still using a teacher-centered learning approach. From observations of teaching and learning activities, researchers found that teachers are more active than students. Teachers typically only explain the material like in a lecture, then assign tasks or questions for students to complete. However, if teachers dominate too much, students tend to become passive (Wang, 2021, p. 1-18), which affects their involvement in the learning process and ultimately makes it difficult for them to understand the material. Sanjani, (2021, p. 32-37) also states that teaching methods such as lectures are not very effective because only the teacher is actively involved, not the students.

A potential solution is the implementation of TPACK-based e-modules that integrate a scientific approach. E-modules, as digital learning media, have the potential to enhance student engagement and facilitate more interactive learning. Research conducted by Alfani et al. (2024, p. 1-8) shows that TPACK-based e-modules on wave material for 11th-grade high school students are highly suitable for use as a learning medium, with an average validation score of 86.89%. The results of implementing the project-based learning model from this research is students' TPACK abilities are at the exploring level. Students can integrate physics learning with suitable technology. However, students lack the confidence to conclude the evaluation results because learning is not applied in real classes (Ekawati & Prastyo, 2022, p. 1-10). Besides that, many teachers agree and enthusiastic that learning based on TPACK and 21st century skills is very interesting to implement (Handini & Mustofa, 2022, p. 530-537).

Although some studies have discussed the application of TPACK and e-modules in learning, there is still a gap in research that integrates the TPACK model, scientific approach, and

e-modules simultaneously in the context of PAI learning. Most previous studies have focused on one of these aspects separately. Therefore, research is needed to examine the learning implementation using the TPACK model with a scientific approach assisted by e-modules in PAI learning holistically, to address existing challenges and improve the quality of learning.

Therefore, this article will specifically discuss the differences in student learning outcomes through the application of TPACK learning using a scientific approach assisted by PAI e-modules compared to students who receive TPACK learning using a scientific approach without the assistance of PAI e-modules. Based on the issues raised, this study focuses on analyzing whether students' learning outcomes from applying TPACK learning using the scientific approach assisted by PAI e-modules are significantly higher than those of students who only receive TPACK learning using the scientific approach. Through these efforts, the researchers hope to improve students' learning outcomes.

RESEARCH METHOD

This study was conducted at a junior high school in Situbondo Regency. In order to comply with the research code of ethics, the name of the school in the study is written using initials. Cluster sampling is the technique used to select samples in this study. According to Sugiyono, (2012, p. 64), cluster sampling means that samples are not selected from individuals but from specific groups or areas. Two sample groups were obtained, with the experimental class being IX A and the control class IX B, comprising 25 and 28 students, respectively. This study uses a quantitative research approach. The research design adopted for this study is a non-equivalent control group design involving two classes: the experimental class, which implements TPACK learning with a scientific approach using PAI e-modules, and the control class, which implements TPACK learning with a scientific approach without using PAI e-modules. Questionnaires, tests, and observation techniques were used to collect data. The primary research instruments consisted of learning outcome tests and observation sheets.

This study aims to analyze whether the improvement in student learning outcomes by applying scientific TPACK learning with the help of PAI e-modules is significantly higher than that of students who only apply scientific TPACK learning without the help of PAI e-modules. First, the N-gain between the pretest and posttest was calculated for each student to determine the significant difference in improving student learning outcomes in both classes. Then, the N-gain data was tested inferentially to determine whether the learning outcomes in the experimental class were significantly higher than those in the control class. Furthermore, prerequisite testing was conducted to determine the appropriate testing statistics by testing normality using the Shapiro-

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Wilk test. After ensuring that the data was normally distributed, a homogeneity test was conducted to determine whether the data taken from the same population had sufficient consistency. The homogeneity test was conducted using the Levene test with the help of SPSS at a significance level of 0,05. If the Asymp.sig value is $\geq 0,05$, the data is considered homogeneous. Conversely, if the Sig. value is $< 0,05$, the data is considered non-homogeneous (Usmadi, 2020, p. 50-62). After conducting normality and homogeneity tests, an Independent Sample T-Test is then conducted to see the differences in learning outcomes. However, the Mann-Whitney test will be conducted if the data is not normally distributed.

Table 1. The Criteria of N-Gain Score

Nilai N-Gain	Kategori
$g > 0,7$	Tinggi
$0,3 \leq g \leq 0,7$	Sedang
$g < 0,3$	Rendah

Source: Melzer in Syahfitri (2008, p. 33).

FINDINGS AND DISCUSSION

In conducting learning in the experimental and control classes, the researchers followed the learning implementation plan. In the control class, the researchers applied TPACK learning using a scientific approach. Meanwhile, in the experimental class, the researchers applied TPACK learning using a scientific approach assisted by the PAI E-Module. Before being given the treatment, the students first took a pretest. This test was given to students in classes IX A and IX B.

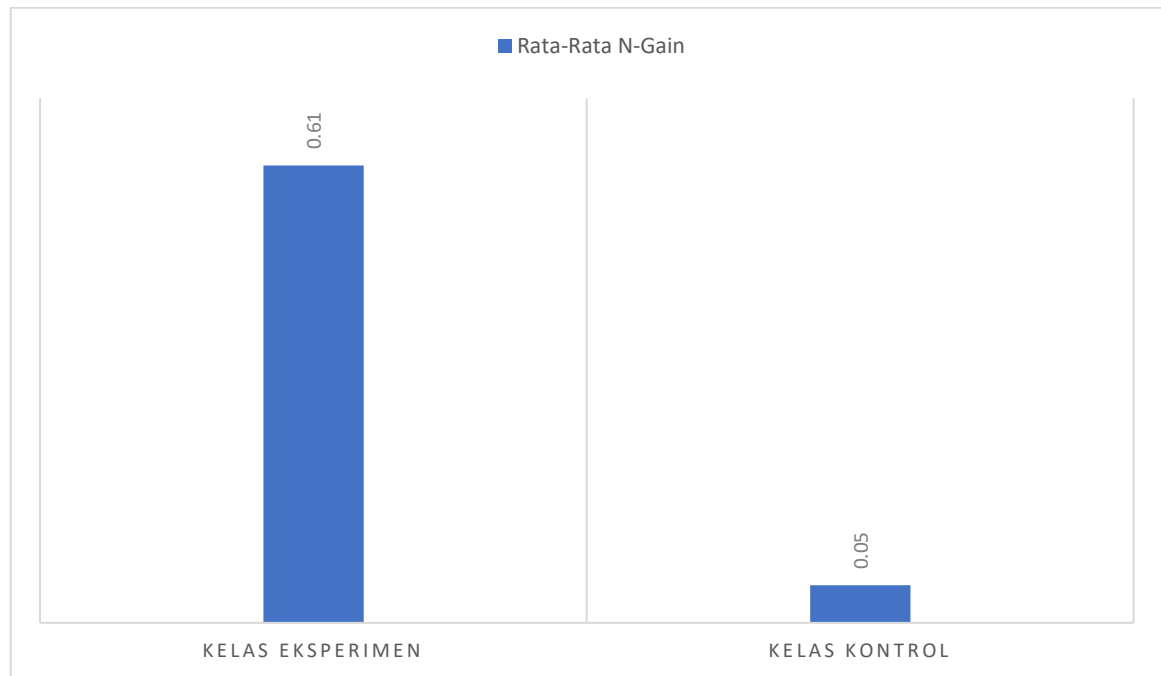
After the students received the treatment over three sessions, they were asked to complete a post-test. All students in classes IX A and IX B participated in the pre-test and post-test. The number of students in class IX A was 25, while class IX B was 28 students. Class IX A was designated as the experimental class, while Class IX B served as the control class. The N-Gain scores from the students' learning outcomes are presented in Table 2. The N-Gain scores were obtained from the analysis of students' learning scores using IBM SPSS Statistics 25.

Table 2. Summary of Learning Outcomes for Experimental and Control Class Students

Aspect	Experiment Class			Control Class		
	Pretest	Posttest	N-Gain	Pretest	Posttest	N-Gain
Maximum Score	77	96	0,91	77	75	0,2
Minimum Score	51	80	0,22	51	55	-0,09
Average	64	87	0,61	62,5	64,9	0,05

Source: Processed from research data, 2024

Based on the statistical results above, it is known that the maximum and minimum N-Gain values for the experimental class are 0,91 and 0,22. Meanwhile, the average N-Gain value for the experimental class is 0,61 which is categorized as moderate. In the control class, the maximum and minimum N-Gain values are 0,2 and -0,09. Meanwhile, the average N-Gain of the control class is 0,05 which categorized are low. Thus, the experimental class achieved the highest learning outcomes compared to the control class. The following is a summary of the average N-Gain results of the experimental and control classes presented in Figure 1.



Grafik 1. Distribution of Average N-Gain Results of Experimental and Control Classes

From these results, the learning outcome data in the two classes then underwent inferential testing to determine whether the learning outcomes obtained by students in the experimental class were significantly higher than those in the control class. Furthermore, a normality test was carried out using the Kolmogorov Smirnov test in IBM SPSS Statistics 25. The Kolmogorov Smirnov test was used because it did not present validity and reliability data as prerequisite tests. The following are the results of the normality test using the Kolmogorov Smirnov test in table 3.

Tabel 3. Recapitulation of Normality Test Data for Experimental Class and Control Class

Classes	Kolmogorov Smirnov		
	Statistic	df	Sig.
Pretest A (Eksperimen)	0,16	25	0,07
Posttest A (Eksperimen)	0,14	25	0,20
Pretest B (Kontrol)	0,09	28	0,20
Posttest B (Kontrol)	0,16	28	0,05

Source: Processed from research data, 2024

Referring to the statistical results in the table above, with a significance level of 5% ($\alpha = 0,05$), it is known that the pretest and posttest data in the experimental class are normally distributed. This is because the significance values obtained for the pretest and posttest are 0,07 and 0,20 which are greater than 0,05. Meanwhile, the pretest and posttest data in the control class are not normally distributed. This is because the significance values obtained for the pretest and posttest are 0,20 and 0,05, respectively, where the posttest significance value does not exceed 0.05. This indicates that the data in the experimental class are normally distributed, but not in the control class.

Based on the presentation of data in the control class, which was assessed as not normally distributed, no homogeneity test was conducted in the future. Therefore, the researcher directly performed the Mann-Whitney test. The Mann-Whitney test was used as a non-parametric statistical test that was appropriate for the following statistical hypothesis formulation.

$H_0 : \eta_1 = \eta_2$ The average increase in N-Gain from the learning outcomes of students who received TPACK learning treatment using the scientific approach assisted by PAI e-modules (η_1) was the same as the average N-Gain of students who received TPACK learning treatment using the scientific approach (η_2).

$H_1 : \eta_1 > \eta_2$ The average increase in N-Gain from the learning outcomes of students who received TPACK learning treatment using the scientific approach assisted by PAI e-modules (η_1) was significantly higher than the average N-Gain of students who received TPACK learning treatment using the scientific approach (η_2).

An important point to note in this study is that there was no initial difference between the two groups, as indicated by the symbol ($=$) in H_0 , so the study focused directly on proving the existence of a significant difference. Based on the above hypothesis description, this study focuses on testing whether TPACK learning using a scientific approach assisted by PAI e-modules produces significantly different learning outcomes compared to TPACK learning using a scientific approach. Thus, if there is a significant difference, so H_0 will be rejected. The testing criteria used are: If the Asymp Sig. value is $< 0,05$, then H_0 is rejected. Conversely, if the Asymp Sig. value is $\geq 0,05$ H_0 cannot be rejected. The results of the Mann-Whitney test can be seen in the table below.

Tabel 3. Mann-Whitney Test Results

Indikator	Hasil Belajar Siswa (Tes Mann-Whitney)
Mann-Whitney U	0,000
Z	-6,252
Asymp. Sig. (2 tailed)	0,000

Source: Processed from research data, 2024

Based on the table above, the Asymp. Sig. (2-tailed) value is $0,000 < \alpha$. Because the Asymp. Sig. (2-tailed) is less than 0.05, it was $0.000 < \alpha$, so that H_0 is rejected. This means that the learning outcomes of students who learn with TPACK using the scientific approach assisted by the PAI e-module are significantly higher than those of students who learn by applying TPACK learning using the scientific approach alone.

Based on the findings described, there is a difference in learning outcome improvement between students who apply TPACK learning using the scientific approach assisted by the PAI e-module and students who only apply TPACK learning using the scientific approach. The Mann-Whitney test with a significance level of 5% yielded a significance value of 0,000. Therefore, it can be concluded that students who used TPACK scientific approach learning assisted by PAI e-modules achieved significantly higher scores than those who only used TPACK scientific approach learning without PAI e-module assistance.

This study shows that students who participate in learning using the TPACK model with a scientific approach supported by e-modules for Islamic religious education achieve significantly higher scores than students who only receive learning using the TPACK model with a scientific approach without e-module support. These findings have important implications for the innovation of 21st-century learning, especially in the context of religious education, which is often considered a field that does not make maximum use of technology.

The TPACK model is a framework that combines three important aspects of learning: teachers' knowledge of content, pedagogy, and technology. According to Rosenberg & Koehler (2015, p. 186), mastery of these three aspects enhances teachers' ability to design and implement effective and relevant learning experiences that align with contemporary needs. In the context of this study, TPACK-based learning was applied in both groups, whether using e-modules or not. However, significant differences were observed in student learning outcomes when e-modules were used as supplementary teaching materials. This indicates that the concrete integration of technological elements (in this case, interactive e-modules) strengthens the effectiveness of the TPACK approach itself. E-modules are teaching materials presented in digital format, designed for independent and interactive learning. E-modules combine text, images, videos, animations, and

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other interactive elements to enhance student understanding and make learning more interesting (Tambunan & Tambunan, 2023, p. 1029-1038). As research conducted by Lestari et al. (2024, p. 80-87) find a finding that interactive e-module with science content is very good qualifications.

While research results on e-modules in learning using tpack with a scientific approach have not been widely conducted, the latest research results are the development of a flipbook-based e-module which resulted in the finding that the flipbook-based digital learning module is very suitable for use, with media expert assessment results of 92.5% and material experts 100% (Fatma Febriyanti, Fauziah, & Wulandari, 2025, p. 153-165).

The scientific approach used in both learning groups signifies the goal of preparing students to be multi-talented. This is because scientific learning has five main steps, including observing, questioning, experimenting, reasoning, and communicating. Among the many challenges in implementing scientific learning, which are often due to the limited reading materials available to students at school (Suparsawan, 2021, p. 608), so Wildani (2022, p. 48) suggests that scientific learning should incorporate activities such as reading instructional materials from various references, watching videos, engaging in religious activities, group discussions, and presentations in class. This approach aligns with the perspective of Nurul Febrian dan Safitri (2024, p. 37-51) who emphasize that knowledge is actively constructed by students through direct experience.

Scientific-based learning in Islamic Religious Education (PAI) is characterized by the application of a scientific approach that follows five key steps: observing, questioning, experimenting or gathering information, associating, and communicating. This model encourages students to actively construct knowledge through direct experience, inquiry, discussion, and problem-solving activities. It emphasizes student-centered learning by fostering logical, analytical, and communicative thinking skills, while integrating Islamic values with empirical facts and contextual phenomena. Teachers are required to be innovative in designing strategies and learning media to align the dogmatic nature of some PAI materials with the scientific approach effectively (Rangkuti, Sitorus, Arlina, & Jauzah, 2025, p. 246-255).

However, the superior results of the group using the PAI e-module show that although the scientific approach provides a good learning framework, the success of the learning process is greatly influenced by the supporting teaching materials used. E-modules allow students to access materials independently, interact with digital content flexibly, and adjust their learning pace according to their individual needs (Janati, Kosim, Nisrina, & Sutrio, 2025, p. 1736–1742). This reinforces student-centered learning and improves learning outcomes.

E-modules have advantages in terms of availability, flexibility, and interactivity. Digital modules designed according to TPACK principles allow teachers to package PAI content in visual,

audio, and interactive animation formats that can stimulate students' interest in learning. Research by Astuti, Riyana, dan Huda (2021) shows that the use of e-modules in learning increases students' motivation and independence in learning, as well as providing a more enjoyable and meaningful learning experience. As online learning resources about Islam become more varied, authoritative resources need to be created by teachers for students in schools (Askar, Nurdin, Pettalongi, Pettalongi, & Basire, 2025, p. 1-20). Furthermore, Askar et al., (2025, p. 15) explain that authoritative online learning resources designed by teachers themselves will have an impact on students' knowledge of Islam, making it more reliable.

In this study, the PAI e-module used is not only a learning aid but also the primary source in the self-learning process. This module allows students to review materials, access additional information, and conduct self-assessments through interactive exercises available within it. This directly impacts the improvement of students' conceptual understanding and information retention.

Previous studies support the findings of this research. A study by (Imas Tesia Putri, Rina Oktaviyanthi, & Khotimah, 2022, p. 820-830) shows that TPACK-based instructional materials are deemed suitable and valid for facilitating students' mathematical problem-solving abilities. Furthermore Imas Tesia Putri et al., (2022, p. 820-830) emphasize that interactive E-Module teaching materials based on TPACK are suitable for use, with a suitability rate of 91.6% from media expert testing, 88.3% from mathematics education expert testing, and 95% from mathematics expert testing. Student responses in the field test were positive, with 63% indicating that the materials were very complete, 50% finding the design appealing, 53% praising the color combination, 57% noting that the language was easy for junior high school students to understand, 57% stating that the illustrations effectively represented the algebra material, and 57% agreeing that the E-Module could assist in developing mathematical problem-solving skills. Therefore, it can be concluded that the interactive E-Module teaching material based on TPACK is suitable for use and can help improve the mathematical problem-solving skills of seventh-grade junior high school students. The research findings by Purnawati, Maison, dan Haryanto (2020, p. 126-133) confirm that TPACK-based learning supported by interactive digital media significantly improves high school students' physics learning outcomes, so the E-LKPD products produced are categorized as highly suitable for use in teaching Physics class X material on Temperature and Heat.

Similarly, in a study conducted by Nurkhasanah, Kustati, dan Gusmirawati, (2023, p. 1294–1302), it was found that a scientific approach combined with digital learning media (such as e-modules) improves students' critical thinking skills and scientific attitudes. In the context of Islamic

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Religious Education learning, these aspects are important because religious education does not only emphasize cognitive aspects, but also affective and psychomotor. E-modules enable the delivery of contextual and applicable materials, for example through video simulations of worship procedures, visual stories of Islamic figures, and interactive reflections on moral values in everyday life. The use of e-modules based on a scientific approach in schools can improve student learning outcomes and character (Lestari, Adrianus I Wayan Ilia Yuda, & Simamora, 2024, p. 80-87).

CONCLUSION

Based on the research and findings discussed, it can be concluded that at a significance level of 5% and a sig. (2 tailed) value of 0.000, it shows that students who follow TPACK learning using a scientific approach assisted by PAI e-modules in grade IX of junior high school achieve much higher learning outcomes than students who only follow TPACK learning using a scientific approach. These results are also justified by a number of previous studies that confirm the effectiveness of digital teaching materials in improving the quality of learning. Through the results of this study, it also proves that PAI learning, which initially tended to be textual, abstract so that student learning outcomes decreased, is now more concrete, interactive, applicable and has succeeded in improving student learning outcomes through the use of e-modules.

This study is limited to two different learning elements, namely content and process. The researcher recommends that further research consider other elements of different learning, namely products. This research design can be developed in development research, so that in the future it can produce many varied digital teaching materials at each level of education.

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