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THE INFLUENCE OF STEAM, MEDIA-ASSISTED STEAM, AND CONVENTIONAL ON PRIMARY ISLAMIC EDUCATION OUTCOMES

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ABSTRACT

This research is motivated by low learning outcomes in Islamic Religious Education (PAI) for elementary school students, which are still dominated by conventional teaching and lack student-centered approaches. This study uses a quantitative approach with a quasi-experimental factorial 2 × 3 design and a non-equivalent posttest-only control group. The research population comprised all grade VI students at SD Negeri in Sukarami District, Palembang, and a purposive sample of 90 students was selected. The research instrument is a PAI learning outcome test that has been tested for validity, reliability, difficulty, and differentiation. The data analysis used a two-way ANOVA, followed by a post hoc test using the HSD Tukey test at a significance level of 0.05. The results showed that: (1) there were significant differences in PAI learning outcomes between students taught using STEAM, media-assisted STEAM, and conventional learning approaches; (2) the learning outcomes of students taught using the media-assisted STEAM approach are higher than STEAM without conventional media and learning; (3) there are differences in PAI learning outcomes based on gender, where female students have higher average learning outcomes than male students; and (4) there is a significant interaction between learning approaches and gender on students' PAI learning outcomes. Overall, the media-assisted STEAM approach is most effective in improving PAI learning outcomes in both male and female students. differences in student characteristics based on gender.

Keywords: PAI Learning Outcomes, STEAM Approach, Media-Assisted STEAM, Gender.

INTRODUCTION

Education is a planned process that aims to develop students' potential as a whole, enabling them to become human beings with faith, piety, noble character, intelligence, creativity, and the ability to face the challenges of modern life. At the basic education level, the learning process focuses not only on mastering knowledge but also on developing 21st-century skills, including critical thinking, creativity, collaboration, and communication. (Manurung et al., 2022). In line with the Independent Curriculum, elementary school learning is intended to be active, contextual, and student-centered to improve learning outcomes holistically. (Barus, 2024; Ministry of Education and Culture of the Republic of Indonesia, 2020). According to Bloom, student learning outcomes include 3 aspects, namely cognitive, affective, and psychomotor. (Anderson & Krathwohl, 2001).

In this context, Islamic Religious Education (PAI) plays a strategic role in shaping students' character by fostering the internalization of values of faith, piety, and noble morals. PAI learning not only emphasizes cognitive aspects, but also includes affective and psychomotor domains that are manifested in students' attitudes and behaviors in daily life (Daradjat, 2020; Azra, 2019). Therefore, PAI learning should ideally be carried out through an active, contextual approach, so that Islamic values can be understood deeply and applied in the realities of modern life.

However, various studies show that teacher-centered, memorization-oriented approaches with minimal exploratory activities still dominate PAI learning in elementary schools. This condition is associated with low student involvement and suboptimal learning outcomes, especially in materials that require conceptual understanding and the association of Islamic

values with real life (Hidayat, 2022). The results of initial observations at several State Elementary Schools in Sukarami District, Palembang, also showed that some students had not met the Minimum Completeness Criteria (KKM) and had a relatively low level of participation in PAI learning.

The challenges of PAI learning are increasingly complex in line with the demands of 21st-century competencies that demand the development of high-level thinking skills. Traditional learning approaches are considered less effective at fostering critical thinking, creativity, collaboration, and communication. (Trilling, B., & Fadel, 2009). Therefore, an alternative learning approach is needed that can integrate these various competencies into a single meaningful learning unit.

One of the learning approaches that has developed in response to these demands is STEAM (Science, Technology, Engineering, Arts, and Mathematics). The STEAM approach integrates five scientific areas holistically to develop high-level thinking skills through problem-solving and project-based learning. (Yakman, 2019). Innovative approaches such as STEAM (Science, Technology, Engineering, Arts, and Mathematics) are increasingly being applied to increase student engagement, creativity, and conceptual understanding.

Some empirical research shows that the STEAM approach is effective in improving the learning outcomes, motivation, and active engagement of elementary school students. Systematic review by Puspita et al. (2024) found that STEAM significantly improved learning outcomes, critical thinking skills, creativity, and motivation among elementary school students compared to conventional learning. Experimental research by Nihayati & Wulandari (2024) also shows that STEAM project-based learning improves students' active engagement and problem-solving abilities compared to traditional methods. Choirunnisa et al. (2023) and Henita (2023) reported that STEAM-based learning provided higher learning outcomes than conventional learning. Systematic review Amanova et al. (2025) also affirmed that STEAM has a positive impact on students' 21st-century learning outcomes and skills, although its implementation remains predominantly in science and mathematics. In the context of PAI, Khoirrunnisa & Isdaryanti (2024) found that applying STEAM significantly improved learning outcomes, but the study did not compare variations of STEAM approaches or consider gender factors.

In addition, empirical studies on STEAM applications are still dominated by science and mathematics subjects. Research on the implementation of STEAM in non-STEM subjects, especially in Islamic Religious Education, remains relatively limited. (Amanova et al., 2025). In fact, PAI learning has great potential to be contextualized through the STEAM approach by integrating religious values, everyday phenomena, and students' creativity, thereby making learning more than mere memorization. (Trianto, 2019).

In addition to the learning approach, the use of learning media also plays an important role in improving student learning outcomes. Based on the *Cognitive Theory of Multimedia Learning*, learning is more effective when information is presented in a combination of visual and verbal formats, because the human brain processes information through two main channels. (Mayer, 2009). The integration of the STEAM approach with visual, interactive, or digital learning media is believed to strengthen conceptual understanding, increase motivation to learn, and create a more meaningful learning experience. (Mulyani, 2021).

In addition, students' characteristics, especially gender, can affect learning outcomes. Some studies show differences in learning styles, engagement, and responses to learning between male and female students. (Santrock, 2018; Woolfolk, 2019). In the context of STEAM learning, gender is often positioned as a moderator variable that can affect the effectiveness of learning approaches. (Ma et al., 2022). The results of initial observations at SD Negeri Sukarami, District of Palembang, also showed that PAI learning outcomes varied by gender and the learning approach used.

Based on the literature review described, this research has novelty in three main aspects. First, this study examines the effectiveness of the STEAM approach in non-STEM subjects,

namely Islamic Religious Education (PAI), which has been relatively rarely studied in experimental empirical research. Second, this study not only compares the STEAM approach with conventional learning but also integrates the use of learning media as a treatment variable in a 2×3 factorial design, thereby enabling a more comprehensive analysis of the learning approach's effectiveness. Third, this study examines the interaction between learning approaches and gender in the context of religious education, thereby offering a pedagogical perspective that is more sensitive to students' characteristics.

Academically, this research contributes to the development of a PAI pedagogy that is more innovative, contextual, and adaptive to the demands of the 21st century. In addition, this study expands cross-disciplinary STEAM research by demonstrating that the integrative approach is effectively applied to value- and character-based learning. Findings on the interaction between learning approaches and gender also contribute to the development of religious education studies that more comprehensively consider students' psychopedagogical aspects. Thus, this study not only provides empirical evidence on the effectiveness of media-assisted STEAM but also enriches the conceptual framework for integrating technology and gender-sensitive PAI learning.

LITERATURE REVIEW

STEAM Approach in Education

The STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach is an integrative framework combining five disciplines to develop 21st-century skills. Su et al.'s (2024) systematic review of 19 empirical studies showed that STEAM effectively improves learners' attitudes, knowledge, and skills in elementary schools, grounded in theories such as *Technological Pedagogical Content Knowledge* (TPACK) and *experiential learning theory*. Several meta-analyses confirm these findings: Leavy et al. (2023) reported that technology integration in STEAM increases creativity, motivation, and academic achievement; Amanova et al. (2025) found positive impacts on learning achievement and developmental skills; and Zhang and Ma (2023) demonstrated a moderate positive effect (SMD = 0.441; $p < 0.001$) on learning outcomes based on 66 experimental studies.

However, STEAM implementation in non-STEM subjects remains limited. Chappell and Hetherington (2025) identify that effective STEAM requires interdisciplinary collaboration, real-world connections, and a thinking-making-doing process—characteristics relevant to Islamic Religious Education, which emphasizes the internalization of values and practical application of Islamic teachings. This study, therefore, examines STEAM application in PAI as an expansion of cross-disciplinary research.

Multimedia Learning Theory and the Role of Learning Media

Learning media plays a crucial role in improving the quality of the learning process and students' outcomes. Mayer (2024) explained that *the Cognitive Theory of Multimedia Learning* (CTML) is based on three main assumptions, namely *dual channels*, *limited capacity*, and *active processing*. This theory posits that individuals process verbal and visual information through separate channels, and meaningful learning occurs when learners select, organize, and integrate relevant information with prior knowledge. Noetel et al.'s (2022) review of 29 meta-analyses (78,177 participants) identified 11 design principles that significantly improve learning outcomes, including the contiguity, signaling, and modality principles; these findings were confirmed by Cevikbas et al. (2022) across 136 journal articles.

In Islamic Religious Education, Huda et al.'s (2024) systematic review showed that appropriate media selection positively affects PAI learning. Suharsiwi et al. (2024) found that integrating visual and audio aids enables more concrete learning experiences, helping students understand Islamic teachings more deeply. The combination of STEAM with interactive and

digital media is expected to strengthen understanding of concepts and increase learning motivation among elementary PAI students.

Gender Differences in STEAM Learning and Education Outcomes

Gender is an important variable affecting STEAM learning outcomes. Ma et al. (2022) found that gender-based group composition influences behavioral performance more than individual gender differences, with mixed-gender groups proving most effective in improving high-level thinking, interaction, and emotional expression. Beroíza-Valenzuela and Salas-Guzmán's (2024) systematic review confirmed that social, cultural, and pedagogical factors contribute to the gender gap in STEM education. Santrock (2018) and Woolfolk (2019) noted that female students tend to show higher discipline and affective involvement, particularly in value-oriented subjects.

Boice et al. (2024) emphasize that STEAM education improves gender dynamics and helps learners connect interdisciplinary learning to their lives. The constructivist and collaborative nature of STEAM provides a stimulating environment for knowledge construction in both male and female learners (Arega, 2025). This study contributes to filling the literature gap on the interaction between STEAM approaches, learning media, and gender in value-based subjects such as PAI.

METHODOLOGY

This study uses a quantitative approach with a pseudo-experiment method (*Quasi-Experiment*). According to Ismail (2018)The research design used was a factorial design 2×3, which involved two independent variables, namely the learning approach and gender, and one dependent variable in the form of Islamic Religious Education (PAI) learning outcomes.

Table 1 Factorial design 2×3

Gender	Learning Model		
	STEAM (A1)	STEAM + Media (A2)	Conventional (A3)
Male (B1)	A1B1	A2B1	A3B1
Female (B2)	A1B2	A2B2	A3B2

The first factor is the learning approach, which consists of three categories: STEAM-based learning (A1), media-assisted STEAM learning (A2), and conventional learning (A3). The second factor is gender, consisting of male (B1) and female (B2).

The research was conducted at SDN 115, SDN 123, and SDN 133 in Palembang for 6 months, from August 2025 to January 2026. The research begins with preparing the report.

Table 2 Research Sample

Gender	SDN 115	SDN 123	SDN 133	Quantity
Male	16	15	12	43
Women	14	15	18	47
Quantity	30	30	30	90

The study focused on grade VI students, comprising three classes of 30 students each, for a total of 90 students. Sample selection was carried out using a purposive sampling technique with a Non-equivalent Posttest-only control group design, as the class was pre-formed and did not allow full randomization. (Scott, 2022).

Table 2: Schema *non-equivalent posttest-only group design.*

SDN 115 Palembang	X_1 O_2
SDN 123 Palembang	X_2 O_2
SDN 133 Palembang	X3 O_2

Description:
X_1 = STEAM without media
X_2 = STEAM media-assisted
X_3 = Conventional
O_2 = Posttest learning outcomes

The first group (A1) was taught using the STEAM approach without additional digital media. The second group (A2) used a media-assisted STEAM approach with videos, presentations, and teaching aids. The third group (A3) was taught conventionally through lecture methods and written assignments.

Data were collected through post-test learning outcome tests and observation sheets. The test instrument was developed based on PAI class VI competencies and validated through expert judgment and empirical reliability testing. (Arikunto, 2017). The observation instrument includes aspects of teacher activities and student activities during the learning process.

Data were analyzed using a 2×3 factorial ANOVA after normality and homogeneity tests. The ANOVA tested: (1) the main effect of learning approach on PAI learning outcomes; (2) the main effect of gender; and (3) the interaction effect between learning approach and gender. Tukey HSD post hoc tests, followed by significant results and effect sizes, were analyzed using *Partial Eta Squared to determine the strength of each factor's influence*. The null hypothesis (H_0) was rejected at a significance level of 0.05.

RESULT AND DISCUSSION

Data Description

The average data on learning outcomes by learning approach and gender included pretest and posttest data. In summary, the learning outcomes of the three groups are presented in the table as follows:

Table 3: Description of statistical variables dependent on learning outcomes

A	B	Red	Std. Deviation	N
STEAM	Male	86.2469	7.08354	16
	Women	83.8057	3.42026	14
	Total	85.1077	5.72116	30
Media-Assisted STEAM	Male	87.5527	7.06704	15
	Women	96.4427	4.26840	15
	Total	91.9977	7.30379	30
Conventional	Male	73.3300	4.92612	12
	Women	75.1811	7.16112	18
	Total	74.4407	6.33380	30
Total	Male	83.0977	8.89095	43
	Women	84.5357	10.41339	47
	Total	83.8487	9.68880	90

The results of the descriptive statistical analysis showed that the media-assisted STEAM learning approach had the highest average learning outcomes (Mean = 91.99), followed by the media-free STEAM approach (Mean = 85.11) and the conventional learning approach (Mean = 74.44). This difference in average scores shows a tendency to increase learning outcomes along with the use of more innovative learning approaches, and is supported by learning media.

Based on gender, female students' average learning outcomes (Mean = 84.54) were higher than those of male students (Mean = 83.10). Although the average difference is not large, it still shows a tendency for variations in learning outcomes by gender.

Table 4 Observation Results of students and teachers of each approach

Yes	Learning Approach	Teacher Activity (%)	Student Activity (%)	Criteria
1	STEAM	87,5	82,5	Excellent
2	Media-Assisted STEAM	95,0	90,0	Excellent
3	Conventional	65,0	55,0	Enough

The results of the observation showed differences in the levels of teacher and student activity across the learning approaches. In STEAM learning without media, teacher activity reached 87.5%, and student activity reached 82.5%, both in the very good category. Media-assisted STEAM learning showed the highest level of activity, with teacher activity at 95% and student activity at 90% in the excellent category.

On the other hand, in conventional learning, teacher activity reaches only 65% and student activity 55%, both in the sufficient category. This data shows that the STEAM learning approach, especially when supported by media, can significantly increase teacher and student involvement in the learning process.

Analysis Prerequisites Test

Table 5 Normality Test

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual for Hasil_belajar	.089	90	.078	.977	90	.109

Before the hypothesis test was conducted, the learning outcome data were tested for statistical assumptions. The results of the normality tests using the Kolmogorov–Smirnov and Shapiro–Wilk tests were 0.078 and 0.109, respectively, indicating that the residuals were normally distributed, with significance values greater than 0.05.

Table 6 Homogeneity Test Results using *Levene's*

		Living Statistic	df1	df2	Sig.
Y Learning Outcomes	Based on Mean	2.181	5	84	.064
	Based on Median	1.254	5	84	.291
	Based on Median and with adjusted df	1.254	5	80.101	.292
	Based on the trimmed mean	2.064	5	84	.078

The variance homogeneity test using Levene's Test also showed that the variances between groups were homogeneous, with a p-value of 0.064 ($p > 0.05$). Thus, the research data meet all the prerequisites for a two-way ANOVA analysis.

Hypothesis Test

The hypothesis test in this study uses Bi-directional Variance Analysis (ANOVA), because it involves two independent variables, namely Learning Approach and Gender, as well as one dependent variable, namely Student Learning Outcomes. (Creswell, 2014).

Table 7 ANOVA 2 x 3 Test

Source of Variation	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5356.961a	5	1071.392	30.022	.000
Intercept	621851.751	1	621851.751	17425.106	.000
Learning Approach	4683.878	2	2341.939	65.624	.000
Gender	169.615	1	169.615	4.753	.032
Gender × Approach	489.747	2	244.874	6.862	.002
Error	2997.718	84	35.687		
Total	641108.579	90			
Corrected Total	8354.678	89			

a. R Squared = .641 (Adjusted R Squared = .620)

Effect size analysis using Partial Eta Squared showed that the learning approach had a very large influence on learning outcomes ($\eta^2p = 0.610$). The gender variable had a small to moderate effect ($\eta^2p = 0.054$), while the interaction between learning approaches and gender had a large effect ($\eta^2p = 0.140$). These findings show that learning approaches are the dominant factor influencing students' PAI learning outcomes, followed by gender, with the interaction between the two also making a significant contribution.

The results of the two-way ANOVA analysis showed that the learning approach factor had a significant effect on PAI students' learning outcomes ($p = 0.000$; $p < 0.05$). Gender factors also significantly influenced learning outcomes ($p = 0.032$; $p < 0.05$).

In addition, the analysis showed a significant interaction between learning approaches and gender on student learning outcomes ($p = 0.002$; $p < 0.05$). The *Adjusted R Squared* value of 0.620 indicates that 62% of the variation in students' PAI learning outcomes can be explained by the learning approach, gender, and their interaction. After the ANOVA, there were significant main effects and interactions, and a follow-up test (post Hoc) using Tukey's HSD was conducted to test the simple effect hypothesis.

Post Hoc Test of Tukey HSD

Table 8 Post *Hoc Test (Tukey HSD)*

					95% Confidence Interval	
(i) Ac	(J) A	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
STEAM (no media)	Media-Assisted STEAM	-6.8900*	1.54245	.000	-10.5702	-3.2098
	Conventional	10.6670*	1.54245	.000	6.9868	14.3472
Media-Assisted STEAM	STEAM (no media)	6.8900*	1.54245	.000	3.2098	10.5702
	Conventional	17.5570*	1.54245	.000	13.8768	21.2372
Conventional	STEAM (no media)	-10.6670*	1.54245	.000	-14.3472	-6.9868
	Media-Assisted STEAM	-17.5570*	1.54245	.000	-21.2372	-13.8768

Tukey's HSD follow-up test showed significant differences in learning outcomes in Islamic Religious Education (PAI) across all pairs of learning approaches. The comparison between the STEAM and media-assisted STEAM approaches yielded a Mean Difference of −6.890 *(Sig. < 0.05), indicating that student learning outcomes in the media-assisted STEAM approach are higher than those in* the STEAM approach. These findings confirm that the use of learning media can increase the effectiveness of implementing the STEAM approach.

The comparison between STEAM and conventional learning also showed a significant difference, with a *Mean Difference* value of 10.667 and a significance of 0.000 (Sig. < 0.05). A positive average difference value indicates that the STEAM approach is more effective than conventional learning in improving student learning outcomes.

Furthermore, the comparison between media-assisted STEAM and conventional learning showed the largest difference in learning outcomes, with a *mean difference* of 17.557 and a significance of 0.000 (Sig. < 0.05). These results show that the media-assisted STEAM approach is the most effective for improving students' PAI learning outcomes.

Overall, the results of this follow-up test strengthen ANOVA's finding that the learning approach has a significant effect on students' PAI learning outcomes. The media-assisted STEAM approach produces the highest learning outcomes, followed by STEAM (no media), while conventional learning shows the lowest outcomes.

Simple Effect *Test* of Male Gender Factors

Table 9 *Multiple Comparisons*

Multiple Comparisons
Dependent Variable: Hasil_Belajar
S.S. S.S.

					95% Confidence Interval	
(I) A	(J) A	*Mean Difference (I-J)*	*Std. Error*	*Sig.*	*Lower Bound*	*Upper Bound*
STEAM (without media)	Media-Assisted STEAM	-1.3058	2.35589	.845	-7.0398	4.4283
	Conventional	12.9169*	2.50328	.000	6.8241	19.0097
Media-Assisted STEAM	STEAM (without media)	1.3058	2.35589	.845	-4.4283	7.0398
	Conventional	14.2227*	2.53879	.000	8.0435	20.4019
Conventional	STEAM (without media)	-12.9169*	2.50328	.000	-19.0097	-6.8241
	Media-Assisted STEAM	-14.2227*	2.53879	.000	-20.4019	-8.0435

The Tukey HSD follow-up test in the male group showed no significant difference in learning outcomes between the media-free and media-assisted STEAM approaches. A significance value of 0.845 (Sig. > 0.05) with *a Mean Difference* of −1.3058 and a 95% confidence interval that included zero indicated that the two STEAM approaches provided relatively equal learning outcomes for male students.

In contrast, comparisons between media-free STEAM approaches and conventional learning showed significant differences in learning outcomes. The results of the Tukey HSD test indicate a Mean Difference of 12.9169 with a significance of 0.000 (Sig. < 0.05), indicating that male students taught with a media-free STEAM approach achieve higher learning outcomes than those taught with a conventional approach.

Furthermore, comparisons between media-assisted STEAM approaches and conventional learning also showed significant differences in learning outcomes. The *Mean Difference* value of 14.2227, with a significance of 0.000 (Sig. < 0.05), indicates that the media-assisted STEAM approach yields the highest learning outcomes for male students compared to conventional learning.

Overall, these results show that, in the male student group, the STEAM approach, with or without media, is more effective than conventional learning. However, the difference in effectiveness between media-assisted STEAM and media-assisted STEAM in a group of male students was not significant.

Simple Effect *Test* of Women's Gender Factors

Table 10 *Multiple Comparisons*

S.S. S.S.

(I) A	(J) A	*Mean Difference (I-J)*	*Std. Error*	*Sig.*	*95% Confidence Interval*	
					Lower Bound	*Upper Bound*
STEAM (no media)	Media-Assisted STEAM	-12.6370*	2.00349	.000	-17.4964	-7.7775
	Conventional	8.6246*	1.92120	.000	3.9648	13.2844
Media-Assisted STEAM	STEAM (no media)	12.6370*	2.00349	.000	7.7775	17.4964
	Conventional	21.2616*	1.88483	.000	16.6899	25.8332
Conventional	STEAM (no media)	-8.6246*	1.92120	.000	-13.2844	-3.9648
	Media-Assisted STEAM	-21.2616*	1.88483	.000	-25.8332	-16.6899

Tukey's HSD follow-up test showed a significant difference in learning outcomes between female students taught with the media-free STEAM approach and those taught with the media-assisted STEAM approach. A significance value of 0.000 (Sig. < 0.05) with *a Mean Difference* −12.6370 and a 95% confidence interval that does not include zero values indicates that the media-assisted STEAM approach produces higher learning outcomes than the media-free STEAM.

In addition, comparisons between media-free STEAM approaches and conventional learning in female students also showed significant differences. The results of the Tukey HSD test indicate a Mean Difference of 8.6246 and a significance of 0.000 (Sig. < 0.05), indicating that female students taught with the STEAM approach without media achieve better learning outcomes than those in conventional learning.

Furthermore, a comparison between media-assisted STEAM approaches and conventional learning revealed the greatest differences in learning outcomes. The *Mean Difference* value of 21.2616, with a significance of 0.000 (Sig. < 0.05), confirms that the media-assisted STEAM approach is the most effective for improving PAI learning outcomes in the female student group.

Overall, these results show that, among female students, the effectiveness of the learning approach gradually increases from conventional learning to media-free STEAM, then to media-assisted STEAM, with the latter yielding the highest learning outcomes.

Gender Interaction Test and Approach

Table 11: *Levene's Test and Independent Samples Test*

		Levene's Test for Equality of Variances		*t-test for Equality of Means*						
									95% Confidence Interval of the Difference	
		F	*Sig.*	*t*	*df*	*Sig. (2-tailed)*	*Mean Difference*	*Std. Error Difference*	*Lower*	*Upper*
Learning Outcomes	*Equal variances assumed*	3.967	.056	1.173	28	.250	2.44116	2.08025	-1.82004	6.70236
	Equal variances not assumed.			1.225	22.237	.233	2.44116	1.99289	-1.68929	6.57161

The results of the analysis showed that the Levene's Test significance value was 0.056 (Sig. > 0.05), indicating that the variances in learning outcomes for male and female students were homogeneous, and the analysis continued under the assumption of equal variances. The results of *the Independent Samples t-test* showed a t-value of 1.173 with df = 28 and a significance level of 0.250 (Sig. > 0.05), indicating that there was no significant difference in learning outcomes between male and female students. Although descriptively, the average learning outcomes of male students are slightly higher than those of female students, the difference is not statistically significant. These findings show that gender independently does not have a significant effect on

learning outcomes, and the variation in student learning outcomes is more determined by the learning approach used.

Gender in a Media-Assisted STEAM Approach

Table 12: *Levene's Test and Independent Samples Test*

		Levene's Test for Equality of Variances		*t-test for Equality of Means*						
		F	*Sig.*	*t*	*df*	*Sig. (2-tailed)*	*Mean Difference*	*Std. Error Difference*	*95% Confidence Interval of the Difference* *Lower*	*Upper*
Results Learn	*Equal variances assumed*	*2.693*	*.112*	*-4.170*	*28*	*.000*	*-8.89000*	*2.13170*	*-13.25659*	*-4.52341*
	Equal variances not assumed.			*-4.170*	*23.015*	*.000*	*-8.89000*	*2.13170*	*-13.29961*	*-4.48039*

The results of the analysis showed that the Levene's Test significance value was 0.112 (Sig. > 0.05), indicating that the variances in learning outcomes for male and female students were homogeneous, and the analysis was continued under the assumption of equal variances. The *Independent* Samples *t-test* yielded a t-value of −4.170 with df = 28 and a significance level of 0.000 (Sig. < 0.05), indicating a significant difference in learning outcomes between male and female students using the media-assisted STEAM approach. These results indicate that in media-assisted STEAM learning, female students obtain significantly higher learning outcomes than male students. These findings show that the use of media in the STEAM approach has a more optimal impact on female students. In addition, these results reinforce the interaction between learning approaches and gender, showing that their effectiveness varies across students.

Gender in Conventional Approaches

Table 13: *Levene's Test and Independent Samples Test*

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
Learning Outcomes	Equal variances assumed	3.838	.060	-.779	28	.443	-1.85111	2.37664	-6.71944	3.01722
	Equal variances not assumed.			-.839	27.942	.409	-1.85111	2.20708	-6.37253	2.67031

The results of the analysis showed that the Levene's Test significance value was 0.060 (Sig. > 0.05), indicating that the variances in learning outcomes for male and female students were homogeneous, and the analysis continued under the assumption of equal variances. The *Independent Samples t-test* yielded t = −0.779 with df = 28 and p = 0.443 (Sig. > 0.05), indicating no significant difference in learning outcomes between male and female students in conventional learning. Thus, H_{015} ($\mu A_3B_1 = \mu A_3B_2$) is accepted and H_{115} ($\mu A_3B_1 \neq \mu A_3B_2$) is rejected. These results indicate that, in conventional learning, the learning outcomes of male and female students are similar and do not differ statistically. This condition shows that conventional learning has not optimally accommodated differences in learning characteristics based on gender.

Figure 1 *Diagram Estimated Marginal Means of Hasil_Belajar*

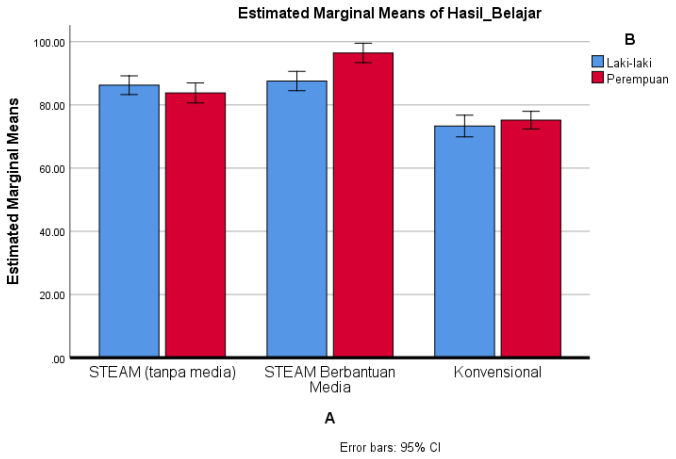

Figure 1 shows that the learning approach has more influence on learning outcomes than gender. Media-assisted STEAM produced the highest average in both genders, followed by non-media STEAM, while conventional was the lowest. The gender distribution is relatively similar across media-assisted and conventional STEAM, although in media-assisted STEAM, female students are slightly higher. *Error bars* (CI 95%) clarify the differences between approaches.

These findings also reinforce previous analyses, which show that significant gender differences emerge in more innovative approaches, particularly in media-assisted STEAM. Overall, it can be concluded that learning approaches have a more dominant influence on learning outcomes than gender factors. Nevertheless, the interaction between learning and gender approaches remains important, especially in media-assisted STEAM approaches that show different effectiveness for male and female students. The results showed that the learning approach had a significant effect on students' PAI learning outcomes, with the media-assisted STEAM approach producing the highest achievements. Theoretically, this finding can be explained through a revised Bloom taxonomy. Anderson & Krathwohl (2001) which emphasizes that learning outcomes include cognitive processes from low levels (remembering) to high levels (analyzing, evaluating, creating). The media-assisted STEAM approach provides students with the opportunity not only to remember and understand PAI material but also to analyze contextual problems, evaluate solutions, and produce products or works grounded in Islamic values. Thus, learning moves to a higher level of thinking (Higher Order Thinking Skills), which directly affects learning outcomes.

In addition, the advantages of media-assisted STEAM can be explained through the *Cognitive Theory of Multimedia Learning,* submitted by Mayer (2009). This theory states that individuals process information through two main channels: the visual and the verbal (dual coding). Learning that integrates text, images, video, and animation enables simultaneous processing across both channels, thereby improving knowledge retention and transfer. In this study, media use in the STEAM approach enriches the representation of PAI concepts, making abstract material more concrete and easier to understand. This explains why the media-assisted STEAM approach has a much larger effect size than other approaches.

These findings are consistent with research. Puspita et al. (2024) which states that the STEAM approach significantly improves students' learning outcomes and creativity. Similarly, Nihayati & Wulandari (2024) found that STEAM project-based learning increased student active engagement compared to conventional methods. However, this study makes a new contribution by showing that the effectiveness of STEAM is more optimal when combined with learning media and analyzed in a factorial design that considers gender variables.

Based on gender, the results show that female students achieve higher average learning outcomes than male students, especially in the media-assisted STEAM approach.

Psychologically, Santrock (2018) and Woolfolk (2019) explain that gender differences in learning are often related to motivation, self-regulation, and responses to learning stimuli. Female students tend to exhibit higher levels of rigor, discipline, and affective involvement in the learning process, especially in subjects that emphasize values and reflection, such as PAI.

In the context of media-assisted learning, dual coding theory Mayer (2009) It can also explain why female students get higher results. Visual and audiovisual media not only strengthen cognitive understanding but also stimulate emotional responses. Some studies show that female students are more responsive to visual and narrative stimuli laden with social values and meanings. Hence, integrating media into STEAM strengthens the deeper internalization of the PAI concept.

In addition, the collaborative, project-based approach of STEAM aligns with female students' learning styles, which tend to be more cooperative and communicative. (Woolfolk, 2019). Discussions, group reflections, and creative exploration activities in media-assisted STEAM allow female students to participate more actively and express their understanding. This explains why the interaction between learning approaches and gender shows a significant influence in this study.

The findings regarding the significant interaction between learning approaches and gender reinforce the constructivist view that learning outcomes are the product of interaction between learning strategies and student characteristics. Piaget affirmed that knowledge is built through active interaction with the learning environment. The media-assisted STEAM approach provides a learning environment rich in visual stimulation, collaborative activities, and contextual experiences, thereby enabling students to construct knowledge more in depth and meaningfully.

Overall, the results of this study not only confirm the effectiveness of STEAM in improving PAI learning outcomes, but also show that the integration of learning media and sensitivity to gender differences are important factors in designing innovative and inclusive learning. Given the very large effect size for the learning approach variables, it can be concluded that the transformation of learning strategies makes a much more dominant contribution than demographic factors alone.

Although some studies show that gender differences in learning are not always significant, this study finds that gender becomes significant when combined with innovative media-assisted approaches. This suggests that pedagogical factors can strengthen or weaken the influence of individual characteristics.

CONCLUSION

Based on the results of the two-way ANOVA, the learning approach, gender, and their interaction have a significant effect on the learning outcomes of Islamic Religious Education (PAI) among elementary school students. The media-assisted STEAM approach proved the most effective, followed by media-free STEAM, while conventional learning showed the lowest learning outcomes.

The effect size indicates that the learning approach has a much larger influence on learning outcomes than gender. This emphasizes that learning strategy transformation is the dominant factor in improving the quality of PAI learning outcomes. Nonetheless, the interaction between approaches and gender also makes a significant contribution, particularly to media-assisted STEAM approaches, which are more effective among female students.

Overall, PAI learning that is designed integratively and contextually, and supported by learning media, can optimize high-level cognitive processes and increase student involvement in learning.

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