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Optimizing STEAM-Based Differentiated Instruction to Enhance the Effectiveness of Surah At-Tin Memorization among Fourth-Grade Students at Elementary School

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Abstract

This study investigated the effectiveness of a differentiated instructional model grounded in STEAM principles, augmented by an interactive PILAR media, on the memorization of Surah At-Tin among fourth-grade elementary students. A true experimental pretest–posttest control-group design was employed, involving an experimental cohort (n=6) and a control cohort (n=9). Both groups completed a baseline assessment of Qur'anic memorization before undergoing four instructional sessions; the experimental group received STEAM-based differentiated activities and digital media support, whereas the control group experienced conventional lecture-based instruction. Posttest results revealed that the experimental group achieved a mean score of 91.67 (SD=8.54), compared to 69.44 (SD=15.32) in the control group. Normalized gain analysis indicated a high gain (g=0.90) for the experimental cohort and a moderate gain (g=0.64) for the control cohort. These findings demonstrated that aligning pedagogical strategies with individual learning preferences, integrating multimodal STEAM tasks, and leveraging interactive technology significantly enhanced both the quantity and accuracy of Qur'anic memorization. The study concluded that a differentiated STEAM-based approach, supported by PILAR media, constituted a superior method for optimizing primary-level Qur'anic memorization and recommended its broader application and longitudinal evaluation.

Keywords: STEAM-based learning; differentiated instruction; Quran memorization; elementary education; Surah At-Tin

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Introduction

Learning to memorize the Qur'an is one of the essential components of Islamic religious education, especially at the elementary level [1]. Students are not only required to be able to memorize the verses of the Qur'an, but also to understand the meaning and practice the values contained in it [2]. However, memorization learning at the elementary school level, including in grade IV, focuses only on memorization mechanically, without a deep understanding of the meaning of the memorized letters [3]. As a result, students are able to memorize verses fluently, but do not understand the essence and value contained in them, making it difficult for them to practice them in their daily lives [4].

Some previous research, such as the one conducted by Fajeri [5], showing that traditional memorization approaches that do not pay attention to the accuracy of the reading of each letter in the Qur'an verses are less effective in shaping the practice of Qur'anic values among students. Other research by Eva'atussalamah [1] also highlighted the importance of proper pronunciation of Hijaiyah letters to the meaning of the letter, because proper memorization and understanding the meaning of the letter also have a significant impact on the daily behavior of students. This shows the need to integrate memorization and understand the meaning of the letter in the process of memorizing the Qur'an [3].

In addition, the rapid development of digital technology in the current era brings new challenges in the learning process [6]. Technology, which should be a tool in increasing learning effectiveness, is often used unwisely [7], causing distraction and decreased students' focus on Qur'an memorization material [8]. Excessive use of gadgets and addiction to social media can distract students from activities that are academic and spiritual in nature [9], including memorization of the Qur'an. In this context, there is an urgent need to integrate technology positively in the learning process in order to help students memorize and understand the Qur'an more effectively.

However, technology also has great potential to be used in learning the Qur'an [10]. A STEAM-based differentiated learning approach (Science, Technology, Engineering, Arts, and Mathematics) offers innovative solutions [11], in utilizing technology to improve the quality of learning to memorize the Qur'an [12]. The STEAM approach allows for more interactive, creative, and tailored learning to each student's needs and learning styles [13]. By utilizing technology wisely through this approach, students will not only be more motivated to memorize [14], but also better able to understand the meaning of memorized letters, as well as internalize them in daily life [15].

In addition, the memorization methods used in various schools are often still uniform, regardless of the differences in students' learning styles, abilities, and interests [16]. Students with good memorization skills may be able to

memorize faster, but those with different learning styles or slower learning speeds often lag behind [17]. Therefore, a differentiated learning approach is needed that can accommodate the individual differences of each student [18], while maintaining a focus on improving the memorization of the Qur'an.

One of the letters in learning Islam in grade IV that needs to be memorized is Surah At-Tin. Surah At-Tin reminds Allah to create the best human beings, but only those who believe and do righteous deeds remain noble [19]. The eight verses also contain the meaning of the foundation of faith, morals, and the logic of responsibility [20]. In addition, it can foster gratitude, encouragement to behave well, and the belief that every action will be judged fairly, in line with the goals of the Pancasila Student Profile and the character education curriculum [21].

Memorizing and studying Surah At-Tin at the elementary level in grade IV instills the foundation of monotheism and morality as early as possible: its verses strengthen the belief in rubûbiyyah (the belief that Allah is the Creator and Sustainer) through an oath over His creation, affirming the principle of human nature that man is created "fi aḥsani taqwîm" (in its best form) so as to foster gratitude and positive self-esteem, as well as teach the concept of hisab that every deed will get a reward or a decrease in degree which is the core of the lesson of faith and fiqh of worship about good intentions and deeds; With a straightforward but profound content, this surah is a practical means to get to know the interpretation, basic tajwid, and values of Islamic character as a whole, enriching the Islamic Religious Education curriculum in the golden age of the formation of children's faith [22].

Research on the memorization of At Tin letters has been carried out before by [23] However, in the research, cooperative methods were used, and did not use STEAM to support learning. Research by [24] highlighting intelligent systems to assist Muslims in reading and memorizing the Quran. In contrast to Muhammad's research, this study emphasizes STEAM-based differentiated learning, which is expected to have a positive impact on the memorization of Surah A-Tin. Meanwhile, the study focuses more on learning Tajweed for the correct reading of letters, using the *Mel-Frequency Cepstral Coefficient (MFCC)*, by extracting voice features recorded using MFCC and comparing them with the voices of experts stored in the database.

São Paulo [25] He has also conducted research on the application of differentiated learning. However, the research emphasizes that a teacher must apply differentiated learning in order to know the needs of each student to improve academic learning outcomes. The findings do not highlight the refinement learning that can improve the memorization of At-Tin letters,

especially when collaborated with technology. Meanwhile, in this study, it will emphasize this.

Some studies indicate that there is still a lack of research on STEAM-based differentiated learning research to improve the correct memorization of the Qur'an. This research is important because of the urgency to optimize the learning process of memorizing the Qur'an at the elementary level, especially in the context of Islamic religious education in the digital era [26]. By utilizing a STEAM-based differentiated approach, this research not only offers solutions to improve students' memorization, but also the meaning of each verse of the Qur'an is essential for students to practice the values contained in it in their daily lives.

This research offers novelty by combining differentiated learning and STEAM approaches to overcome challenges in learning Qur'an memorization. Not only does it focus on memorization, but the study also emphasizes the importance of each letter and verse memorized, something that is often overlooked in traditional methods. In addition, the innovation of this research lies in the positive integration of digital technology in the learning process, which is not only used as an interactive medium, but also as a tool tailored to the individual needs of students. This approach seeks to utilize technology in supporting the memorization process, as well as providing guidance to students in using technology wisely, so that negative distractions can be minimized. Based on the findings of the problems that have been described, the formulation of the problem in this study is How can a STEAM-based differentiated learning approach enhance the effectiveness of memorizing and understanding Surah At-Tin among Grade IV students?

Method

This research uses a methodological approach. Theoretically, this study uses the *Pretest-Posttest Control Group Design* approach. The problem-solving approach in this study uses STEAM-based differentiated learning to improve the memorization of grade IV students of the Qur'an. First, students are grouped based on abilities, interests, and learning styles (visual, auditory), so that each group gets a customized learning method. Technology will be used wisely through interactive media such as digital applications and educational videos, making learning more engaging and effective. The initial evaluation is carried out to assess student competence with the traditional method, then it is re-evaluated after the application of this approach to measure the improvement of

memorization. Education on the positive use of technology is also provided so that students use technology as a learning tool, not a distraction.

This study uses *True Experimental Design Type, Pretest-Posttest Control Group Design*. The study respondents were divided into 2 groups, namely the experimental and control groups. Detailed *Pretest-Posttest Control Group Design* is presented in Table 1.

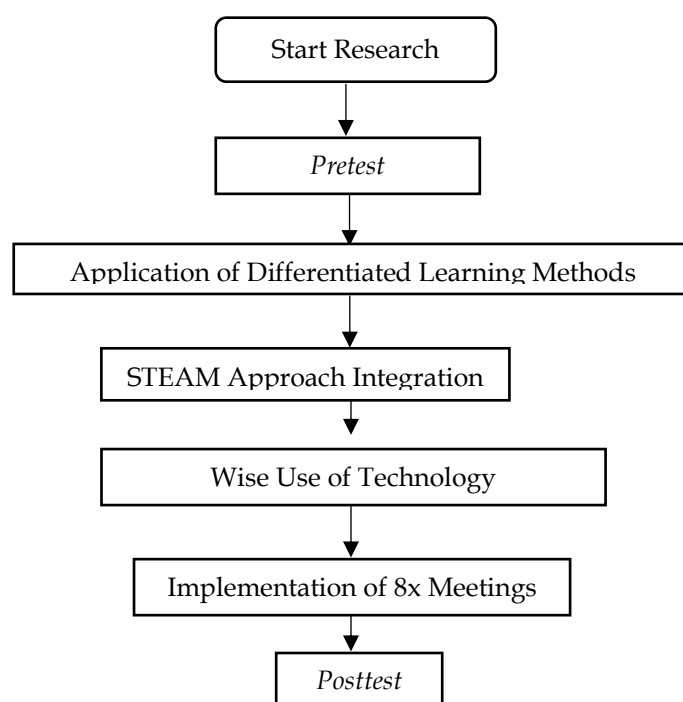
Table 1. *Pretest-Posttest Control Group Design*

Group	Pretest	Treatment	Posttest
Experiment	O1	X1	O2
Control	O3	X2	O4

Information:

- O1 : Measuring the initial ability (pretest) of the experimental group
- X1 : Treatment (application of STEAM-based learning)
- O2 : Measuring the results of the post-test of the experimental group
- O3 : Measure the initial ability (pretest) of the control group
- X2 : Treatment (application of STEAM-based learning)
- O4 : Measuring the results of the control group's post-test

The research flow chart is presented in Figure 1.



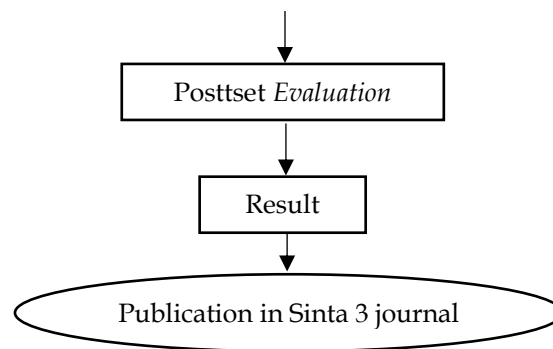


Figure 1. Research Flow Diagram

The explanation of the research steps in the flowchart is as follows:

1. The first step was for the research respondents to be given **pretest questions** to see the students' initial ability.
2. The next step after being given a pretest is **to be given treatment in the learning process**. Using a STEAM-based differentiated model, the first step in the learning process is to group students based on abilities, interests, and learning styles (visual, auditory, kinesthetic). Each group will get a learning method that suits its characteristics, making learning more directed and effective. Students with visual learning styles will utilize media such as pictures or diagrams, auditory students use audio recordings, and kinesthetic students engage in physical activity to support memorization. Furthermore, the STEAM approach is integrated into learning. The Science component is used to explain the scientific context in the verses of the Qur'an, Technology is a digital memorization application that makes it easier for students to practice, Engineering involves simple projects that support students' understanding, Arts encourages students' creativity in expressing through arts such as calligraphy, and Mathematics by involving students in the counting of verse or letter patterns to train logic and memory through a numerical approach. In the learning process, technology is used wisely. Interactive learning apps and tools help students to memorize more fun and structured, while still maintaining focus and avoiding excessive distractions. Educational videos and infographics also help students understand the meaning of the memorized verses. This process is given over 8 meetings.
3. The last step is to do a *posttest*. The evaluation was carried out to measure the progress of student memorization. Thus, this STEAM-based differentiated learning is expected to not only improve students' memorization, but also

help them internalize and understand the meaning of the Qur'an in depth.

The sampling techniques used are *purposive sampling*. Determination of the number of samples using the Slovin formula [27]:

$$n = \frac{N}{N \cdot e^2 + 1}$$

Information:

n = Number of Samples

N = Total Population

e = The desired critical value (margin of error) is 5%

The data analysis technique used to determine the increase uses the N-Gain formula, with the following formula [28]:

$$N - Gain = \frac{T_{pos} - T_{pre}}{T_{maks} - T_{pre}}$$

Information:

T_{pos} : average score *Posttest*

T_{pre} : average score *Pretest*

T_{max} : Ideal maximum score

N-Gain score obtained with these equations can be analyzed in categories using the interpretation table *Gain Score* [29] :

Table 1. Categories N-Gain Score Acquisition $\langle g \rangle$

Value $\langle g \rangle$	Category
$\langle g \rangle > 0.7$	Tall
$0.3 \leq \langle g \rangle \leq 0.7$	Keep
$\langle g \rangle < 0.3$	Low

Result

Based on the results of the pretest, the students' initial ability to memorize the At-Tin Letter was very low in both groups. The average pretest score of the experimental class was 14.50 and the control class was 15.00 (scale 0–100). This is equivalent to less than 2 verses that were successfully memorized correctly out of a total of 8 verses. This shows that both groups have comparable initial

memorization abilities and are both still low. None of the students achieved memorization completeness at the pretest stage, so learning interventions were needed to improve memorization results.

After 4 meetings on the implementation of STEAM-based differentiated learning in experimental classes, there was a significant increase in results. The average posttest score of the experimental class reached 91.67, much higher than the control class which was only 69.44. The memorization achievement of students in the experimental class was very high: 3 out of 6 students (50%) managed to memorize 8 verses (score 100), 2 students memorized 7 verses (score 87.5) and 1 student memorized 6 verses (score 75). No experimental student memorized less than 6 verses. In contrast, in the control class only 1 in 9 students (11.1%) achieved memorization of 8 verses (score of 100), 1 student memorized 7 verses (87.5), while the majority memorized partially: 2 students of 6 verses (75), three students of 5 verses (62.5), and two students of 4 verses (50). Thus, the improvement of memorization ability in the experimental class was much better than that of the control class, both in terms of average scores and the distribution of the number of verses memorized. Table 2 compares the pretest and posttest results between the experimental and control classes, including each group's minimum, maximum, and N-Gain scores. *N-Gain* is a normalized gain that reflects the proportion of increase from the ideal maximum score.

Table 2. Statistics of the pretest and posttest results of memorization of the *At-Tin Letter* in the experimental and control classes.

Group	Average Pretest	Posttest Average	Minimum Score	Maximum Score	N-Gain (Category)
Experiments (n=6)	14,50	91,67	75	100	0.90 (High)
Control (n=9)	15,00	69,44	50	100	0.64 (Medium)

Based on Table 1, the average posttest of the experimental class increased by +77.17 points from the pretest, while the control class increased by +54.44 points. The minimum posttest score in the experimental class (75) was higher than the control class's average, indicating that all experimental students had achieved a good level of memorization. The N-Gain value of the experimental class of 0.90 is classified as high, while the N-Gain of the control class of 0.64 is classified as the medium category. By criteria [29], $N-Gain > 0.7$ is classified as high, 0.3–0.7 as medium, and < 0.3 low. Thus, learning in the experimental class can be said to be very effective in improving memorization *Surat At-Tin*, whereas conventional learning in the control class is only quite effective. This difference

in the N-Gain category indicates that the STEAM-based differentiated learning approach has a greater impact on improving learning outcomes than the usual approach. Figure 1 shows the distribution of the number of students based on the number of verses that were successfully memorized in the posttest for both groups. It can be seen that the distribution curve of the experimental class shifts towards the maximum score, while the control class is spread in the lower score range.

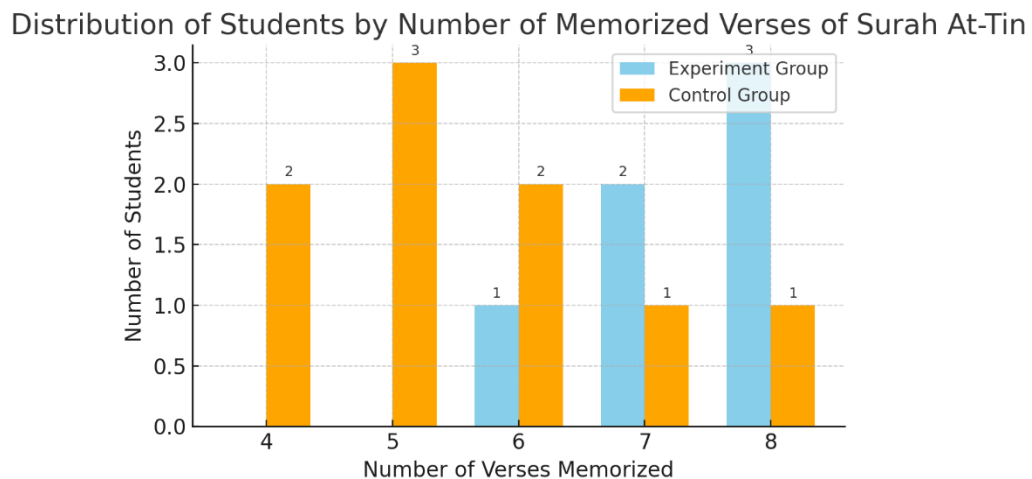


Figure 1. Distribution of the Number of At-Tin Verses Successfully Memorized by Students in the Experimental and Control Groups

In Figure 1, it is clear that the difference in the profile of the memorization results of the two groups is clear. All students in the experimental class memorized at least 6 verses or more, with the majority (50%) reaching 8 verses. In contrast, the control class showed lower variation in outcomes; There were students who only mastered 4–5 verses and only 11% of control students managed to memorize 8 verses. This distribution confirms that the implementation of STEAM-based differentiated learning results in more students with perfect memorization and overall promotes even memorization achievement at a high level. Meanwhile, conventional methods in the control class tend to produce mixed outcomes and most students have not yet achieved full memorization.

The significant increase in results in this experimental group is inseparable from the advantages of the learning methods applied. Some of the key factors that contribute to the effectiveness of learning in the experimental classroom include: differentiated approaches according to learning styles, the use of interactive PILAR media, and the integration of the STEAM approach in the learning process. The following will be discussed for each of these contributions.

Discussion

Differentiated Approach According to Learning Style

One of the main factors of the advantages of experimental classes is the application of differentiated learning that pays attention to the variation of students' learning styles. Teachers provide different strategies and media according to the needs and learning preferences of each student, for example with a combination of visual, auditory, and kinesthetic. Each student is given a "different path" to acquiring memorized material: students with auditory predisposition are facilitated by listening to murattals or memorized songs, visual students are aided by colored text or verse illustrations, and kinesthetic students are engaged through movements or games containing verse. Adjusting teaching methods to students' learning styles has been proven to improve their motivation and learning performance. In his reserach, [30] stated that by updating teaching methods to suit learning styles, students' motivation increases and achievement also improves. In the context of this research, the differentiated approach makes students more actively involved and comfortable in the memorization process.

Students who are usually bored with a single method become more motivated because the material is delivered in a way that they like. As a result, they can absorb and remember the verses more effectively. This is consistent with the view [31] that students need a variety of *Avenues* or ways to learn content so that every student can learn effectively. With differentiation, each student feels success in learning within their capacity, which in turn increases their confidence and learning outcomes [32]. The results of this study show that when students' individual needs are met, their Qur'an memorization achievement increases far beyond uniform learning without differentiation.

Use of interactive media "PILAR"

In addition to differentiation strategies, STEAM-based PILAR media contributes significantly to higher learning outcomes in experimental classes. The PILAR media in this study is an interactive learning media designed to help memorize *the At-Tin Letter*. This media is packaged attractively using technology, possibly through digital modules equipped with audio-visual features and interactive exercises. Through this medium, students can listen to the reading of verses (murattal audio), see Arabic texts and their translations and illustrations (*visual*), and do quizzes or memorization challenges (*kinesthetic/interactive*). This kind of interactive multimedia-assisted learning has been proven to improve the quality of learning. Interactive audio-visual learning media can make learning more interesting and *engaging* for students through sound, image, and interaction elements. In the context of Qur'an memorization, this helps to stimulate the

various senses to strengthen students' memory. Students with visual learning styles can be helped by the aesthetic appearance of text and images, while the chanting of verses heard repeatedly helps auditory students. The media's quiz or light game feature involves student activities so that learning is not monotonous.

Previous development research supports the effectiveness of this kind of PILAR media. For example, the media [33] developed in the form of interactive digital books containing pictures, videos, quizzes, and evaluation questions have proven to be very practical and effective for use in learning. Engaging and feature-rich digital media can be used anytime and anywhere, so students can learn independently outside of class hours. Moreover, interactive media has been shown to help significantly improve memory and understanding of the material. Research report by [34] showed that the use of media can help improve the ability to remember and understand material up to 50% better than without media. Thus, it can be understood why the experimental group that used the PILAR media obtained higher memorization results. This medium succeeds in bridging the gap between students and memorization materials in a more fun way, so that students do not get bored quickly and it is easier to remember verse by verse. This is an advantage that learning in control classes that may only rely on traditional methods (e.g., students memorize themselves repeatedly without interactive supporting media

Integration of the STEAM approach

In addition to differentiation, integrating STEAM (Science, Technology, Engineering, Arts, Mathematics) in rote learning significantly increases students' motivation and understanding of [35]. The STEAM approach makes memorization more interactive and contextual in [36]. In this study, the science is applied by explaining the scientific context and facts related to the letter At-Tin (for example, the discussion of figs and olives mentioned in the first verse) so that students better understand the meaning and peculiarities of the contents of the letter [37].

Aspects Technology is realized through interactive digital media (PILAR media) and the Qur'an memorization app, which helps students practice memorization independently in and out of the classroom. The PILAR media allows students to hear the chanting of verses with correct tajwid, re-record their memorization, and get immediate feedback, so the memorization process becomes more fun and structured. This is in line with the opinion [12] that interactive e-learning platforms can increase students' learning motivation in STEAM education. Furthermore, this involves simple projects, for example, modeling or creative memorization tools, that stimulate active engagement and problem-solving. It is also applied by encouraging students to express their

understanding of the letter through art, such as writing calligraphy verses or making illustrations of the letter's contents. This artistic approach provides an aesthetic and immersive learning experience, helping to reinforce memorization through visual and emotional pathways. Last, involve students by inviting them to pay attention to the pattern of numbers or letter structure (e.g., counting the number of certain verses, words, or letters in a letter) as a mnemonic method to strengthen their memory. The combination of these five aspects of STEAM makes memorization learning no longer monotonous, but rich in activities that stimulate various senses and students' compound intelligence. This is in line with the view [38], [14], [39] and [9] that STEAM-based education allows for more creative, interactive, and appropriate learning styles, thereby significantly increasing student engagement.

Furthermore, using digital technology (PILAR media and memorization applications) in this approach answers learning challenges in the modern era. Previously, many students were distracted by gadgets and social media that were less educational [40]. Through this innovation, technology is used as a tool for effective memorization, no longer a distraction. Students are reported to be more enthusiastic about practicing memorization using interactive applications than traditional methods, due to the presence of game, audio-visual, and personalization elements in these digital media. These findings align with the study by [41], who developed an *application of Tilawatil Qur'an* as an intelligent system to support the memorization of the Qur'an; their results show that the technology can significantly improve the efficiency of memorization. In this study, the PILAR media functions similarly as an interactive means that facilitates students to practice at any time with virtual guidance, so that the frequency and duration of memorization exercises increase. This increase in the intensity and quality of exercise is strongly suspected to contribute to the high posttest scores of the experimental group. In addition, through digital media, students can measure their abilities (e.g., listening to their own memorized recordings) and be motivated to correct pronunciation errors and increase the number of verses memorized. Thus, the positive integration of information technology in learning Quran memorization has proven to be effective in improving learning outcomes, in line with recommendations for Islamic education in the digital era [41].

Based on the findings, it is clear that STEAM-based differentiated learning has a superior impact in increasing the effectiveness of *At-Tin* letter memorization compared to conventional learning. The combination of student-centered strategies, the use of interactive PILAR media, and context enrichment through STEAM can increase the quantity and quality of memorization. All the verses memorized by the students of the experimental group met the criteria of

proper pronunciation and tajweed because this method emphasizes correct understanding and practice from the beginning, not just mechanical memorization. The positive implications can not only be seen from higher scores, but also from students' confidence in chanting their memorization correctly. With N-Gain being in the high category, this learning model can be said to be very effective in achieving memorization learning goals. The results of this study enrich the empirical evidence that pedagogical innovations that accommodate individual differences and utilize educational technology can significantly improve learning outcomes. In the future, this STEAM-based differentiated learning model has the potential to be applied to other letter memorization materials or different subjects to optimize the learning potential of each student.

Conclusion

This study concluded that the differentiated instructional model based on STEAM principles, supported by the interactive PILAR media, significantly enhanced students' memorization of Surah At-Tin in fourth-grade elementary education. The experimental group achieved a mean post-test score of 91.67 with a high normalized gain (N-Gain = 0.90), whereas the control group reached a mean score of 69.44 with a moderate gain (N-Gain = 0.64). The superior results in the experimental cohort were attributed to the alignment of instructional strategies with individual learning preferences, the integration of multimodal STEAM activities that deepened conceptual understanding and engagement, and the affordances of digital media that fostered motivation, self-regulated practice, and recitation accuracy. These findings indicated that a differentiated, STEAM-based pedagogy, augmented by interactive technological resources, constituted a practical approach for optimizing Qur'anic memorization at the primary level. Future research was recommended to examine long-term retention of memorized passages and investigate this pedagogical framework's applicability to other Qur'anic texts or broader religious education settings.

Author Contributions

Rina Murtyaningsih: Conceptualization, Methodology, Writing – review & editing, Supervision, Project administration. **Esty Setyo Utaminingsih:** Methodology, Writing – review & editing, Investigation. **Mohamad Munawar; Mohammad Nurul Qomar & Muhammad K Ridwan:** Conceptualization, Methodology, Writing – review & editing, Investigation.

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Conflict of Interest

The authors declare no conflicts of interest.

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