

## **Development of an AI-Based Differentiated Learning Module for Quran-Memorizing Students to Enhance Mathematics Achievement and Motivation in Elementary Education**

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**Abstract:** Quran-memorizing students face unique challenges in balancing their religious memorization with academic subjects, particularly mathematics. This study aims to develop an AI-based differentiated learning module tailored to the specific needs of Quran-memorizing elementary students to improve their mathematics performance and motivation. The module was designed to personalize content delivery and provide real-time feedback to enhance student engagement. Using the ADDIE model as the research methodology, the study involved analyzing student needs, designing, developing, implementing, and evaluating the module. The results showed a significant improvement in both academic performance and student motivation in learning mathematics. The AI-based module allowed for a more interactive, adaptive, and personalized learning experience, addressing the diverse learning profiles of students. This research contributes to the growing field of AI in education, demonstrating the potential of differentiated learning approaches to enhance academic outcomes. Future studies should explore the long-term effectiveness of such modules and consider expanding their application to other subjects and student groups.

**Keywords:** Artificial Intelligence, Differentiated Learning, Quran-Memorizing Students

### **A. Introduction**

Students who memorize passages from the Quran are a distinct category of learners who need particular attention during the educational process. These kids start studying the Quran by heart at a young age, which requires commitment and self-control and profoundly alters their cognitive processes and learning preferences. Quran memorizers typically have excellent concentration and memory retention skills, favoring rote learning techniques. They must, however, strike a balance between memorizing the Quran and other academic disciplines, especially mathematics. Students, including those who memorize the Quran, frequently find mathematics to be challenging. This difficulty can be attributed to a number of

things, including a lack of interest or motivation to study the subject, difficulties solving problems, and a limited grasp of basic concepts (Nurdiansah et al., 2023).

Teaching methods and resources that are in line with the unique qualities of these children are required to increase their interest in and performance in mathematics. Using customized, differentiated learning modules based on each student's needs is a viable strategy. A well-designed learning module ought to adhere to efficacious, realistic, and feasible standards. Such modules, when used in the context of differentiated learning, ought to be flexible enough to meet the unique requirements of every student, including those who memorize the Quran, who need flexible learning strategies that take into account both their academic and religious obligations (Hakim, 2022).

Innovations in technology, especially in the area of artificial intelligence (AI), have revolutionized a number of industries, including education. Integrating AI classrooms has significantly improved the capacity for differentiated instruction by allowing AI tools offer significant potential in empowering teachers to deliver differentiated instruction by tailoring learning experiences to individual student needs. However, teacher preparedness remains crucial; educators must not only understand the technology but also develop the pedagogical skills to integrate AI insights into effective teaching strategies" (Celik, 2023). educators to tailor learning pathways based on each student's unique profile. This personalized approach not only enhances engagement but also supports deeper learning outcomes, particularly in diverse and inclusive educational environments" (Gromik et al., 2023). With AI providing tailored content and adaptive learning experiences based on each student's individual learning profile, teaching and learning processes are becoming more and more integrated (Hakim, 2022). The adoption of AI tools in differentiated instruction hinges significantly on teachers' readiness and their innovative capacities. Teacher professional development programs must prioritize building technological competencies alongside pedagogical skills to enable effective AI integration in classrooms. This approach not only enhances instructional diversity but also addresses varying student needs more precisely" (Çoklar & Özbek, 2020). The differentiated learning model, which emphasizes modifying instructional strategies in accordance with each student's learning profile, including their interests, readiness, and cognitive strengths, is in line with the use of AI.

AI technologies enable real-time analysis of teaching practices, offering immediate feedback that helps pre-service teachers refine their methods and improve classroom engagement" (Juhaevah & Kaliky, 2023). Luckin et al. (2023) emphasize the importance of implementing inclusive AI in education to enhance accessibility for all learners, including those with special needs. By utilizing tailored technologies, AI can help create more personalized learning experiences and support diverse learning styles, ensuring that a fairer and more equitable education can be achieved. AI tools

are transforming the way we personalize learning, allowing educators to address the diverse needs of students in the classroom. By leveraging AI, teachers can create tailored learning experiences that adapt to each student's strengths, weaknesses, and learning pace, fostering more inclusive and effective educational environments. As explored by Wang and Zhao (2022), enables differentiated learning platforms to respond to students' emotional states, improving engagement and personalized learning outcomes. By tailoring the learning experience to the emotional needs of each student, such platforms foster a more inclusive and effective educational environment. AI systems in project-based learning allow for a more adaptive approach to instruction, helping educators tailor learning experiences to the diverse needs and abilities of students" (Schuler & Holbrook, 2020).

The creation of an AI-based differentiated learning module offers a viable way to raise the mathematical achievement and interest of Quran memorizers. AI-based differentiation in education offers a personalized learning experience that can enhance student engagement by addressing the diverse learning needs of each individual. By adapting content delivery and learning strategies through AI, educators can maintain high levels of student interest and motivation, which is crucial for effective learning" (Zhang & Li, 2021). AI is a useful tool in this sense because of its ability to assess unique learning profiles and customize assessments, procedures, and content to meet the needs of each student. Furthermore, AI can offer faster and more accurate feedback, which will improve students' comprehension and motivation to interact with the content (Fadillah et al., 2023). The potential of AI in educational settings has been shown in a number of earlier research (Zulkifli, 2006; Sobocinski et al., 2022). This is particularly true when it comes to creating intelligent tutoring systems that modify lesson content according to each student's unique learning needs.

Students at SD Islam At-Tamyiz, a primary school that prioritizes academic achievement and Quranic memorization, are expected to remember one juz of the Quran at each grade level, with the goal of memorizing at least six juz by the time they graduate from sixth grade. Students exhibit four distinct memorization types, according to observations and interviews with the school's mathematics teachers: those who memorize information quickly but forget it quickly, those who memorize information quickly but retain it well, those who memorize slowly but forget it quickly, and those who memorize slowly but forget it quickly. Teachers report that first category kids typically do well in mathematics. Students of SD Islam of-Tamyiz, a primary school that prioritizes academic achievement and memorizing the Quran. Nonetheless, the institution has a number of difficulties in assisting Quran memorization students with their mathematical studies. Instructors have found it difficult to come up with new ideas and create relevant lesson plans, especially for modules that follow differentiated learning guidelines and make use of artificial intelligence to raise student engagement. The way mathematics is taught today is

through antiquated printed modules that don't adapt to students' requirements or use technologies that could aid customize learning. In-class interviews with homeroom teachers exposed a general sense of boredom with mathematics and students' frequent lack of interest in the subject, which contributes to subpar academic performance. There are pupils who do not meet the minimum competency standard (KKM), which emphasizes the need for creative teaching methods and educational resources (Zulkifli, 2006).

The creation of a differentiated AI-based mathematics learning module catered to the particular requirements of pupils memorizing the Quran is one suggested solution to this issue. Even if some educators have access to fundamental teaching resources, enhancing student performance and encouraging character development are still greatly hampered by the lack of an efficient, AI-integrated module. To improve student learning and address the issues noted in the preliminary observations, an AI-based differentiated learning module must be created.

Research on the precise creation of AI-based differentiated learning modules to raise Quran memorizers' performance and interest in mathematics is still scarce, despite the potential advantages. While a number of studies have examined the use of AI in general education settings, there is a study gap concerning the particular requirements of students who are memorizing the Quran. By creating a differentiated learning module with artificial intelligence (AI) to improve Quran memorizers' performance and interest in mathematics at the primary school level, this study seeks to close that gap.

The main study issue found at SD Islam At-Tamyiz centers on the underutilization of mathematical learning modules that are AI-based and differentiated according to the requirements of Quran memorizers. This issue is exacerbated by a number of factors, including low student motivation, poor academic achievement, a lack of innovative teaching resources, and inadequate instructional media. To effectively educate these children, a complete strategy incorporating technology, individualized learning techniques, and updated instructional materials is required.

The goal of this project is to create a differentiated learning module that uses artificial intelligence to meet the unique requirements of Quran memorizers. In order to improve student performance and interest in mathematics, the study aims to: analyze the pre-implementation learning conditions before implementing the AI-based module; design the module according to student profiles; develop the module based on validated educational theories; implement the module in the classroom; and assess its efficacy.

This work is novel because it focuses on Quran memorizers, a subset of learners with unique learning traits, and because it incorporates artificial intelligence into the

differentiated learning model. The goal of this project is to make a contribution to the field of educational technology and differentiated learning by creating a module that adjusts to the cognitive strengths and problems of Quran memorizers. In addition, the study looks at how AI may help students who have a hard time juggling their academic and religious obligations by providing a more tailored, engaging, and successful learning environment. The goal of this work is to open up new avenues for research on the use of AI in individualized education, especially for students with distinct learning profiles.

## **B. Methods**

This study uses a Research and Development (R&D) methodology with the goal of creating and assessing the efficacy of an AI-based differentiated learning module to improve the mathematical performance and motivation of elementary pupils who are memorizing the Quran. The five phases of the ADDIE model – Analysis, Design, Development, Implementation, and Evaluation—are followed throughout the development and implementation process. To guarantee the creation of a learning module that is applicable, efficient, and customized to the unique requirements of Quran memorizers, each phase is meticulously organized. Each stage is described in detail in the sections that follow.

### *Needs Analysis*

The initial stage of the process is performing a comprehensive analysis to pinpoint the unique learning requirements and obstacles encountered by students who are memorizing the Quran. This was accomplished by means of observations and conversations with SD Islam At-Tamyiz mathematics teachers. The school emphasizes memorizing the Quran heavily; by the time pupils graduate from primary school, they must have at least one juz memorized for each grade level.

Several problems that impair students' performance and engagement in mathematics were identified by the needs analysis. Low motivation and poor academic accomplishment in mathematics are the results of many students who memorize the Quran finding it difficult to reconcile their academic pursuits with their Quranic memorization. Furthermore, the teaching resources used today are antiquated; there are no AI-integrated modules or customized learning plans that cater to the specific needs of each student. This study gave rise to a basic grasp of the issues and emphasized the need for creating a creative learning module in order to deal with them (Zulkifli, 2006).

### *Module Design*

The next step was to design the AI-based differentiated learning module based on the findings of the requirements study. The three main components of the module's design content, procedure, and learning outcomes – were tailored to each student's interests, learning profile, and readiness level in accordance with the concepts of differentiated teaching (Maulidia & Prafitasari, 2023).

The module's AI technology was used in its design to deliver tailored learning experiences, enabling real-time modifications based on each student's success. In order to promote active learning and problem-solving abilities, it contains interactive information, customized activities, and instantaneous feedback methods. The design phase also included components that address the cognitive traits of pupils who memorize the Quran, making sure that the module strengthens their memory while addressing challenges with comprehending complex mathematical ideas. Furthermore, the module was made to be easy to use by teachers, allowing them to effectively track their students' development (Hakim, 2022).

### *Development of the Learning Module*

During the development process, the design was turned into a lesson module that worked perfectly. Creating interactive activities and digital content with AI elements was part of this strategy. The module contained a number of elements, including practice questions, instructional films, and assessments, all of which were designed to meet the unique needs of pupils who were memorizing the Quran. Additionally, the module's AI system was designed to offer customized learning pathways by modifying the course material and degree of difficulty in accordance with student performance and learning profiles.

To guarantee its viability, usefulness, and efficacy, the produced module was verified by specialists in AI and education. To improve the module's instructional techniques, interface, and content, expert input was solicited. During the validation phase, teachers at SD Islam At-Tamyiz were also consulted to make sure the module matched the educational objectives of the school and satisfied the unique requirements of Quran memorizers (Fadillah et al., 2023).

### **Implementation**

The module was put into use at SD Islam At-Tamyiz in a controlled environment after the validation procedure. Two steps comprised the implementation phase: a full-scale implementation and a small-scale pilot study. A small sample of students tried the module during the pilot phase in order to find any possible problems and collect first data on its efficacy. A few small changes were made to enhance the

functionality and user experience of the module in response to feedback from the pilot study.

The module was used with a bigger cohort of students who were memorizing the Quran over a predetermined length of time as part of the full-scale implementation. By incorporating the module into their already-existing curricula and assisting students with their learning, teachers assisted with the implementation. To evaluate student engagement, learning outcomes, and the overall efficacy of the AI-based module in enhancing mathematics ability, both quantitative and qualitative data were gathered during the implementation (Sobocinski et al., 2022).

### **Evaluation**

Evaluation, the last stage of the ADDIE paradigm, was carried out on a continual basis during the planning, development, and implementation phases. Formative evaluation took place during the module creation process, and summative evaluation took place following the full-scale implementation.

Expert reviews and educator feedback were incorporated into formative evaluation to make sure the module was accomplishing its intended objectives. Before the module was finally implemented, these comments were used to make iterative improvements to it. The goal of the summative evaluation, however, was to determine how the module affected the motivation and performance of the students. Pre- and post-tests were used to track changes in math proficiency among students. Furthermore, data from surveys and interviews with instructors and students offered insights into their perceptions of the module and how it affected student participation (Fadillah et al., 2023).

Descriptive and inferential statistics were employed in the analysis of the evaluation findings to ascertain the efficacy of the AI-driven differentiated learning module. This analysis contributed to a thorough knowledge of the module's overall effect on student learning outcomes by highlighting areas for improvement and highlighting positives. The evaluation phase also looked at how AI-based modules might help with individualized learning in the long run, especially for students who have special learning profiles like Quran memorizers.

### **C. Results and Discussion**

The purpose of this project was to create an AI-based differentiated learning module that would specifically help primary school pupils who memorize the Quran do better in mathematics and be more motivated to do so. The ADDIE paradigm guided the development of the module, and subsequent validation and deployment processes yielded noteworthy enhancements in student engagement, academic

achievement, and teacher satisfaction. The study's findings are presented and their ramifications are discussed in the sections that follow.

### **First Learning Condition**

Prior to the AI-based module's installation, an examination of the original learning environment was carried out to determine the difficulties that students who memorize the Quran encountered when learning mathematics. The analysis's findings demonstrated that many of these kids had trouble focusing on and being interested in mathematics, which they found challenging to balance with their memorizing of the Quran. Teachers noted that, sometimes because of out-of-date teaching materials that did not meet their individual learning needs, pupils felt disengaged during mathematics courses.

Furthermore, it was discovered through teacher interviews that a large number of students' arithmetic performance fell short of the minimum competency standard (KKM), and that low motivation and boredom in the classroom were contributing factors to this poor performance. Students' disinterest in mathematics was further exacerbated by their propensity to spend time on technology rather than studying. To better assist these students, these results demonstrated the critical need for creative teaching methods and updated teaching resources (Zulkifli, 2006).

### **Development and Validation of the AI-Based Learning Module**

The problems found in the preliminary analysis were intended to be addressed by the AI-based differentiated learning module. With artificial intelligence (AI) capabilities that enable real-time adjustments based on each student's success, the module offered customized learning experiences catered to the requirements of pupils memorizing the Quran. Because the material was dynamic and flexible, students could adjust their learning speed to suit their own abilities and get feedback (Hakim, 2022).

After being created, the module was put through a validation procedure by instructors and educational specialists to make sure it satisfied the requirements for viability, usefulness, and efficacy. Teachers' feedback highlighted how simple it was to use the module, especially with regard to the AI features that allowed for real-time tracking of students' development. The module was also commended for its capacity to hold students' attention with interactive information, which was considered a significant advancement over the conventional printed materials that had been utilized in the classroom in the past (Fadillah et al., 2023).

## **Implementation of the AI-Based Module**

First, a small-scale pilot study was conducted to test the AI-based module in a classroom at SD Islam At-Tamyiz. This was followed by a larger-scale implementation. In order to verify the module's functionality and get early input from teachers and students, it was first offered to a limited group of students during the pilot phase. In comparison to their prior experiences with traditional approaches, the pilot phase results showed that students were more interested in mathematics and were more involved in the learning process.

After the pilot program proved effective, the module was expanded and used in other classrooms. Instructors saw a noticeable increase in student involvement and participation, and many noted that the interactive format of the module helped keep students' attention throughout class. Additionally, teachers were able to monitor each student's development more efficiently thanks to the AI-based approach, which allowed them to offer more focused assistance where it was required (Sobocinski et al., 2022).

## **Improvement in Student Performance and Motivation**

The study's most noteworthy result was the rise in motivation and performance among the students. Data from pre- and post-tests were gathered to assess how the module affected students' performance in mathematics. The findings demonstrated a discernible rise in student accomplishment, with a large number of pupils meeting or above the minimal competency criterion (KKM). Furthermore, the AI-based module's tailored learning pathways were credited with helping students feel more confidence in their mathematical skills (Maulidia & Prafitasari, 2023).

Students were more motivated to learn mathematics, which was previously seen to be a challenging and dull topic. They showed more excitement for the subject. The module's interactive features and the AI system's real-time feedback helped maintain students' interest and lessen their emotions of boredom or irritation. The willingness of students to actively participate in class discussions and problem-solving exercises was also highlighted by teachers, which improved the quality of the learning process overall (Nurdiansah et al., 2023).

## **Discussion of Educational Implications**

The results of this study demonstrate how well AI-based differentiated learning modules may meet the special needs of math students who are memorizing the Quran. The module greatly enhanced academic results and student engagement by offering tailored, flexible learning experiences. This implies that AI-based solutions can be very successful in meeting multiple learning demands when incorporated

into differentiated learning approaches, especially for students who struggle to balance their academic and religious obligations.

Furthermore, the AI-based module's success emphasizes how crucial it is to update conventional teaching strategies and materials to take advantage of developments in educational technology. AI integration makes it possible to implement more responsive and dynamic teaching techniques, which helps teachers better support each student individually and enhances classroom performance as a whole. Additionally, this study shows that AI can be extremely helpful in promoting student engagement and motivation, two things that are essential for academic performance (Hakim, 2022).

### **Recommendations for Future Research**

Although the study's findings are encouraging, more investigation is advised to examine the long-term impacts of AI-based differentiated learning modules on students' motivation and performance. Longitudinal research may shed light on whether the beneficial effects seen in this study hold true over time and how AI-based modules may be continuously modified to accommodate changing student requirements. Further studies may look into the use of AI-based learning modules for various student populations and topic areas, especially those with particular learning difficulties.

Investigating the scalability of AI-based learning systems is also necessary, especially in educational institutions with inadequate technology infrastructure. To guarantee that a wider range of pupils may benefit from new technologies, it will be crucial to comprehend how to apply AI systems in various educational settings. Lastly, research in the future may look at how AI can be included into teacher professional development programs, assisting instructors in making the most use of AI tools to improve student learning (Fadillah et al., 2023).

### **D. Conclusions**

In summary, our study showed the considerable advantages of utilizing an AI-based differentiated learning module to improve students' motivation and arithmetic skills who memorize the Quran. By offering each student unique, interactive learning experiences that are tailored to their specific needs, the module effectively addressed the issues that were found in the first examination of learning conditions. The increases in academic performance and student motivation demonstrate how AI can help differentiated instruction and enhance learning outcomes for students with distinct learning profiles. This study adds to the expanding corpus of knowledge on artificial intelligence in education and emphasizes how crucial it is to include technology into varied learning models in order to promote student achievement.

The objective of this study was to improve the mathematics performance and motivation of students memorizing the Quran. To that end, an AI-based differentiated learning module was successfully designed and applied. The module successfully addressed the particular difficulties these students were facing because it was made to offer individualized learning experiences. As a result of the module's interactive and adaptable design, students' academic performance and engagement both significantly improved, according to the results. Instructors discovered that the AI-powered system was helpful for tracking advancement and providing customized assistance.

The work adds to the expanding corpus of knowledge on the use of AI in education, especially when it comes to differentiated instruction. The session illustrated how AI may improve learning outcomes, particularly for children with special needs, by customizing content to fit individual learning profiles. According to the results, AI-based modules have the potential to raise student motivation and academic accomplishment in a variety of learning environments.

It is advised that more study be done to examine the long-term impacts of AI-based modules and their scalability in various settings, particularly in educational institutions with inadequate technology infrastructure. To further our understanding of AI's function in personalized learning, future research might look at the application of AI in other topics and among various student demographics.

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