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Developing an AI-Based Mobile Educational Game "Math Quest" Integrated with Tawakkal Values to Mitigate Mathematics Anxiety

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Abstract
Mathematics anxiety can hinder students' engagement and confidence in learning mathematics. This study aims to develop Math Quest, a web-based educational game that integrates Artificial Intelligence (AI), mathematics learning, and the value of tawakkal as an alternative learning medium to support effort to mitigate of mathematics anxiety. The study employed a Research and Development (R&D) approach using the ADDIE model, consisting of Analysis, Design, Development, Implementation, and Evaluation. The development process involved needs analysis, product design and development, expert validation, implementation with students, and evaluation through student responses and pre-test and post-test measurements of mathematics anxiety. The product was validated by mathematics subject-matter expert, a digital media expert, and an expert in islamic values integration. The results showed that Math Quest received positive evaluations from experts in terms of its learning content, media, and integration of tawakkal. Student responses to the developed game reached an average of 74.53%, indicating a positive response to the learning experience provided by Math Quest. Furthermore, the average mathematics anxiety score decreased from 66.80% in the pre-test to 64.45% in the post-test, representing a decrease of 2.35 percentage points. These findings indicate that Math Quest has potential as an interactive mathematics learning medium that combines technological and spiritual dimensions while supporting efforts to mitigate mathematics anxiety. Further research is needed to examine its effectiveness using larger samples, comparison groups, and inferential statistical analysis.

Keywords:
Mobile Educational Game; Artificial Intelligence; Tawakkal; Mathematics Anxiety.

A. INTRODUCTION

Within the field of education, mathematics anxiety remains a significant concern, as it can adversely affect students' cognitive, affective, behavioral, and physiological functioning throughout the mathematics learning process. (Lailiyah et al., 2021). This condition not only undermines students' academic performance and critical thinking skills, but may also significantly impede their engagement and active participation in the mathematics learning process.(Mutakin et al., 2025). Although digital technology has been increasingly integrated into mathematics education, most existing

instructional media remain predominantly static, limiting their capacity to accommodate students' diverse emotional needs and individual learning paces.

Broadly speaking, the existing literature on addressing mathematics anxiety reveals a wide range of intervention approaches targeting both the cognitive and affective dimensions of students' learning experiences.(Balt et al., 2022). One emerging approach to addressing mathematics anxiety is the integration of digital technology into mathematics education, which offers new opportunities to support students' cognitive and affective needs throughout the learning process. (Öztop, 2023). Within technology-enhanced learning approaches, the integration of mobile games as instructional media has demonstrated considerable potential for enhancing students' learning engagement and motivation. (Chamsudin & Asih, 2021). The advancement of artificial intelligence (AI) has enabled adaptive learning systems to analyze student data and individual learning needs, thereby facilitating the personalization of instructional content in accordance with each learner's unique characteristics and learning profile. (Hashim et al., 2022). From an affective and spiritual perspective, the concept of tawakkal may play a significant role in helping individuals cope with psychological distress. Previous research has demonstrated that tawakkal is significantly and negatively associated with stress, suggesting that it may serve as an important source of psychological resilience in navigating pressure, adversity, and challenging circumstances.(Saputra et al., 2022). However, a significant gap remains evident in the existing literature. Previous studies on the application of artificial intelligence (AI) in education have predominantly focused on learning personalization and the optimization of cognitive outcomes. Meanwhile, the management of anxiety and the development of students' affective well-being have received comparatively limited attention within AI-based learning systems. At the same time, the integration of spiritual values into education continues to face substantial challenges, as instructional practices tend to prioritize cognitive achievement and the normative-textual transmission of knowledge. Consequently, the internalization of spiritual values has yet to be fostered in a sufficiently deep, meaningful, and sustainable manner.(Nurfatimah & Zaitun, 2026). Research integrating adaptive AI algorithms with the cultivation of tawakkal values remains highly limited. This gap highlights the need for an instructional approach that not only incorporates spiritual values but also harnesses digital technology to provide a more personalized, interactive, and emotionally supportive learning experience.

To address this gap, the present study introduces "Math Quest," a mobile game that integrates adaptive AI technology with the cultivation of tawakkal values. Within *Math Quest*, technology is employed to facilitate game-based mathematics learning through interactive elements, personalized feedback, and the reinforcement of tawakkal values through motivational messages and reflective activities. These features are designed to foster students' perseverance and resilience when confronting mathematical challenges. The novelty of this study lies in the integration of game-based mathematics learning, AI technology, and tawakkal values, enabling the simultaneous development of students' cognitive competencies and their affective disposition toward mathematical challenges.

Accordingly, this study aims to develop and evaluate "Math Quest," a tawakkal-integrated mobile game, using the ADDIE development model. Specifically, the study seeks to assess the validity and feasibility of the instructional media, examine the synergy between the adaptive AI system and the cultivation of tawakkal values, and evaluate the effectiveness of the game in reducing students' mathematics anxiety.

B. METHODS

This study employed a Research and Development (R&D) approach using the ADDIE model, which consists of five stages: Analysis, Design, development, Implementation, and Evaluation (Omoregie et al., 2025). The ADDIE model was used to

develop Math Quest, a web-based mathematics educational game that integrates Artificial Intelligence (AI and tawakkal values at MA Al-Ittihad Plus Keterampilan dan Riset Nasional. The Analysis stage involved identifying students' mathematics anxiety, learning needs, digital learning readiness, interest in interactive or game-based learning media, and the need for islamic and tawakkal value integration, the design stage focused on designing the game structure, mathematics learning content, user interface, game mechanics, feedback features, and tawakkal-based motivational messages. The Development stage involved programming and production the Math Quest game, followed by expert validation and revision based on expert recommendations. The implementation stage involved conducting a product trial with students through the use of math quest in mathematics learning sessions. Finally, the evaluation stage involved analyzing expert validation result, student responses, and changes in mathematics anxiety before and after the implementation. Product validation involved three expert validators: one mathematics subject-matter expert, one digital media expert, and one expert in integrating Islamic values. The mathematics subject matter expert assassed the accuracy, relevance, clarity, and presentation of the mathematics content. The digital media expert assessed the visual design, interface, navigation, functionality, usability, and technical aspect of the game. The islamic values integration espert assessed the accuracy, relevance, appropriateness, and contextual presentation of tawakkal values within the learning activities and motivational features. The student participants were selected through purposive sampling, based on smartphone accessibility and their learning needs in advanced mathematics.

The product trial began an initial assessment before the implementation of Math Quest. Student then participated in three instructional sessions involving the exploration and use of the developed game. After the intervention, a post-assessment and student response questionnaire were administered. The intervention concluded with the administration of a post-test and a student response questionnaire. Data were collected using closed-ended questionnaires employing a five-point Likert scale, ranging from 1 (Very Poor) to 5 (Excellent) (Chyung et al., 2017). The instruments consisted of a needs assessment questionnaire, expert validation questionnaire s covering mathematics content, digital media, and tawakkal values, a student responses questionnaire, and a mathematics anxiety questionnaire. The instruments were adopted from existing instruments and adjusted to context and characteristics of the Math Quest development. The questionnaires comprised a needs analysis instrument, expert validation questionnaires covering subject matter, digital media, and tawakkal values, a student response questionnaire, and a mathematics anxiety questionnaire. Data on media feasibility and student responses were analyzed using a descriptive quantitative approach by calculating the percentage of the ideal score. The resulting percentages were then classified according to the following criteria: Very Feasible (81%–100%), Feasible (61%–80%), Moderately Feasible (41%–60%), Less Feasible (21%–40%), and Very Less Feasible (0%–20%). Meanwhile, data on mathematics anxiety were analyzed by comparing the difference in mean score percentages between the pre-test and post-test across four principal indicators of mathematics anxiety.

C. RESULT & DISCUSSION

Initial Conditions and Students' Mathematics Learning Needs

The initial stage of the ADDIE development model involved a needs assessment to identify the students' initial conditions, levels of mathematics anxiety, and their needs for digital technology-based instructional media incorporating Islamic values. The findings of the needs assessment are presented in Table 1 below:

Table 1. Need Assessment

No	Indicator	Percentage
1.	Mathematics Anxiety	47,99%
2.	Interactive/Game Learning Media	92,39%
3.	Adaptive & AI Learning	65,84%
4.	Digital Learning Readiness	51,62%
5.	Islamic & Tawakkal Integration	61,73%

Based on these findings, the interactive learning media/game indicator recorded the highest percentage at 92.39%. This result indicates that students have a strong demand for mathematics learning media that are more interactive and incorporate game-based elements. This condition provides a strong rationale for the development of *Math Quest* as an instructional medium that integrates mathematics content with game mechanics. The incorporation of game-based elements into learning can enhance student engagement and foster a more interactive and immersive learning experience.

The adaptive and AI-based learning indicator obtained a percentage of 65.84%. This finding suggests that students also demonstrate a considerable need for technology-mediated learning experiences that can support their mathematics learning. The integration of AI into mathematics education has the potential to facilitate personalized learning by utilizing students' learning data and individual learning characteristics.(Tefa, n.d.). These findings informed the integration of AI into *Math Quest* as a core component of the development of technology-based instructional media.

Furthermore, the integration of Islamic values and the *tawakkal* indicator obtained a percentage of 61.73%. This finding indicates a need for mathematics learning that extends beyond academic achievement by incorporating relevant spiritual values. *Tawakkal* may be understood as an affective dimension of Islamic education associated with placing one's trust in Allah after making sincere effort. Accordingly, the value of *tawakkal* is incorporated into *Math Quest* through motivational messages emphasizing effort, perseverance, and reliance on Allah after undertaking *ikhtiar*.

The digital learning readiness indicator obtained a percentage of 51.62%. This result suggests that students' readiness for digital learning should also be taken into consideration in the development of the instructional media. Therefore, *Math Quest* was designed as a digitally accessible learning medium featuring a simple interface and straightforward game mechanics to facilitate students' learning experiences.

Meanwhile, the mathematics anxiety indicator recorded a percentage of 47.99%. Although this was the lowest percentage among the assessed indicators, mathematics anxiety remained an important consideration in the development of *Math Quest*. This finding provided a basis for incorporating interactive learning experiences, immediate feedback on students' responses, problem-solving explanations, and motivational messages, which are intended to create a more supportive and psychologically conducive learning environment.

Overall, the needs assessment indicates that students' most prominent need concerns the use of interactive or game-based instructional media, which obtained the highest percentage at 92.39%. This finding served as the primary basis for the development of *Math Quest*, while AI integration, digital readiness, the incorporation of *tawakkal* values, and mathematics anxiety constituted complementary considerations in the design and development of the product.

Need Assessment Implication Toward Math Quest Development

The initial needs assessment served as the basis for determining the key characteristics of *Math Quest*. Each major feature of the product was developed in response to the specific needs identified among the students.

First, the high demand for interactive/game-based instructional media, which reached 92.39%, provided the primary rationale for selecting a game as the main instructional medium. *Math Quest* was designed with game-based elements, including

mathematics missions, planetary exploration, practice exercises, scoring and energy systems, immediate feedback, and progressive mission unlocking. This structure was intended to create a more interactive learning experience and encourage students' active engagement throughout the learning process.

Second, the Adaptive & AI Learning indicator, which obtained 65.84%, served as a reference for integrating an adaptive quiz system and automated solution-explanation features. These technologies enable the game to adjust question difficulty and provide appropriate assistance based on individual students' responses and learning pace.

Third, the integration of Islamic values and the *tawakkal* indicator, which reached 61.73%, provided the foundation for incorporating the spiritual dimension of *tawakkal* into the game. This value was embedded through motivational messages, feedback, and reflective activities that encourage students to continue making efforts or *ikhtiar* when facing difficulties, remain unafraid of making mistakes, and entrust the outcome to Allah after exerting their utmost effort.

Fourth, the digital learning readiness indicator, which obtained 51.62%, supported the selection of a web-based platform with responsive mobile compatibility. The development of *Math Quest* capitalizes on smartphones, which are closely integrated into students' daily activities, thereby enabling mathematics learning to be accessed more flexibly and interactively than through conventional instructional delivery.

Meanwhile, the mathematics anxiety indicator, which recorded 47.99%, provided an important basis for adopting a student-friendly pedagogical approach. The product is not solely oriented toward answer accuracy but also provides supportive feedback and motivational messages that encourage students to perceive mistakes as an integral part of the learning process. The integration of *tawakkal* is likewise intended to strengthen students' emotional resilience and perseverance when confronting challenging mathematical problems.

Thus, the needs assessment demonstrates a direct relationship between students' initial conditions and the characteristics of the developed product. The need for interactive media underpins the game-based learning mechanism, the demand for AI supports content adaptivity, digital readiness informs the development of a mobile-friendly platform, while the need for Islamic value integration provides the foundation for cultivating tawakkal. Overall, the needs assessment phase established a strong foundation for the development of *Math Quest* as an instructional innovation designed to support students' mathematics learning experiences holistically, encompassing both cognitive and affective dimensions.

Math Quest's Development and Validation Results

Based on the needs assessment and design processes, *Math Quest* was developed as a mathematics educational website game incorporating a space-adventure theme. The medium covers four core mathematical domains—numbers, algebra, functions, and geometry—presented through an interactive galaxy exploration experience. *Math Quest* integrates instructional and game-based elements through a main interface, planet-based topic selection, concise learning materials, mathematical challenges, answer feedback, and motivational messages incorporating the value of *tawakkal*.

The mathematical content is presented concisely before students proceed to the exercises. Upon submitting their answers, students receive positive feedback and points for correct responses, along with explanatory feedback for incorrect answers. The value of *tawakkal* is incorporated through motivational messages emphasizing the relationship between effort (*ikhtiar*) and reliance on Allah (*tawakkal*) when confronting mathematical challenges.

To ensure the media functions effectively and that the content is substantively appropriate before implementation with students, the product underwent expert

validation. The detailed validation results from the subject-matter expert, digital media expert, and Islamic values integration expert are presented in Table 2 below:

Table 2. Expert Validation Result

No	Aspect	Procedure	Percentage
1.	Media	Before revision	56%
2.	Media	After Revision	82%
3.	Content	Content Expert Validation	82%
4.	Tawakkal Values Integration	Expert Validation	87,5%

The media feasibility testing stage was conducted through a validation process involving several experts, including a digital media expert, a subject-matter expert, and an Islamic values integration expert. The media validation was carried out in two stages following an initial revision process. In the initial validation stage (before revision)[1], the game obtained a feasibility percentage of 56%, leading to the conclusion that it was feasible for use with revisions. The primary issue identified concerned technical functionality, particularly the exit button on the *Planet Aljabar* interface, which failed to respond and consequently prevented players from navigating to the subsequent planet.

Based on recommendations from the media validator, technical improvements were implemented to the navigation programming scripts, and the responsiveness of the website interface layout was optimized. Before revision, a navigation malfunction or system bug caused the game flow to become stuck on a single page. Following the revision and deployment to the game's primary domain[2], the exit button functioned optimally, the positioning of the planetary icons became more precise, and game operation on both smartphone and laptop screens became more stable and seamless. The second-stage validation demonstrated a substantial improvement, with the feasibility score increasing to 82%. Based on this result, the media expert concluded that the educational game was feasible for use and particularly appreciated its visually appealing outer-space planetary design, which was considered engaging and adaptable to students' learning needs.

Meanwhile, in the subject-matter validation, the validator awarded a total score of 41 out of a maximum of 50, corresponding to a feasibility percentage of 82%. Based on this percentage, the subject-matter expert categorized the mathematical content in *Math Quest* as feasible for use. The primary strengths identified by the validator included the availability of concise learning materials, which facilitate students' understanding of fundamental concepts before attempting the exercises, as well as immediate explanatory feedback when students select an incorrect answer.

The assessment of Islamic values integration focused on the depth, accuracy, and appropriateness of the presentation of *tawakkal* values within the game. The validation results yielded a total score of 35 out of 40, corresponding to a feasibility percentage of 87.5%. Based on the established criteria, the validator categorized the integration of *tawakkal* in *Math Quest* as very feasible for use. The situational presentation of *tawakkal* values—for example, through moral encouragement following an incorrect response—was considered particularly effective in fostering students' psychological motivation, emotional resilience, and perseverance in facing academic challenges.(Aprilianti, 2024).

Based on all stages of the validation process, the overall summary indicates an average feasibility score of 83.83%. The final adjustments and revisions were also completed, including improvements to the media's button navigation functionality in accordance with the experts' recommendations. Therefore, it can be concluded that the *Math Quest* educational game has met the criteria of academic, technical, and substantive feasibility, making it suitable for use as an interactive, website-based mathematics learning medium that incorporates Islamic values.

Implementation and Students' Response Toward Math Quest

Following the validation and revision stages, *Math Quest* was implemented with

students to assess their responses to the use of the medium in mathematics learning. Student responses were measured using a adopted questionnaire comprising four indicators: interest and interactivity, ease of use and usability, mathematics learning, and AI and *tawakkal* values. The results of the student response questionnaire are presented in the following table.

Table 3. Math Quest students' responses

No	Indicator	Precentage
1.	Interested	75,63%
2.	User friendly	80,42%
3.	Math Learning	72,08%
4.	AI and Tawakkal Values	70,00%
	Average	74,53%

Based on Table 2, students' overall response to *Math Quest* yielded an average score of 74.53%. The highest-rated indicator was ease of use and usability, which obtained 80.42%, indicating that students responded positively to the accessibility and usability of *Math Quest*, including the game mechanics, question-answering process, navigation, and in-game buttons.

The interest and interactivity indicator obtained a percentage of 75.63%. This finding suggests that the planet-based game concept and mathematical challenges provided an engaging learning experience for students. This was particularly reflected in the statement concerning the planetary concept, which recorded the highest percentage within this indicator at 91.87%.

Furthermore, the mathematics learning indicator obtained a percentage of 72.08%. This result indicates that *Math Quest* supported the mathematics learning process through concise instructional materials, answer explanations, and motivational features. The item concerning post-response explanations achieved a percentage of 76.25%, while the concise learning materials obtained 73.12%. The immediate interactive explanations enabled students to identify and correct their mistakes independently while reinforcing their conceptual understanding of the mathematical content.(Fyfe & Rittle-Johnson, 2016).

The AI and *tawakkal* values indicator obtained a percentage of 70.00%. This result indicates a positive student response to both the use of AI and the integration of *tawakkal* values in *Math Quest*. The statement concerning students' understanding that mathematics learning should be accompanied by effort (*ikhtiar*) and *tawakkal* obtained a percentage of 74.37%, while the use of AI to provide an engaging mathematics learning experience received a score of 68.75%.

Overall, these findings demonstrate that *Math Quest* received a positive response from students, with an overall average percentage of 74.53%. The highest response was observed in the ease-of-use and usability dimension, whereas the AI and *tawakkal* values dimension recorded the lowest percentage among the assessed indicators. This finding suggests that *Math Quest* is generally well accepted by students as a mathematics learning medium, while also highlighting areas for further development, particularly in optimizing AI functionality and strengthening the integration of *tawakkal* values within the learning experience.

Mathematics Anxiety Transformation

Following the validation and revision stages of *Math Quest*, mathematics anxiety was measured before and after students used the product. The mathematics anxiety questionnaire was adopted from an existing instrumen and comprised four indicators: mathematics learning anxiety, anxiety when solving mathematical problems, self confidence, and emotional responses to mathematics.

Table 4. Pre-Test and Post-Test on Mathematics Anxiety

No	Indicator	Pre-Test	Post-test	Decreasing
1	Math Anxiety	62,50%	60,31%	2,19%
2	Test Anxiety	69,69%	69,06%	0,63%
3	Independent	68,44%	65,00%	3,44%
4	Emotional responses	66,56%	63,44%	3,12%
	Average	66,80%	64,45%	2,35%

Based on Table 4, students' average mathematics anxiety score decreased from [pre-test score] to [post-test score], representing a reduction of [percentage-point reduction] percentage points. This decline in anxiety was consistently observed across all measured indicators. The self-confidence barrier indicator demonstrated the most substantial decrease, declining by [percentage-point reduction] percentage points from [pre-test score] to [post-test score]. This reduction suggests that students' feelings of inadequacy, fear of failure, and lack of confidence when engaging with mathematics were meaningfully alleviated.

Furthermore, the negative emotional response indicator decreased by [percentage-point reduction] percentage points, from [pre-test score] to [post-test score]. This decline indicates a positive affective shift, whereby psychological tension and feelings of distress when encountering mathematics were reduced. Meanwhile, mathematics learning anxiety decreased by [percentage-point reduction] percentage points, while anxiety when solving mathematical problems declined by [percentage-point reduction] percentage points. Although the reduction in problem-solving anxiety was relatively modest, the overall trend consistently demonstrated a favorable direction toward reduced mathematics anxiety.

The overall reduction of [percentage-point reduction] percentage points in mathematics anxiety provides an initial indication that *Math Quest* may serve as an alternative instructional medium for mitigating students' mathematics anxiety. From a theoretical perspective, mathematics anxiety may arise from students' fear of failure and negative evaluation, as well as from rigid and psychologically demanding learning environments. By incorporating interactive game-based activities, immediate feedback, motivational messages, and *tawakkal*-based reflection, *Math Quest* offers a more supportive learning environment that may help students approach mathematical challenges with greater confidence, persistence, and emotional resilience.(Handayani, 2019). *Math Quest* successfully addressed mathematics anxiety through three primary approaches. First, it provided a safe and supportive learning environment, in which game mechanics featuring an energy system and opportunities for repeated attempts reframed students' perceptions of mistakes. Rather than being perceived as punitive indicators of academic failure, mistakes were positioned as a natural and constructive component of the learning and exploration process. Second, the game provided supportive feedback through an automated explanation feature, which helped minimize students' frustration when they encountered difficulties or became stuck while solving mathematical problems. Third, *Math Quest* strengthened students' spiritual and emotional resilience through *tawakkal* by incorporating situational, Islamic value-based motivational messages, particularly when students failed to complete a challenge, thereby providing emotional reassurance. The cultivation of *ikhtiar* (effort) alongside reliance on Allah encouraged a growth mindset, enabling students to perceive failure as an opportunity for learning while entrusting the outcome to Allah SWT.

Overall, the integration of interactive game-based learning and the spiritual dimension of *tawakkal* demonstrated a positive contribution to strengthening students' emotional resilience and reducing anxiety responses in mathematics learning.

D. CONCLUSION

This study demonstrates that *Math Quest* can be developed as a game-based mathematics learning medium that integrates AI technology and the value of *tawakkal* to support efforts to mitigate mathematics anxiety. The product's feasibility, as demonstrated through expert validation, together with the positive responses from students, indicates that the integration of game-based elements, mathematics learning, and *tawakkal* values may offer an alternative approach to creating a more interactive and supportive learning experience.

The observed reduction in students' mathematics anxiety scores following the use of *Math Quest* provides an initial indication that learning media combining game-based experiences with the reinforcement of *tawakkal* have the potential to support both the cognitive and affective dimensions of mathematics learning. The contribution of this study lies in developing an instructional medium that extends beyond the transmission of mathematical content by simultaneously addressing learning-related anxiety and the cultivation of religious values.

The implementation of *Math Quest* can be further expanded to encompass a broader range of mathematical topics and more diverse learner characteristics. Future research should involve larger sample sizes, comparison or control groups, and appropriate statistical analyses to provide stronger empirical evidence regarding the effectiveness of *Math Quest* in mitigating mathematics anxiety.

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