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Utilizing the game design factor questionnaire to develop engaging games for adaptive learning in the serious educational game: the Ma'had

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ABSTRACT

This study explores the unique mandatory residence, Ma'had Sunan Ampel Al Alyi (MSAA), at the State Islamic University (UIN) Maulana Malik Ibrahim Malang, aiming to develop Quranic reading competence in new students. The varying educational backgrounds of admitted students lead to differences in their Quranic reading capabilities, highlighting the need for adaptive learning. In response to this diversity, adaptive learning using artificial intelligence is employed, implemented through the serious education game "The Ma'had." Survey results from expert individuals using a Game Design Factor Questionnaire reveal the game's substantial potential. The results show high agreement (100%) on clear goals, engaging gameplay, and a sense of freedom, with 67% strongly agreeing on improved understanding. Challenges are motivating, and the game successfully sparks curiosity. "The Ma'had" Game proves effective, but further research is recommended to explore variations in player engagement and compare results with expert test subjects, employing alternative quantitative testing methods for a comprehensive analysis.

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1. INTRODUCTION

The Ma'had Sunan Ampel Al Alyi (MSAA) is mandatory residence for new students at the State Islamic University (UIN) Maulana Malik Ibrahim Malang. This policy is a distinctive feature of UIN Malang that is not possessed by other State Islamic Higher Education Institutions (PTKIN). The MSAA aims to develop new students into individuals with strong competence and skills in reading the Quran [1]. The learning within MSAA includes religious education such as Quranic studies, Islamic thought, Arabic language, and English language. It also involves extracurricular activities like Qiro'ah training, MC (Master of Ceremonies) training, Sholawat Banjari, speech, and calligraphy [1]. MSAA has established a curriculum for religious activities, encompassing teaching methods, subject matter, and learning assessments.

Every year, UIN Malang conducts admissions for new students, and these admissions are inclusive. The university accepts students from various educational backgrounds, including graduates of Madrasah 'Aliyah (MA), Madrasah 'Aliyah Kejuruan (MAK), Pesantren Muadalah, Sekolah Menengah Atas (SMA), Sekolah Menengah Kejuruan (SMK), or their equivalents. The diverse school origins result in varying levels of students' abilities in reading the Quran. These differences in prior knowledge are not only observed at the higher level but also at the elementary level [2] [3].

MSAA categorizes students' Quranic reading abilities into five levels (I'dadi, Asasi, Qiroah, Tartil and Tafsir). The I'dadi level represents the lowest tier within the Quranic education class. This level is intended for students who possess very limited ability to proficiently read Quranic verses. The second, Asasi classes are tailored for students who have yet to achieve fluency in Quranic reading and lack understanding of Tajweed rules. The Qiroah class targets students capable of fluent Quranic recitation, although not conforming to the correct rules. The Tartil class caters to students fluent in Quranic recitation and adhering to Tajweed rules, yet still grappling with the intricacies of Quranic recitation. The fifth, the Tafsir class accommodates students proficient in Quranic reading but encountering challenges in interpreting and comprehending the meaning of Quranic verses. The determination of a student's level is carried out using a placement test method [1]. Each level comprises several topics that students must fully understand to progress to the next level. Up until now, the teaching of these topics within each level has been conducted using a conventional method, meaning the material is taught sequentially according to the textbook, without considering the students' existing capabilities at that level.

To optimize the learning process, adaptive learning is implemented in serious educational game (SEG) by providing Quranic teaching materials that students have mastered. Adaptive learning is based on the concept of using technology [4] including artificial intelligence to deliver customized learning materials tailored to individual learner characteristics [5] [6]. Learner characteristics can include abilities, disabilities, interests, backgrounds, learning styles, learning resource configurations, tasks, assessments, and more [6], [7]. Just as learner characteristics vary, the aspects of adaptivity in education also differ, including what to adapt (what to adapt), and which methods and technologies are suitable for implementing adaptive learning (how to adapt) [8].

In the game, the identification of students' difficulties with the existing materials is performed through a pre-test activity. The materials that students have the least mastery of are determined using the Multi-Criteria Decision Making (MCDM) method based on their specific characteristics of inadequacy. MCDM is a branch of decision-making methods that determine the best alternatives by considering more than one criterion in the selection process [9-11].

This research introduces an innovative approach to adaptive learning through the implementation of 'The Ma'had,' a serious educational game, specifically designed for teaching Ta'lim Al Quran. The use of game-based media in the learning process is believed to enhance learner motivation and performance [12–15]. The primary objectives of serious educational games (SEG) are to improve the learning experience and increase enjoyment while interacting with SEGs [16-18]. Several studies have also demonstrated that materials learned through serious game media tend to be better retained in memory [19]. SEGs, as adaptive learning media, are expected to provide better motivation, improved learning outcomes, and longer-lasting retention.

The utilization of technology in the form of a serious game represents a novel step in delivering adaptive learning content for Ta'lim Al Quran. Moreover, the integration of the Multi-Criteria Decision Making (MCDM) method to determine adaptive learning materials within the game constitutes a unique contribution to the field. By using 'The Ma'had,' learners are not only motivated and engaged but also experience prolonged retention of the learning material. This study thus presents a fresh perspective on adaptive learning methodologies, highlighting the significant potential of serious educational games like 'The Ma'had' in enhancing the results of learning Ta'lim Al Quran. As the part of the game development cycle, a series of tests are conducted prior to the game The Ma'had being made playable by students in the MSAA. The purpose of these tests is to ensure that The Ma'had game meets high-quality standards and functions as intended. One of the tests in this research carried out for The Ma'had game involved expert individuals who used a survey instrument adapted from the Game Design Factor Questionnaire.

2. MATERIALS AND METHODS

2.1 Materials

2.1.1 Ta'lim Al-Quran

At-Ta'lim is the one of terms in Islamic education. The term "Ta'lim" itself means the process of knowledge transfer with the aim of enhancing an individual's skills [20]. Therefore, "Ta'lim Al-Quran" refers to the transfer of knowledge or the teaching of reading and writing the Quran. Every MSAA student is expected to have the ability to read the Quran correctly and fluently. Hence, "Ta'lim Al-Quran" is a mandatory component of MSAA's curriculum. The division of Quranic learning classes within the MSAA environment is based on the initial abilities of the students. There are five levels of Quranic learning classes at MSAA [1], namely:

1. I'dadi: Aimed at students who still have difficulty differentiating Arabic letters, including similar ones.
2. Asasi: Intended for students who are not yet fluent in reading and do not understand the rules of Quranic recitation.
3. Qiraah: Designed for students who can read fluently but have a weak understanding of the rules of Quranic recitation.
4. Tartil: Geared towards students who can read fluently and apply the rules of Quranic recitation correctly but have not mastered the intricacies of Quranic styles and the complex aspects of Quranic verses.
5. Tafsir: Meant for students who can read the Quran fluently and with proper pronunciation but need to improve their ability to comprehend and interpret Quranic verses.

This level-based approach ensures that students receive instruction tailored to their individual abilities and helps them progress in their Quranic studies.

2.1.2 Adaptif learning

Adaptive learning is an educational approach that utilizes artificial intelligence technology to deliver learning materials tailored to the specific needs and individual progress of each learner. The fundamental concept of adaptive learning is to modify educational content, pace, and assessment based on each student's advancement, achievements, and learning preferences. Adaptive learning is a model where the learning approach is chosen based on the results of an individual learner's pre-test [21]. It ensures that instruction remains engaging and appropriately challenging by adapting to the unique requirements of each learner.

Adaptive technology can be applied to three elements of learning: content, assessment, and sequence [22]. Adaptive content means delivering learning materials in a format that allows learners to move from the part they are currently studying. In the learning process, students' knowledge levels can be assessed through questions or inquiries. Learners can then be directed back to sections they have less mastery of, or they can skip sections they have already mastered.

Adaptive sequencing means selecting materials based on relevance, difficulty level, and the sequence of learning materials based on an analysis of the learning activities. Adaptive sequencing methods require data analysis to determine the individual learner's learning path.

Adaptive assessment means that each question depends on the answers to previous questions. The better a learner performs, the more challenging the subsequent questions become. If a learner has difficulty answering questions, the following questions will become simpler until the learner acquires the necessary knowledge.

2.1.3 Serious Education Games

The use of games in an educational environment has an impact on students' engagement, behavior, and motivation, contributing to the development of their knowledge and skills [23]. A serious education game is characterized as a computer program that merges serious, knowledge-focused, and entertainment-oriented gaming elements [24]. According to Rosyid et al. [16], SEG development must encompass two critical components: knowledge and game content spaces.

2.1.4 Game Design Factor Questionnaire

The Game Design Factor Questionnaire (GDFQ) serves as an instrument that can be used as a guide for game designers in creating game-based learning. This instrument focuses on creating educational game designs that are more enjoyable for learners. When it can encourage student motivation, they would naturally achieve advanced learning outcomes [24]. The critical factors and an appended game design dimension, the Game Design Factor Questionnaire covers Game Goals, Game Mechanism, Interaction, Freedom, Game Fantasy, Narrative, Sensation, Game Value, Challenges, Sociality, Mystery, and Flow [24, 25].

2.1.5 The Ma'had Game

'The Ma'had' is set within the context of learning at a Ma'had. Figure 1 shows the main menu of the game. The game has five main menus, there are credit, setting, start, instructions and quit.

Figure 1. The main menu of the game

In the game, there are four classes, each inhabited by a Non-Player Character (NPC) shown in Figure 2. The primary task of each NPC is to gather data on whether the player has previously studied certain sections of the lesson material within the class and to track the player's progress in the class. Inside the class, the player undergoes a pre-test, followed by the actual learning of the material.

Figure 2. Non-player character (NPC)

The pre-test taken by the player yields both a score and a duration. The experiential data, score, and duration are subsequently employed to determine the sequence of material that the player should study first, utilizing the MCDM method. This process generates an alternative ranking of learning material, where the highest-ranked material becomes mandatory for the player to study. After completing the compulsory

material as recommended, the player can choose to delve into additional material. Figure 3 shows the game display.

(a) (b)

Figure 3. The game displays (a) player starting the pre-test (b) a preview of the pre-test question

2.2 Methods

In this study, the primary approach involves conducting interviews with key experts in the field of game development, particularly game designers. These interviews will serve to generate questionnaire instruments related to the Ma'had Game that will be used to collect quantitative data. The data collected through these questionnaires will then be analyzed to extract valuable quantitative insights. Figure 4 offers a visual representation of the research process.

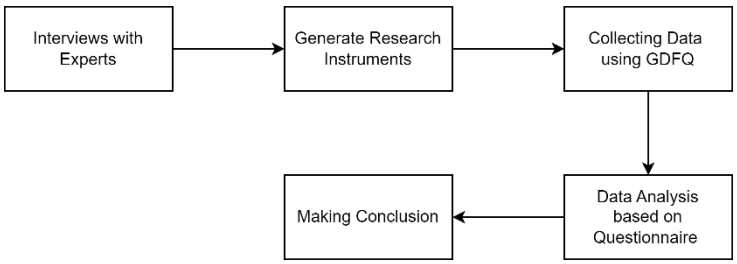

Figure 4. Research method

2.2.1 Interviews with experts

In this study, the researchers conducted interviews with three professional experienced Game Designers and Game Developers, and a professional lecturer of Game and Digital Media who is involved and really knows about Ma'had and its activity. A set of questions was prepared and posed to the experts following the GDFQ with 11 out of the 12 criteria. The questions were based on Game Goals, Game Mechanism, Interaction, Freedom, Game Fantasy, Narrative, Sensation, Game Value, Challenge, Mystery, and Flow. The insights gained from these interviews served as a comparative dataset. This comparative analysis aimed to assess the alignment between the professional Game Designers and Game Developers, and a professional lecturer of Game and Digital Media obtained through the GDFQ instrument in this research.

2.2.2 Research Instruments

The research employed a combination of online questionnaire surveys. Online data collection was conducted via Google Forms. The instrument utilized in this study is an adapted version of the Game Design Factor Questionnaire, tailored to suit the specific characteristics of game testing. The original Game Design Factor Questionnaire consists of 12 factors: Game Goals, Game Mechanism, Interaction, Freedom, Game Fantasy, Narrative, Sensation, Game Value, Social, Challenge, Mystery, and Flow. The "Social" factor was excluded from this study since the Ma'had Game is designed to be played individually without the need for friends or group participation. The questionnaire is composed of 11 factors, resulting in a set of 30 questions to be presented to respondents. The survey questions were aligned with the Game Design Factor

Questionnaire instrument and utilized a 4-point Likert Scale measurement format. Table 1 provides an overview of the 30 questions tailored specifically to the Ma'had Game.

Table 1. Game design factor questionnaire for "The Ma'had" game

No	Game Factors	Quetions
1	Game goals	a. "The Ma'had" has clear tasks and stages.
		b. I understand and have a clear goal when playing the game "The Ma'had."
		c. I want to achieve my goals and get the best results when playing "The Ma'had."
2	Game mechanism	a. The gameplay of "The Ma'had" aligns with the genre it represents.
		b. The rules of the game of "The Ma'had" are easy to understand.
		c. I enjoy the gameplay in "The Ma'had."
3	Interaction	a. "The Ma'had" has clear and easy-to-understand gameplay and controls.
		b. The assistance and guidance features in "The Ma'had" are clear and easy to understand.
		c. The interactions in playing "The Ma'had" are enjoyable.
4	Freedom	a. Players can easily control the character in "The Ma'had."
5	Game Fantasy	a. The art style and visual design of "The Ma'had" are in line with the game's thematic content and story.
		b. The scenes and characters in "The Ma'had" are in accordance with the game's thematic material and story.
		c. The narrative of "The Ma'had" is relevant and consistent with the gameplay.
6	Narrative	a. "The Ma'had" has an engaging story.
		b. "The Ma'had" has a logical plot.
		c. I'm glad and enjoy following the story in "The Ma'had".
7	Sensation	a. The visuals and gameplay experience of "The Ma'had" remind me of activities at the Ma'had.
		b. The visuals in the game make me interested in playing "The Ma'had."
		c. By playing "The Ma'had," I feel like I have a better understanding of the ta'lim Quran material.
8	Game Value	a. I want to achieve the highest score.
		b. The material content becomes interesting when it's added to the game.
		c. I find the Ma'had elements in this game interesting.
		d. My understanding of the content presented in the game has improved after playing "The Ma'had."
9	Challenge	a. I feel challenged to complete "The Ma'had" game.
		b. I can easily win the game.
		c. I want to play the next version of "The Ma'had" game.
10	Mystery	a. Before completing the game, I feel curious about what I will find in the next game.
11	Flow	a. I am very focused when playing "The Ma'had".
		b. I do not feel bored while playing "The Ma'had".
		c. I pay less attention to my surroundings when playing "The Ma'had".

2.2.3 Survey

The survey was carried out online by distributing Google Form links to the participants. The respondents were instructed to complete the Google Form, and the data collected was subsequently analyzed by the research team.

2.2.4. Participants

The participants in this study are experienced game designers and game developers who has developed many games in 10 years and also a lecturer who has knowledge about game development, Ma'had and its activity.

2.2.5. Data Analysis

This study employed qualitative description for the analysis of interview results and quantitative descriptive methods for survey data. Qualitative description is a qualitative research approach that delves deep into understanding, exploring, and interpreting symptoms within their context. On the other hand, quantitative research seeks to address questions and draw objective conclusions through rigorous design, such as correlation, experimentation, and quantitative description. Subsequently, the data collected from the questionnaires were calculated as percentages for each criterion of the Game Design Factor Questionnaire (GDFQ). The survey data results were then visualized using Pie Charts. The findings from the questionnaire were described quantitatively from experts then compared to draw conclusions.

3. RESULTS

The first factor, game goals are the primary objectives of this game, where players can successfully complete the game according to the designed goals. Figure 5 shows the results from the questionnaire, that 56% "strongly agree" and 44% "agree", indicating that the game has and provides a clear goal to be completed. The high percentages of agreement and strong agreement indicate that the game offers a clear end goal for the players.

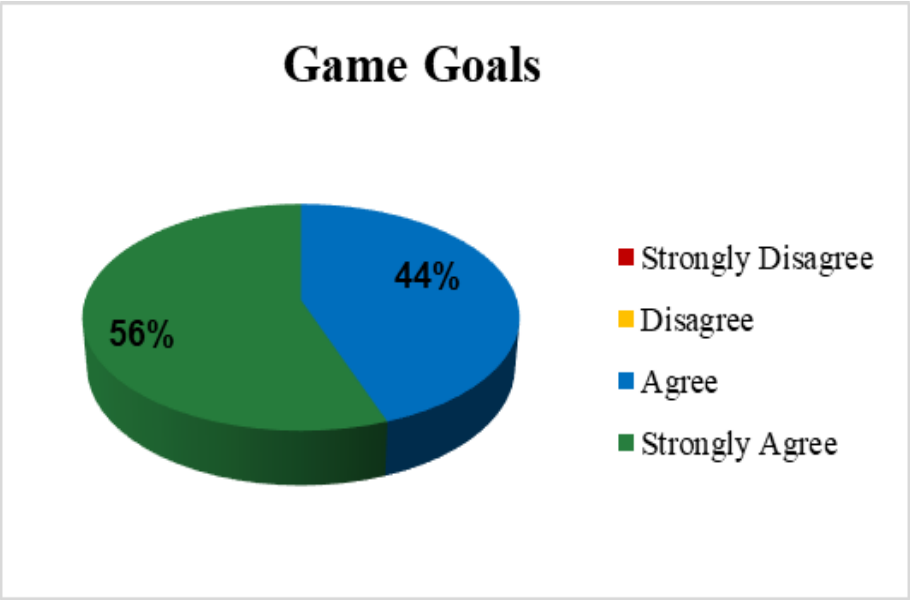

Figure 5. Game goals factor chart

The Game Mechanism factor pertains to the way a game is played and its overall flow. A smooth and straightforward gameplay experience leads to user satisfaction and minimizes the need for players to overthink during the game. The questionnaire results for this game mechanism indicate that 44% of respondents "strongly agreed," while 56% of respondents chose "agree" shown in Figure 6. This indicates that the game design has been proven to have an easily understandable gameplay.

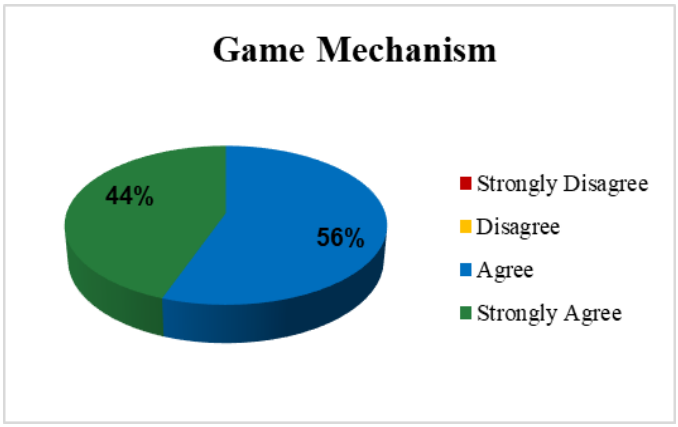

Figure 6. Game mechanism factor chart

Figure 7 explains the results of the questionnaire for the Interaction Factor reveal that 56% of respondents strongly agreed, and 44% agreed, suggesting a high level of satisfaction with the player-to-game interaction design. This effective interaction design enhances the player's overall experience.

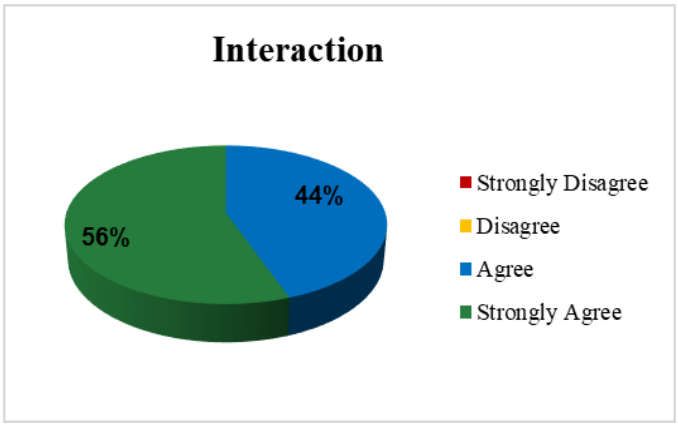

Figure 7. Interaction factor chart

The factor of freedom in Figure 8 shows that 67% strongly agreed, and 33% agreed that the game demonstrated that players have a good understanding of their freedom to determine their own steps and directions to navigate within the game. Based on this result, it will significantly assist players in achieving the game's objectives more easily.

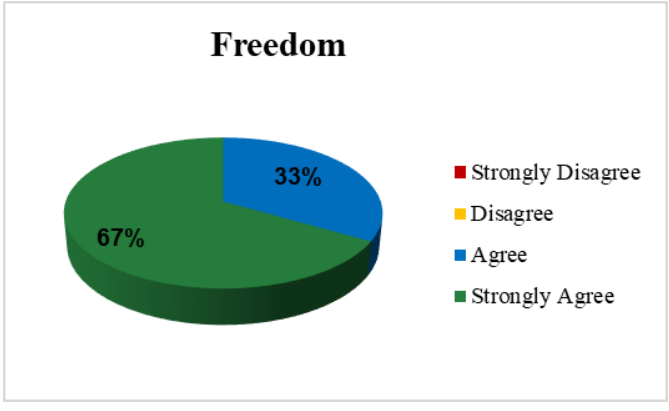

Figure 8. Freedom factor chart

Figure 9. Game fantasy factor chart

Games Fantasy encompass elements that offer players a space for imagination and fantasizing within the game they are playing. In the Game Fantasy Factor, it is expected that players can immerse themselves in the story and visual design of the game. The questionnaire results shown in Figure 9 indicated that 44% strongly agreed, and 56% agreed that "The Ma'had" features visualizations and story that keep players engaged in the game.

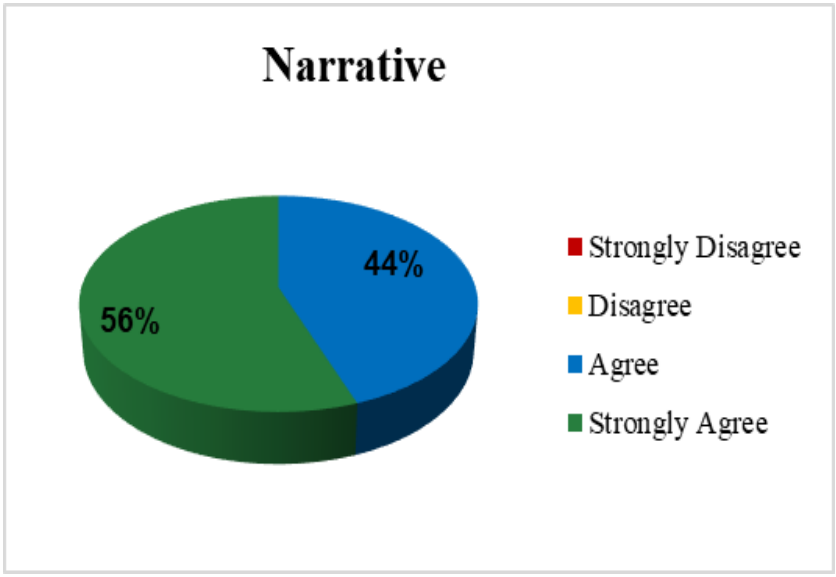

Figure 10. Narrative factor chart

The narrative factor is a factor that processes from the side of the story. The results shows that respondents voted 56% "Strongly Agree" and 44% "Agreed" as shown in Figure 10 above. This number proves that the story given to "The Ma'had" Game provides such a good narrative that that effectively captivate and maintain player engagement throughout the game.

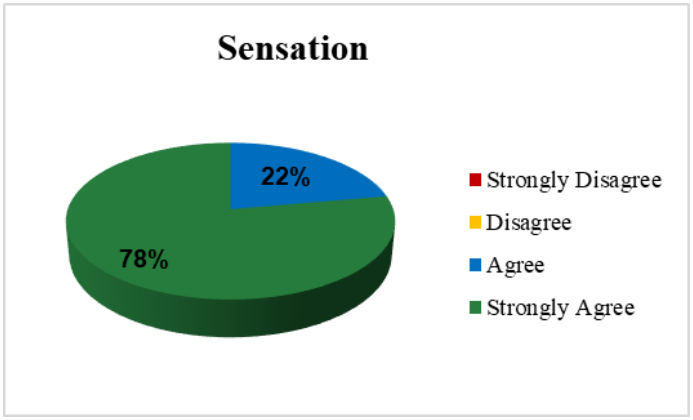

Figure 11. Sensation factor chart

On the Sensation Factor as shown in Figure 11, 78% of the respondents chose "Strongly Agree," while 22% "Agreed", indicating that the game successfully creates sensations and visuals that make players feel and experience the learning environment as if they are in a real Ma'had. Certainly, this applies even to respondents who have never physically been in a Ma'had or studied Ta'lim Quran materials.

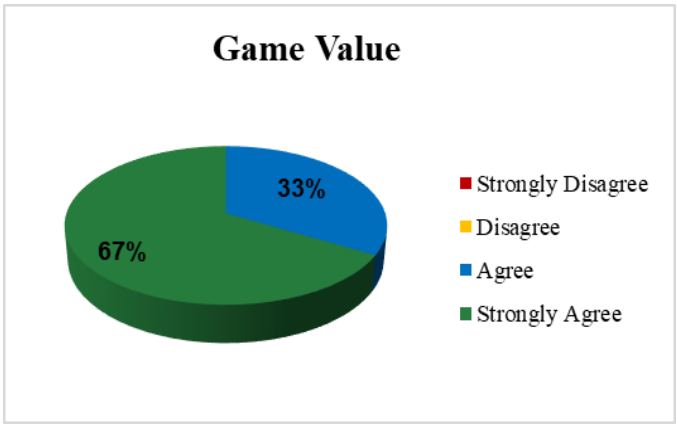

Figure 12. Game value factor chart

Figure 12 above shows 67% of the respondents chose "Strongly Agree," and 33% chose "Agree" in the Game Value Factor. It can be concluded that players perceive value in playing the game, which they find engaging, motivating them to complete the game so by the end of the game, their understanding of the presented materials also improves.

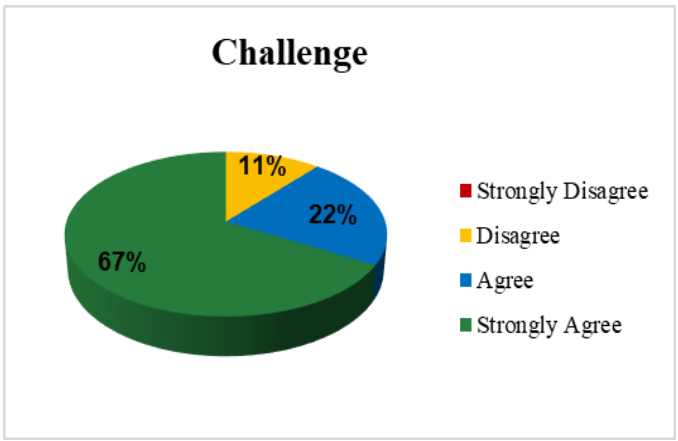

Figure 13. Challenge factor chart

Challenge is one of the factors that motivate people to play a game. The Ma'had Game presents a challenge that is not overly difficult, as it involves answering questions correctly about the game's content. Figure 13 shows 67% of respondents chose "Strongly Agree," 22% of respondents chose "Agree," indicating that the game's challenges make players feel motivated and capable of easily completing the game. In contrast, 11% disagreed that the challenges in the game were motivating for them to finish the game so it indicating that further development is needed to enhance the challenge design, making it more engaging for players in the game.

The Game Mystery Factor yielded results with 33% of respondents choosing "Agree" and 67% selecting "Strongly Agree" which can be seen in the Figure 14. Respondents agree that the Ma'had game can stimulate their curiosity regarding what they will encounter at each level of questions in the game.pique their curiosity about what they will encounter at each level of questions in the game.

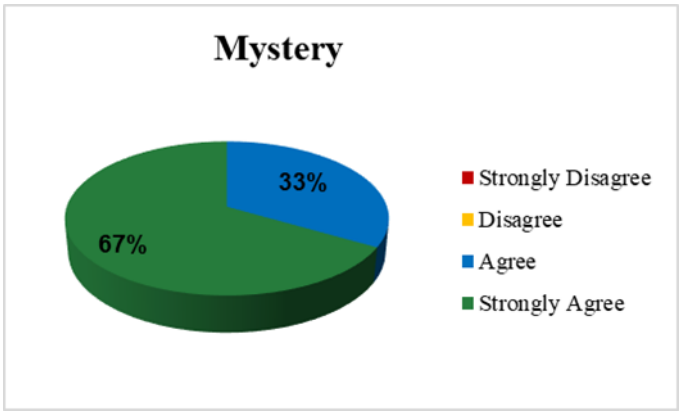

Figure 14. Mystery factor chart

In the Flow Factor Figure 15, there is a balanced difference in the results from respondents. 33% strongly agreed that they play this game with a high level of focus, 33% agreed that they play this game in a focused manner, and 33% disagreed, indicating that one of the respondents may not be very focused when playing this game. Further study is needed for the Flow Factor because there could be variations in the level of interest and focus among the respondents, leading to the variations in the research results. Figure 16 illustrates the survey results, considering all factors that showed blue and green bars, indicating that the respondents mostly strongly agree and agree. Meanwhile, there are two yellow bars indicating that there are two factors, Challenge and Flow factor, where the respondents equally express that they disagree.

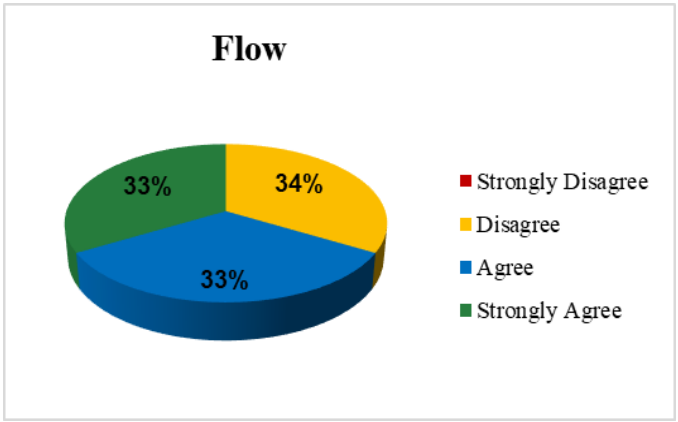

Figure 15. Flow factor chart

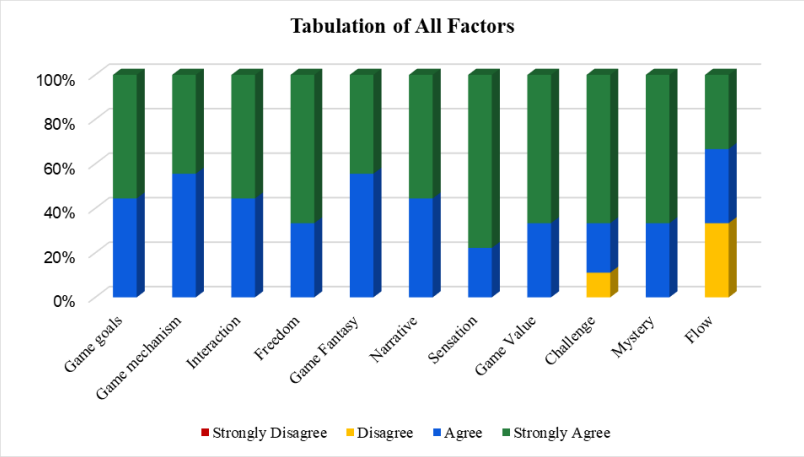

Figure 16. Tabulation of all factors

4. DISCUSSION

Further study is required for this research, where the test subjects are prospective players of the game, namely, university students, who will subsequently be compared to the results obtained from expert test subjects. Additionally, the implementation of alternative quantitative testing methods is essential to facilitate a comparative analysis with the methodologies employed in this research. The qualitative aspect of this study has already been meticulously conducted, involving in-depth interviews, thematic analysis, and participant observation to capture the nuanced perspectives and experiences of the participants. These qualitative findings have provided valuable insights into the motivations, preferences, and learning processes of the players, shedding light on the effectiveness of the game as an educational tool. Moving forward, a comprehensive analysis of each qualitative result will be integrated into this chapter, offering a deeper understanding of the underlying dynamics and implications of the research outcomes.

5. CONCLUSION

In summary, "The Ma'had" Game exhibits significant potential as an effective learning tool, engaging players and promoting learning. It provides clear goals, an easily understandable gameplay experience, and a strong sense of freedom. This is indicated by the choice of "agree" and "strongly agree" which is 100% on game goals, game mechanism, interaction, and freedom. The game's fantasy, narrative, and sensory elements effectively maintain player engagement which is also shown by the choice of "agree" and "strongly agree" that is 100% of the choice on fantasy, narrative, and sensation factor. Players find value in playing the game, resulting in improved understanding of the materials shown by 67% strongly agreed. Challenges are motivating but can be further enhanced. The game successfully piques player curiosity. Further study is required for this research, where the test subjects are prospective players of the game, who are students, to explore variations in player engagement and focus. The test result which will subsequently be compared to the results obtained from expert test subjects. Additionally, the implementation of alternative quantitative testing methods is essential to facilitate a comparative analysis with the methodologies employed in this research.

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