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The Impact of Mechanics, Dynamics, and Aesthetics on Student Engagement in Educational Games

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Abstract

Engaging students in educational games is a significant challenge for game designers and researchers, specially for primary school children, as many games fail to capture their attention or maintain it during a lesson, ultimately affecting learning outcomes. This study tries to investigate how to design educational games that effectively engage young learners by exploring how the elements of the MDA (Mechanics, Dynamics, Aesthetics) framework influence player engagement. Using a mixed-methods approach, the study combines observations of 232 primary children during gameplay with feedback from their parents through a Game Engagement Questionnaire. The findings reveal that suboptimal game mechanics, disruptive dynamics, and unappealing aesthetics significantly impact user engagement. Further qualitative observations build upon these findings to identify specific design flaws that impair the learning experience. Based on these insights, the study introduces a simple linear framework for evaluating educational games, offering a scalable solution to improve game design and user experience. This framework provides actionable guidelines for developers, especially in low-resource settings like Pakistan, to create more engaging and effective educational games. By streamlining the evaluation process, this study contributes to both the academic understanding of designing game elements and its practical application, ensuring that educational games can foster better learning outcomes for children in diverse educational contexts.

Keywords: MDA, Game-Based Learning, Student Engagement, Educational Games, Serious Games, Usability Study

1. Introduction

Game-based learning (GBL) is being adopted swiftly in the modern education system due to its capacity to enhance student motivation, cognitive development, and engagement (Barzilai & Blau, 2014; Plass et al., 2015). Educational games have lately emerged as a promising strategy to enhance student engagement and learning outcomes by enhancing immersion and interactive learning. Some landmark eeducational games combine structured content with interactive gameplay to engage and educate students at a global level like in Spelling City, Prodigy Math, and Minecraft. However, in more localized educational setting for underdeveloped countries like Pakistan, local educational game platforms such as Taleemabad, SabaqAmuse, and Wondertree can support local curriculum by engaging students in game-based learning creating immersive environments that support learning outcomes (Baloch & Taddese, 2020). Despite the proven effectiveness of these platforms,

their effectiveness is sometimes undermined as most of them still face significant challenges in engaging students.

How user experiences the interface of the game, the User-Experience is an important factor in determining engagement in educational games. User experience (UX) in digital systems encompasses emotional, behavioral, and cognitive dimensions of user interaction. In games, UX is closely tied to player engagement—how immersed, involved, or absorbed a player becomes during gameplay (ISO, 2018; Law et al., 2009). In serious games for learning, this has become especially important as achieving learning outcomes depend on sustained engagement. Mihaly Csikszentmihalyi's theory of "flow" emphasized the balance between challenge and skill in achieving deep engagement (Csikszentmihalyi, 2009). His work laid the groundwork for engagement studies incorporating concepts such as immersion (Jennett et al., 2008), presence (Takatalo et al., 2010), and psychological involvement (Kiili &Lainema, 2008), often evaluated using constructs borrowed from motivation, self-regulation, and game mechanics (Martey et al., 2014).

With a rise in use of games and educational technology in teaching and learning, user experience of an educational interface is being recognized as a critical factor in determining the success of these educational games(Zamri & Tan, 2022). Usability issues in educational games are often emerging from poorly designed game interactions and faulty use of game elements, which fail to engage the students, resulting in reduced engagement and a decline in game's overall educational value (Permata et al., 2024). While educational games have a potential of enhancing learning, their success hinges on how well the game designer ensures player engagement along with supporting the educational goals. There is need to achieve a delicate balance of game elements and most serious games still struggle with either too complex mechanics or otherwise overwhelming dynamics failing to keep players engaged (Laine & Lindberg, 2020a). The relationship between these game design elements and user engagement is particularly important as it directly affects how well students are able to absorb and retain knowledge while playing.

Among the many frameworks for evaluating game experience, the Mechanics-Dynamics-Aesthetics (MDA) framework introduced by Hunicke, LeBlanc, and Zubek remains one of the most accessible and widely adopted (Hunicke et al., 2004). MDA breaks down game elements into mechanics (rules and algorithms), dynamics (player interaction and system behavior), and aesthetics (emotional responses). It has been applied across genres and use cases, including both entertainment and educational games(Zhang, 2021). Schnabel later extended MDA by mapping mechanics, dynamics, and aesthetics to Rules, System, and Presentation, respectively, providing a layered understanding of how internal game architecture translates into user experience (Schnabel et al., 2014) (see Fig. 1).

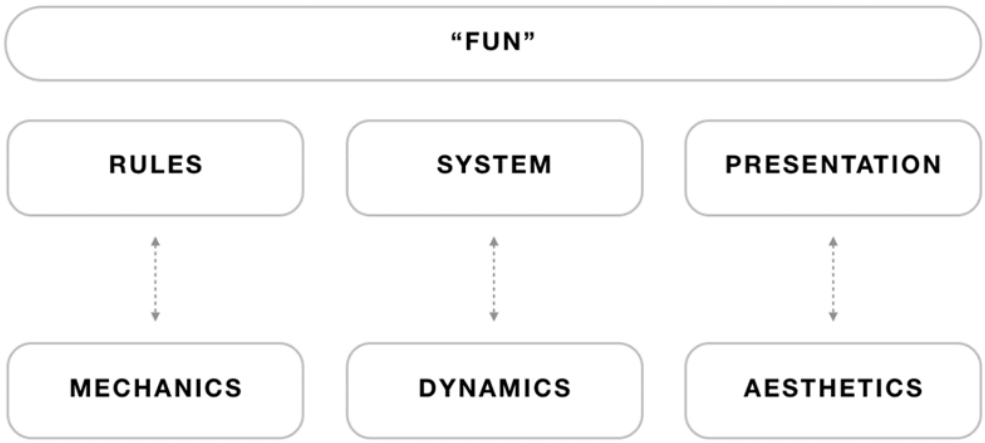

Figure 1. Structure of Mechanics, Dynamics, and Aesthetics (MDA) in relation to Rules, System, and Presentation [16].

Although other educational game evaluation models—such as Kiili's Experiential Learning Model, Amory's Game Object Model, and De Freitas's Four-Dimensional Framework—focus more directly on pedagogical outcomes (Khine, 2011; Pratama&Setyaningrum, 2018), they are limited in evaluating the quality of game experience. Hence, this research delimits its scope to game design evaluation, rather than assessing learning outcomes. Moreover, recent applications of MDA in gamified environments support its utility in serious games; for example, Zhang used MDA to evaluate learner feedback in self-paced online courses and found aesthetics to be the most positively perceived element (Zhang, 2021).

Despite the widespread adoption of educational games globally, empirical evaluations of these games using the MDA framework remain limited, especially in localized contexts such as Pakistan. While platforms like Taleemabad have seen significant adoption in classrooms and homes, there is a notable gap in structured research assessing their gameplay experience using established design-centric frameworks. This is particularly critical because while there is increasing interest in the impact of educational games on student learning outcomes, few studies have thoroughly examined how well these games engage students, especially through frameworks such as MDA. Existing evaluations often overlook the connection between game design elements (mechanics, dynamics, and aesthetics) and user engagement, which hinders the full potential of these games in enhancing learning experiences. This study seeks to address this gap by applying the MDA framework on empirical data gathered through the Game Engagement Questionnaire (GEQ) which is a widely used instrument for evaluation of player engagement in serious games. The GEQ is among the more famous instruments as it offers a comprehensive approach to understanding user interaction, although there are other instruments like the Intrinsic Motivation Inventory (IMI) and the Player Experience Need Satisfaction (PENS) instrument(Denisova et al., 2016). While these tools are valuable in their own spheres, GEQ is valued for its direct approach across a variety of serious game contexts, making it a suitable choice for this study(Brockmyer et al., 2009).

Mechanics-Dynamics-Aesthetics (MDA) is an influential framework in the field of game design as it offers a structured approach to analyzing and improving game elements. Despite its widespread adoption in game development, the framework has not yet been fully

explored in the context of education and particularly its use in conjunction with usability analysis for evaluating user-experience of serious games is novel. While existing research has largely focused on the pedagogical outcomes of these learning games, much less attention has been given to how the interplay of mechanics, dynamics, and aesthetics influences player engagement in educational contexts since achieving learning outcomes is the primary goal(Abdul Jabbar & Felicia, 2015a; Alexiou & Schippers, 2018). By applying the MDA framework to assess usability, this study aims to offer valuable insights into how game design elements contribute to engaging and effective educational experiences from the perspective of game designers.

This study seeks to investigate the relationship between game design elements such as mechanics, dynamics, and aesthetics with player engagement(Dickey, 2005). By linking usability issues to engagement challenges, the study provides actionable insights into how educational games can be improved to foster a more engaging and effective learning experience and provide a linear framework for evaluation of usability in educational games which can guide future research(Abdul Jabbar & Felicia, 2015b; Hamari et al., 2016). The findings will support the work of game designers, developers and educators alike, helping them create more engaging and user-friendly educational games that can enhance student engagement and help achieve better learning outcomes.

2. Background

2.1 Serious Games for Learning

Serious games for education have gained significant spotlight in a couple of decades as researchers and educators started realizing that serious games can play a role in engaging students in deep learning. These games are designed not merely for entertainment but also to support educational goals by making use of game mechanics and interactive learning environments(Lameras et al., 2017). Serious games facilitate learning through immersive experiences, encouraging students to learn by doing, solving problems, and engaging in critical thinking and collaboration (Tsekleves et al., 2016). A growing body of research has shown that serious games positively impact various aspects of learning, including motivation, cognitive development, and the acquisition of specific skills (Lamb et al., 2018). The interactive nature of these games increases engagement, making learning both enjoyable and motivating, this enhances student learning retention and understanding of concepts(Ricci et al., 1996; Yang & Chen, 2023).

Despite their usefulness, considerable challenges remain in designing serious games that can successfully combine pedagogical soundness with player engagement. Many educational games struggle to find a balance between fun and educational content, often failing due to poorly designed game mechanics that do not sustain player interest or fail to maintain challenge at an appropriate level resulting in underutilization of the full educational potential of these games(Alsubaie et al., 2018; Ildephonce& Allen, 2022). To overcome these challenges, it is critical to evaluate the effectiveness of these games from a usability standpoint. This calls for the development of systematic evaluation frameworks that can guide game development and ensure that games are both engaging and educational(Ren et al., 2024).

2.2 Student Engagement in Serious Educational Games

Player engagement is widely regarded as the most critical factor in determining the success of serious educational games. Engagement goes beyond just the amount of time spent in the game; it involves the depth of interaction and the emotional and cognitive investment of

players(Whitton, 2011). Highly engaged players are more likely to retain knowledge, develop essential problem-solving skills, and exhibit intrinsic motivation to continue learning outside of the game (Caserman et al., 2020; Hellín et al., 2023).

One of the main challenges in designing engaging educational games lies in understanding the drivers of engagement. Several theories of motivation and engagement, including Csikszentmihalyi's flow theory, suggest that balancing challenge with skill is crucial to creating an optimal learning experience. The state of "flow," where players become fully immersed and engaged in an activity, is key to maintaining interest and motivation in educational games (Motevalli et al., 2020). However, achieving a balance in game elements like challenge and player responses like excitement or frustration can be difficult and failing to do so can affect player engagement. The MDA framework offers a structured approach to evaluating and improving game design, categorizing game elements into mechanics, dynamics, and aesthetics(Dichev&Dicheva, 2017). This framework allows designers to assess how these elements work together to enhance player engagement and usability.

Student engagement is directly affected be the quality of user experience a student is having with a serious educational games. Good user-experience may enhance student engagement in game, research had proven that well engaged students are more likely to persist in their learning, develop essential skills, and retain acquired knowledge(Ning et al., 2021). Informally, engagement in these games is often determined by how well the game design elements—mechanics, dynamics, and aesthetics— align with players' expectations and the learning goals of the game but the concept has not been tested formally. The design of feedback systems, reward structures, and interactive challenges plays a significant role in motivating players to stay engaged with the content and continue playing(Puritat, 2019).

Despite the growing body of research on engagement in educational games, few studies systematically explore the link between usability problems (such as poor game mechanics or broken feedback systems) and engagement issues. While many frameworks focus either on pedagogical outcomes or player experience, fewer studies examine how these issues directly affect engagement and learning. This research aims to fill this gap by applying the MDA framework to evaluate how design elements (mechanics, dynamics, and aesthetics) impact both usability and engagement in educational games. This study offers valuable insights into how these issues can be addressed during game development to improve the overall player experience and enhance learning outcomes. This research aims to answer the following key research questions:

RQ1: How can the issues of player engagement for educational games be supported by the MDA framework for game design?

RQ2: How are issues of player engagement linked with poor Mechanics, Dynamics, and Aesthetics in an educational game design?

This study is expected to make a significant contribution to the existing body of knowledge by offering practical insights and a structured method for evaluating usability and engagement in educational games. By providing a detailed examination of how game design elements influence the educational experience and introducing a linear framework which can be followed by coming researchers trying to improve the user experience of educational games. Hence, this research will serve as a valuable resource for future educational game developers and academic researchers on serious games and game-based learning.

3. Methods

This study assessed the level of player engagement and user experience within the Taleemabad educational game using a structured, quantitative approach grounded in the Mechanics, Dynamics, and Aesthetics (MDA) framework. The research design was based on a cross-sectional survey employing a modified version of the Game Engagement Questionnaire (GEQ).

3.1 Target Population and Sampling

The target population consisted of primary school students aged 6 to 12 years enrolled in English-medium private schools. Eligible participants came from households with middle to upper socioeconomic backgrounds, with parents who were digitally literate and had access to smartphones, this criteria mirror the user base originally envisioned for Taleemabad. A non-random purposive sampling strategy was adopted to select participants. Six schools located within the Rawalpindi Cantonment area were approached for collaboration. Of these, Silver Oaks and Army Public School agreed to participate in the study. Consent forms were distributed to the parents of students enrolled in Grades 4 and 5, resulting in a total of 267 responses, out of which 232 valid responses were retained for final analysis. Invalid or incomplete submissions were excluded.

3.2 Ethical Considerations

The study was conducted in accordance with ethical research practices. Formal approval was obtained from the Ethical Review Committee of the participating private schools. Written informed consent was secured from the parents or legal guardians of all student participants. Anonymity and voluntary participation were guaranteed throughout the study.

3.3 Survey Administration and Timeline

Data collection was conducted over a two-week period in November 2024. The questionnaire was administered digitally via Google Forms. Parents were instructed to assist their children in understanding and completing the survey items, especially the Likert-scale questions, to ensure clarity and reliability in responses. No personal identifiers were collected.

3.4 Instrument: Adapted Game Engagement Questionnaire (GEQ)

To evaluate player engagement, a customized version of the Game Engagement Questionnaire (GEQ) developed by Brockmyer et al. (Brockmyer et al., 2009) was utilized. The GEQ is a widely recognized instrument that assesses psychological involvement during gameplay across five dimensions: immersion, presence, flow, psychological absorption, and dissociation. Given the non-violent, educational nature of Taleemabad, the dissociation dimension was excluded from this study, as it typically applies to games involving intense psychological detachment or violent content. The remaining four dimensions were retained as they directly relate to educational gameplay experiences.

The adapted GEQ consisted of 15 items:

- 6 multiple-choice questions capturing demographic data and game usage behavior (e.g., frequency of play, duration, device used)

- 9 engagement-focused statements, evaluated on a five-point Likert scale ranging from "Never" to "Always"

This scale allowed for the quantitative measurement of subjective experiences, a well-established method in game user research. The adaptation ensured that survey items

remained age-appropriate and contextually relevant. Sample items included: “I lose track of time while playing,” “I play without thinking about how to play,” and “My thoughts go fast during the game.” Items related to behavioral dissociation (e.g., “I feel spaced out”) were deliberately excluded to avoid misinterpretation or ethical concerns.

The structure of this adapted tool mirrors changes made in previous studies on educational games, for instance (Byun, 2012) customized the GEQ to explore the effects of voice-over elements on engagement. The flexibility of the GEQ allows it to be meaningfully tailored to different game types and target populations.

3.5 Data Handling and Analysis

All responses were automatically compiled through the Google Forms platform. Basic data validation checks were performed to exclude incomplete entries. The resulting data set included both contextual variables (demographics, usage patterns) and engagement scores (Likert-scale responses). The results were analyzed to identify trends in user engagement and were further interpreted using the MDA framework to categorize issues as mechanical, dynamic, or aesthetic in nature.

4. Results

4.1 Participant Demographics and Sampling

Data was collected in two stages from 232 student users who volunteered to participate after engaging with the Taleemabad game over a two-week period. Nearly 70% of respondents were between the ages of 9 and 11, with 69.4% enrolled in Grade 4 or 5. Older students were intentionally targeted to ensure more reliable parent-assisted responses, as students at this stage are better able to express their game experience.

4.2 Engagement Frequency and Play Behavior

When asked about their frequency of play, 49.1% of participants reported playing the game once a week, while 36.2% played once daily. A smaller group engaged with the game multiple times a day.

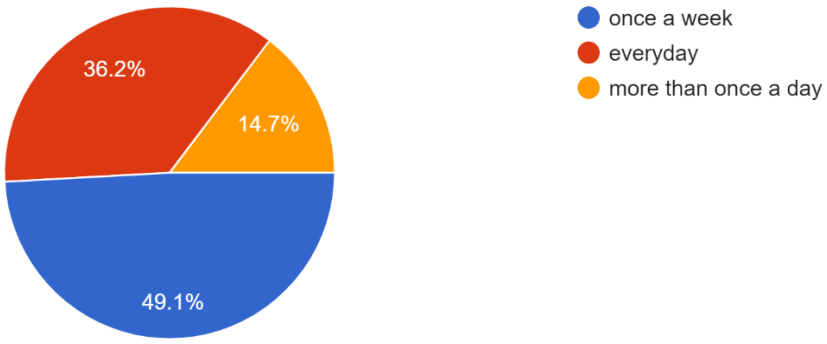

Figure 2. Frequency of playing Taleemabad

In terms of daily duration, 40.5% of respondents played for less than an hour, while 49.6% played for one to two hours. Most students went through one or two lessons a day, with 39% completing a single lesson or fewer and 44.6% completing up to two lessons. Despite relatively limited engagement, only 28.1% reported difficulty understanding the lesson

objectives, while 12.1% claimed consistent success and 31.2% indicated they usually understood the concepts.

4.3 Ease of Use and Game Features

Regarding the usability and interest of game features, 13.9% found them hard or uninteresting. A larger group, 29.9%, reported uncertainty about ease of use, and only 12.6% were fully comfortable with the features.

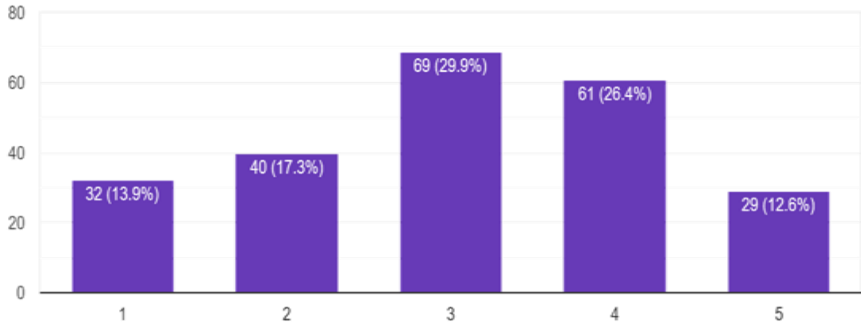

Figure 3. Ease of Use

Approximately 15.2% of students stated that they often got stuck due to game control, while 33.8% reported uncertainty in this area. Only 7.8% expressed confidence that they never encountered such problems.

4.4 Indicators of Game Immersion and Engagement

Participants were asked if they lost track of time while playing—often an indicator of high engagement. Only 6.5% agreed, while 34% were unsure and 18.7% denied experiencing this. On whether gameplay felt automatic, 10% agreed, 8.3% disagreed, and 37.8% were unsure. When asked whether their thoughts raced ahead of gameplay to plan the next move, 10.4% said yes, 8.3% said no, and 35.8% were uncertain. To assess immersion, participants were asked if they became unaware of real-world surroundings (e.g., not hearing others speak). In this case, 25.1% said it never happened, 25.5% said it happened sometimes, and 26% were unsure. Only 7.8% reported consistent occurrence.

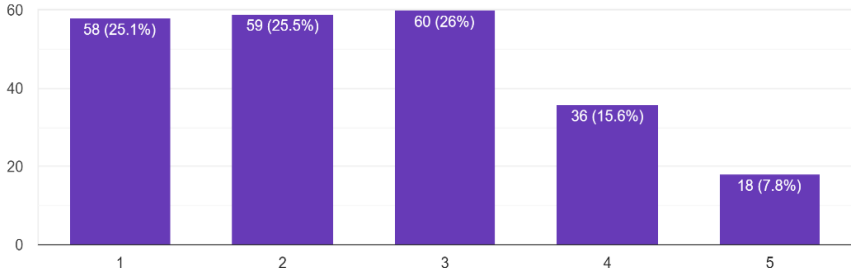

Figure 4. Lack of immersion in the game experience

When asked whether they forgot hunger or thirst during gameplay, 18.2% said they never did, 29.4% rarely did, and 29% were unsure. Only 8.7% reported often forgetting

physiological needs due to gameplay involvement. The question of whether players thought about returning to the game while not playing showed a similarly low engagement pattern: 18.6% said they never felt this way, 30.3% said it rarely occurred, and 27.7% were unsure. Only 5.2% reported frequently thinking about returning. When asked whether they felt as if time had stopped during gameplay, 15.2% reported it never happened, 25.1% said it happened rarely, and 41.6% were unsure. Only 4.8% indicated that they consistently experienced this level of psychological absorption.

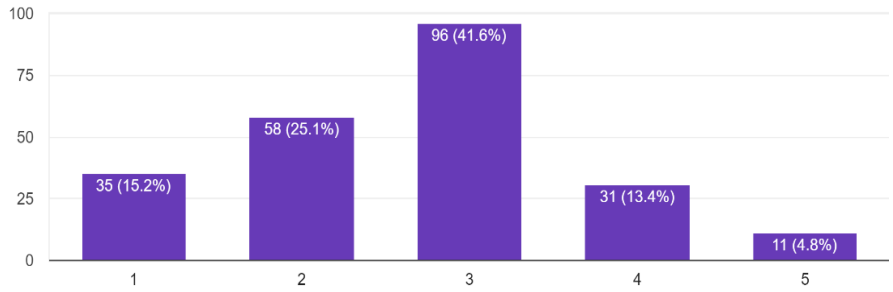

Figure 5. Absorption in game experience

4.5 Proposed Interface Redesign Based on User Feedback

The evaluation of user experience and student engagement within the educational game Taleemabad utilized the MDA framework to systematically categorize usability issues. This approach streamlined the identification and resolution of design problems. Based on the study's findings, several key modifications are recommended. Additionally, prototypes were developed to improve both gameplay performance and user engagement, ensuring a more effective and immersive learning experience.

After identifying major issues using the GEQ, it was recommended that the app optimize its layout, particularly the registration flow and video loading components, to reduce UI latency and prevent screen freezes and crashes. Implementing responsive design and consistent interface standards across Android and iOS was suggested to ensure uniform usability. The app should also switch to portrait orientation, enable profile customization, and introduce content lists, vocabulary banks, and mini-games to improve usability and personalization. Clear information alignment with user expectations was deemed necessary to minimize confusion and interface errors. A complete overhaul of the subscription process was advised to improve transparency and functionality. Aesthetic improvements, such as color and design unity, customizable volume control, subtitles, and brightness adjustments were recommended to enhance user experience. Refining iconography and establishing reliable feedback channels were also suggested. To address privacy concerns, phone number registration was made optional by enabling email-based sign-ups and limiting data access. These recommendations aim to enhance the technical reliability, interaction design, and emotional appeal of the game thus improving student engagement overall.

Low-fidelity wireframes and redesigned interfaces were developed based on the user feedback to illustrate how the Taleemabad application could be improved. These wireframes were designed using Figma and they represent a foundational step towards redesign as they focused on key improvements. The wireframes aim to address core usability challenges such as navigation, accessibility and interface intuitiveness whereas the key elements of the redesign included easy accessibility of common controls like volume controls, search bar and quick access links across all screens; user profile management was made easily available through a visible profile icon; language selection and login options were made simple; gamification features like daily rewards were added to encourage engagement; screen controls like playback speed and screen rotation options were added; leaderboard and progression was also added to track learning progress and motivate learners.

After the major structural improvements were made using the wireframes, interface prototypes were created to simulate the user interaction flow, adhering to core usability principles such as consistency and accessibility. Key improvements included unified design language ensuring responsiveness and uniform behaviour across devices, contextual menus adapting options based on user location within the app and improved content navigation with clearer labels, breadcrumb navigation, and filter options. These iteration designs were guided by user feedback through Game Engagement Questionnaire where they pointed out issues that cause attrition further proving the connection between engagement and usability.

4.6 Expected Impact

These interface enhancements aim to directly address the usability challenges revealed during this study. By offering users intuitive control, contextual guidance, and aesthetically cohesive interfaces, the new designs are expected to:

- Reduce frustration caused by hard-to-find controls
- Improve navigation flow and player autonomy
- Increase engagement through gamified and personalized UI elements
- Align the application experience with modern usability standards for educational technology

Future testing of these designs through moderated usability studies or focus groups is recommended to validate the proposed changes and further iterate on them.

5. Discussion

This study applied the Mechanics-Dynamics-Aesthetics (MDA) framework to evaluate the usability and player engagement in the Taleemabad, the educational serious game. By categorizing usability issues within the game into mechanics, dynamics, and aesthetics, the study identifies key areas of improvement to enhance player engagement. The findings demonstrate that the usability challenges faced by players have a direct impact on their engagement levels, aligning with the broader context of effectiveness of serious games as an educational technology. The study answers the research questions by exploring how the MDA framework can support usability evaluation and how player engagement relates to usability issues in serious game design.

5.1 Evaluating Usability through the MDA Framework

One major contributions of this study is the application of the MDA framework to assess engagement in educational games. The MDA framework has been instrumental in

understanding how the game mechanics, dynamics, and aesthetics interact with each other to influence user experience and effect engagement. According to Hunicke et al. (2004), the framework provides a structured approach for analysing game elements, yet its application in educational game contexts is limited and this research fills this gap by offering a comprehensive analysis of usability issues and their impact on student engagement. The results suggest that usability problems related to game mechanics (such as slow system responses), dynamics (like inconsistent feedback), and aesthetics (such as poor visual design) significantly hinder player engagement, thus affecting the game's educational value (Alotaibi, 2024).

The results support the claim of other recent researchers which is pointing out that careful design of game mechanics like the rules and algorithms are crucial to ensuring proper player involvement (Duggal et al., 2021). Problems like UI latency and screen freezes directly undermine player immersion, which is one of the key indicators of engagement. Furthermore, game dynamics, particularly navigation flow and feedback mechanisms, were found to be central to maintaining engagement. The study highlights that players often disengage when they encounter navigation difficulties or ambiguous control functions, similar findings have been reported by previous research on the importance of intuitive design in sustaining player motivation and engagement (Fonseca et al., 2023).

5.2 Player Engagement and Game Design: Linking Mechanics, Dynamics, and Aesthetics

In response to RQ2, this study found that the relationship between game design elements and player engagement is complex and interdependent. Mechanics, such as user interface responsiveness and ease of control, directly influence the cognitive and emotional aspects of engagement and hence learning. As noted by recent research, mechanics affect player satisfaction and immersion, with poor mechanics lead to frustration and disengagement(Duggal et al., 2021). In the case of Taleemabad, players reported significant issues like screen freezes and bugs, which disrupted the flow of gameplay and made it difficult to stay immersed in the learning process.

Similarly, game dynamics like feedback and progression mechanisms were identified as key factors in player motivation. In this study, the lack of feedback mechanism on student performance negatively impacted engagement levels. In his paper, Li Y(2024) emphasize the importance of feedback loops in games, suggesting that the absence of such mechanisms can lead to disengagement, particularly when players do not feel their actions lead to meaningful outcomes (Li, 2024). This finding is consistent with the work of Chen (2023), who found that inconsistent feedback in educational games undermines user trust and engagement (Chen, 2023).

The aesthetic elements of the game like visual design and audio controls also play a crucial role in enhancing and maintaining player engagement. Overwhelming use of bright colours and distracting animations were frequently pointed out by participants as significant reasons for quick disengagement. These findings align with research by Zoh et al. (2023), who found that visual appeal and colour controls are critical in maintaining emotional engagement in educational games (Zoh et al., 2023). Poorly designed aesthetics not only led to visual fatigue but also create cognitive friction, reducing overall satisfaction.

5.3 Proposed Linear Framework for Game Element Analysis

To consolidate the design evaluation process applied in this study and formulate it as a proper method, a linear framework is proposed to illustrate how feedback on engagement

can lead to devising a structured roadmap for game improvements using Mechanics, Dynamics, and Aesthetics (MDA) framework. This model offers a replicable approach that can be used by game researchers or design teams to improve educational game usability and effectiveness.

The process begins by assessing player engagement through a standardized self-reporting tool based on an adaption of Brockmyer's Game Engagement Questionnaire (GEQ). The responses provide user feedback, offering a perception-based understanding of how the game is experienced in real contexts. Next, this feedback is analysed using the lens of MDA framework with affinity diagrams, allowing the insights to be categorized into: Mechanics: functional and rule-based design aspects, Dynamics: patterns of player interaction, and Aesthetics: emotional and sensory experience. Based on this structured categorization, targeted design changes were proposed, leading to improved wireframes and interfaces which are expected to have enhanced functionality and usability. This streamlined, feedback-driven process is illustrated in Figure 6

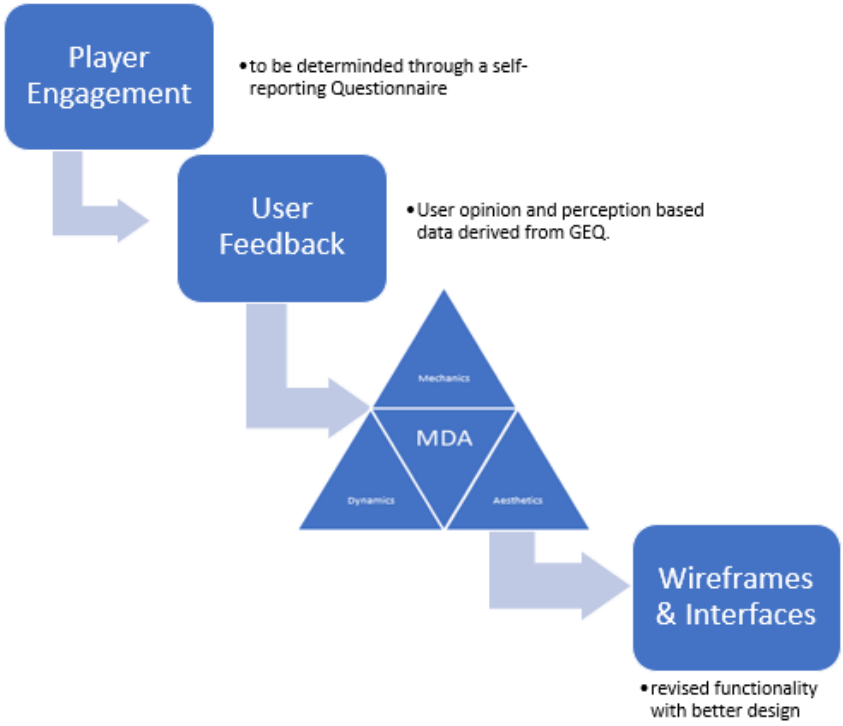

Figure 6. Linear Framework for Game element analysis

5.4 Insights on Improving Engagement and Usability in Educational Games

Based on the findings, this study uses the MDA framework to proposes strategies for improving the usability and engagement of educational games. First, the game mechanics should be optimized to ensure fast and responsive interactions. Game designers should prioritize interface responsiveness and efficiency, addressing cross-platform compatibility to ensure a smooth experience for all users. As highlighted by Zamri (2022), ensuring

consistency across platforms and improving the game's interface design are among the most critical steps in maintaining user engagement(Zamri, 2022).

Similarly, game dynamics must be revisited to provide clearer feedback and progression cues. For example, including visual indicators of learner progress, and other competitive features like leaderboards can help boost motivation and engagement. The absence of any progression feedback in Taleemabad mirrors findings from previous works which have indicated that progression cues are essential for maintaining player engagement, especially in educational contexts where motivation is key to success(Xu et al., 2023; Yu et al., 2021)

Moreover, aesthetic improvements, such as simpler colour schemes, subtle animations, and easy-to-locate sound controls, could significantly improve the overall user experience. This aligns with the findings from Laine & Lindberg (2020), who stresses that subtle aesthetic design and user-cantered interfaces are vital in keeping players emotionally engaged without overwhelming them with excessive visual stimuli (Laine & Lindberg, 2020b).

5.5 Contributions and Future Directions

This study contributes to the growing body of literature on the evaluation of educational games by providing a structured, actionable framework for assessing usability and engagement. The MDA framework proves valuable not only for understanding game design issues but also for offering guidelines for improving engagement and learning outcomes. The study's findings underscore the importance of user experience in serious games, suggesting that addressing usability issues related to game mechanics, dynamics, and aesthetics is crucial for creating engaging and effective educational tools.

In future research, the application of the MDA framework could be extended to other educational games to validate the generalizability of these findings. Additionally, exploring the impact of user-cantered design and adaptive learning technologies could offer further insights into improving engagement and usability in game-based learning environments.

6. Conclusions

This research aims at improving player engagement and user experience in the Taleemabad educational game through a mixed-methods approach grounded in the Mechanics, Dynamics, and Aesthetics (MDA) framework. Even though the educational content shared through the games was reported by teachers and schools to be of high educational value, the questionnaire results revealed low engagement, and the usability analysis identified several issues affecting gameplay, including poor optimization, broken links, confusing layouts, and inadequate feedback mechanisms. The study highlighted key deficiencies in game mechanics, dynamics, and aesthetics that collectively impacted user satisfaction resulting in low engagement.

A significant contribution of this study is the development of a structured evaluation framework that organizes usability insights within the MDA model. This approach provides a clear, actionable roadmap for improving educational game performance. The proposed interface redesigns aim to enhance engagement, though these improvements were not empirically tested in this study. Future research should focus on testing the redesigned interfaces to validate their impact on player engagement and to assess how effectively the new game features address usability issues identified in this study. Additionally, incorporating developer insights and validating the proposed framework across different game contexts will be important for enhancing its generalizability and practical application in the field of educational game design.

Conflicts of interest

The author declares no conflicts of interest. This research was conducted independently, without any financial support, sponsorship, or external funding. The study is based solely on publicly available content from the Taleemabad application. The author is not affiliated with Orenda or Taleemabad and did not receive any data, access, or assistance from the developers beyond what is publicly accessible.

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