

Implementation of Prototype Method in a Web-Based Educational Word Guessing Game with Melodic Elements

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ABSTRACT

The rapid development of digital technology has encouraged the use of interactive learning media, particularly web-based educational games, to support engaging learning experiences. This study aims to design, implement, and evaluate a web-based educational word guessing game integrated with melodic elements as an alternative digital learning medium. The study employs the prototype development method, which enables iterative system development through continuous user feedback. The research stages include needs analysis, prototype design, system development, and system testing and evaluation. System evaluation was conducted through functional testing using a black-box approach to ensure that all features operated according to predefined requirements, as well as descriptive usability evaluation to assess ease of use and user interaction. The results indicate that the developed system functions properly, with core features such as word guessing mechanics, score management, and melodic feedback operating as intended. The usability evaluation shows that the game interface is easy to understand and provides a clear gameplay flow for users.

These findings suggest that the developed web-based educational word guessing game has the potential to serve as an interactive and engaging digital learning medium. This study contributes to the development of educational games by demonstrating the application of the prototype method and the integration of melodic elements to enhance user interaction in web-based learning environments.

INTRODUCTION

The rapid development of digital technology has significantly influenced the transformation of learning media, particularly in the context of digital learning environments. Educational games have emerged as an effective learning medium due to their ability to integrate instructional content with interactive elements that promote learner motivation and engagement. Previous studies indicate that game-based learning can enhance student participation and learning behavior by providing enjoyable and goal-oriented learning experiences (Smiderle et al., 2020)(Sutrisno, 2025).

Gamification has been widely applied in educational contexts to improve learning engagement and outcomes. Through the use of game mechanics such as feedback, challenges, and rewards, gamified learning environments encourage active participation and sustained learner involvement (Rodrigues, 2020)(Aluna et al., 2025). Several studies also report that students show positive responses toward gamified learning media, particularly when interactive digital platforms are used to support learning activities (S et al., 2025).

In addition to visual and interactive components, audio elements play an important role in shaping user experience in digital learning applications. Background music and sound feedback have been shown to influence concentration, emotional engagement, and immersion during interactive activities (Matsumae et al., 2025)(Trevor & Frühholz, 2024). In gamified learning environments, melodic elements function as interaction cues that support user engagement and enhance the overall learning experience (de Freitas et al., 2024).

Despite the growing body of research on educational games and gamification, most existing studies focus primarily on visual interaction and game mechanics, with limited attention given to the integration of melodic elements in web-based educational games. Furthermore, while the prototype development method has been widely used to support iterative system design and usability improvement in educational game development (Cássia Sparapani et al., 2023), its application in developing word guessing games integrated with melodic elements remains underexplored.

Therefore, this study aims to design and implement a web-based educational word guessing game integrated with melodic elements using the prototype development method. By combining interactive gameplay, melodic feedback, and iterative system development, this study seeks to contribute to the development of engaging digital learning media and provide insights into the role of melodic elements in educational game design.



LITERATURE REVIEW

Educational Games and Digital Learning

Educational games have been widely recognized as an effective medium for supporting digital learning due to their ability to integrate instructional content with interactive gameplay. Previous studies indicate that game-based learning can enhance learner motivation, engagement, and participation by providing enjoyable, goal-oriented, and interactive learning experiences. Digital learning environments that incorporate educational games allow learners to actively engage with learning materials rather than passively receiving information, thereby supporting deeper learning processes.

The use of web-based educational games further strengthens learning flexibility and accessibility, as learners can access learning materials across different devices and learning contexts. Research shows that educational games developed on web platforms can serve as flexible and interactive learning media, particularly when they are designed to align with learning objectives and user needs. Such approaches have been shown to positively influence students' motivation and learning outcomes, especially in game-based learning environments that emphasize active participation and feedback mechanisms (Mulasari, 2024)(Sutrisno, 2025)(Aluna et al., 2025).

Overall, educational games play a significant role in digital learning by combining instructional content with interactive elements that support learner engagement and motivation (Arianti & Ismiatun, 2022). These findings suggest that web-based educational games represent a promising approach to developing engaging digital learning media that can support meaningful learning experiences.

Gamification and User Engagement

Gamification has been widely applied in educational contexts as an approach to enhance user engagement and motivation in digital learning environments (Πέλλας et al., 2021). By integrating game elements such as challenges, feedback, rewards, and progression systems, gamified learning environments encourage active participation and sustained involvement in learning activities (Lasambouw et al., 2022). Previous studies have shown that gamification can positively influence students' engagement, learning behavior, and persistence by making learning activities more interactive and enjoyable (Smiderle et al., 2020)(Rodrigues, 2020)(Lee et al., 2025).

User engagement in gamified learning environments is not only influenced by game mechanics but also by learners' preferences and interaction experiences. Research indicates that students demonstrate positive attitudes toward gamified learning media when the design aligns with their expectations and learning needs. Preferences related to gameplay style, feedback mechanisms, and interaction flow contribute to the effectiveness of gamification in supporting learning engagement (S et al., 2025).

Furthermore, gamification supports self-directed learning by providing immediate feedback and clear goals, which help learners monitor their progress and remain motivated throughout the learning process (Dreimane, 2024). These characteristics highlight the importance of designing gamified educational applications that balance functional gameplay elements with user-centered interaction design to sustain engagement in digital learning environments.

Melodic Elements in Game-Based Learning

Melodic elements, such as background music and sound effects, play an important role in shaping user experience within game-based learning environments. Audio components have been shown to influence users' emotional responses, concentration, and immersion during interactive activities. In educational games, melodic elements function not only as aesthetic enhancements but also as interaction cues that support engagement and sustain users' attention throughout the learning process (Chen & Li, 2025).

Several studies indicate that background music can affect cognitive and creative processes by influencing learners' emotional states and focus levels. Appropriate melodic integration may help create a more immersive learning atmosphere, which in turn supports sustained interaction in digital learning environments (Matsumae et al., 2025)(Trevor & Frühholz, 2024). In gamified learning contexts, sound feedback and background music have also been reported to enhance user engagement by reinforcing in-game actions and providing sensory feedback during interaction (de Freitas et al., 2024).

Although the role of audio elements has been explored in various interactive and gamified systems, their application in web-based educational word guessing games remains limited. Most existing studies focus on general gamification or creative tasks, leaving a research gap regarding how melodic elements can be systematically integrated to support interaction and engagement in word-based educational games.

Prototype Method in Educational Game Development

The prototype method is widely used in the development of interactive systems and educational games due to its iterative and user-centered characteristics. This method allows developers to create early versions of a system, gather user feedback, and refine system features through repeated evaluation cycles. By enabling continuous improvement during the development process, the prototype method helps ensure that the final system aligns with user needs and functional requirements.



Previous studies demonstrate that prototyping is effective for improving usability and reducing development risks in educational and serious game development. Through usability testing and iterative refinement, developers can identify interface issues and interaction problems at an early stage, leading to better system performance and user experience (Cássia Sparapani et al., 2023). In addition, reflective and iterative design approaches in game-based learning emphasize the importance of continuously evaluating design decisions to enhance engagement and learning effectiveness (Shaheen & Fotaris, 2024).

The flexibility of the prototype method makes it particularly suitable for educational game development, where system features and interaction mechanisms often require adjustment based on user interaction and feedback. Therefore, the use of the prototype method provides a structured yet adaptive framework for developing web-based educational games.

Research Gap

Based on the reviewed literature, educational games and gamification have been widely studied as effective approaches to enhance engagement, motivation, and learning outcomes in digital learning environments. Previous studies report that game-based learning and gamified systems can positively influence students' participation and learning behavior through interactive mechanics and feedback mechanisms (Smiderle et al., 2020)(Rodrigues, 2020)(Sutrisno, 2025). In addition, web-based educational games have been shown to provide flexible and accessible learning media that support active learner involvement (Mulasari, 2024)(Aluna et al., 2025).

Research on audio and melodic elements further indicates that background music and sound feedback can influence emotional engagement, immersion, and user experience in interactive and gamified learning environments (Matsumae et al., 2025)(de Freitas et al., 2024). However, most existing studies focus on general gamification contexts or creative tasks, with limited attention given to the integration of melodic elements in word-based educational games delivered through web platforms.

Moreover, although the prototype development method has been widely applied to support iterative design and usability improvement in educational and serious game development (Cássia Sparapani et al., 2023), its application in developing web-based educational word guessing games integrated with melodic elements remains underexplored. Therefore, there is a research gap in systematically combining melodic elements with a prototype-driven development approach in web-based educational word guessing games to support engaging digital learning experiences.

METHOD

Research Design

This study employed a **research and development approach** to design and implement a web-based educational word guessing game integrated with melodic elements. The development process followed the **prototype method**, which emphasizes iterative system development through continuous user feedback and refinement (Rachmatika & Bisri, 2020). This approach was selected to ensure that the developed system aligns with user needs and allows improvements at each development stage (Hendra Divayana et al., 2022).

The prototype method is widely applied in the development of interactive systems and educational games due to its flexibility and user-centered nature. Through iterative prototyping, early versions of the system can be evaluated and refined, enabling developers to identify usability issues and functional limitations at an early stage. Previous studies demonstrate that the prototype method effectively supports usability testing and iterative improvement in educational and serious game development (Cássia Sparapani et al., 2023).

By adopting the prototype method, this study ensures a structured yet adaptive development process that supports the integration of gameplay mechanics and melodic elements within a web-based learning environment. This method provides an appropriate framework for developing educational games that require continuous adjustment based on user interaction and system evaluation.

The final stage of the prototype method is system evaluation and refinement. At this stage, feedback obtained from users during the testing phase is analyzed to identify system strengths and areas for improvement. The results of the evaluation are used to refine the prototype, improve system functionality, and enhance user experience. This iterative refinement process ensures that the developed system meets user requirements and operates effectively as an educational learning medium.

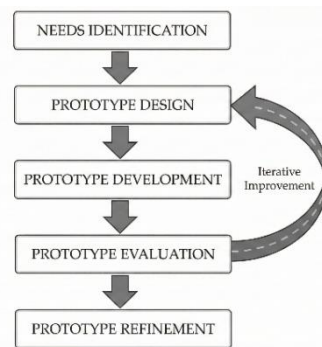


Figure 1. Stages of Prototype Method in the Development of Web-Based Guess Educational Games

Prototype Development Stages

The development process in this study consisted of several stages following the prototype method:

1. **Needs Analysis**
This stage involved identifying functional requirements and user expectations for the educational word guessing game. The analysis focused on gameplay mechanics, learning objectives, and the integration of melodic elements to support user interaction.
2. **Prototype Design**
Based on the identified requirements, an initial prototype of the system was designed. This stage included interface layout design, game flow structure, and the placement of melodic elements such as background music and sound feedback.
3. **Prototype Development**
The designed prototype was implemented into a functional web-based system. Core features such as word guessing mechanics, score management, and melodic feedback were developed and integrated into the system.
4. **Evaluation and Refinement**
The developed prototype was evaluated through system testing and usability assessment. Feedback obtained during this stage was used to refine and improve system functionality and user interaction before finalizing the system.

System Implementation

The implementation stage focused on developing the web-based educational word guessing game based on the refined prototype. At this stage, the system was implemented using web technologies that support interactive user interfaces and dynamic content delivery. The game mechanics were realized through core features such as word display, user input validation, scoring mechanisms, and feedback responses to user actions.

Melodic elements were integrated into the system to enhance user interaction and engagement. Background music and sound effects were embedded within the gameplay to provide auditory feedback during user interactions, such as correct or incorrect word guesses. The implementation ensured that these melodic elements did not interfere with gameplay performance or system responsiveness, but instead complemented the learning experience.

The system implementation resulted in a functional educational game that could be accessed through a web browser. All implemented features were aligned with the design specifications defined in the earlier prototype stages, ensuring consistency between system design, functionality, and user interaction flow. This implementation stage served as the foundation for subsequent system testing and evaluation.

System Testing and Evaluation

System testing and evaluation were conducted to ensure that the developed web-based educational word guessing game functioned properly and met the defined requirements. This stage focused on verifying system functionality, usability, and user interaction flow based on the finalized prototype implementation. Testing was performed to identify potential errors, interface issues, and inconsistencies in gameplay mechanics.

Functional testing was carried out to evaluate core features of the game, including word display, user input processing, scoring calculations, and feedback responses. Each feature was tested to confirm that it operated as expected under normal usage conditions. In addition, the integration of melodic elements was tested to ensure that background music and sound effects functioned correctly and did not disrupt system performance.

Usability evaluation was also conducted by observing user interactions during gameplay. Feedback related to ease of use, clarity of instructions, and overall user experience was collected and used to assess the effectiveness of the system. The results of the testing and evaluation process indicated that the system was able to operate reliably and provide an interactive learning experience, thereby supporting the objectives of the educational game. The system architecture of the developed web-based educational word guessing game is presented in Figure 2.



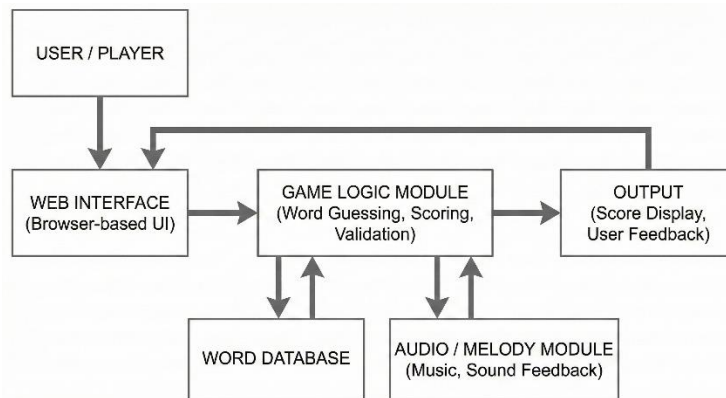


Figure 2. System architecture of the web-based educational word guessing game

Figure 2 illustrates the overall system architecture of the web-based educational word guessing game. The architecture consists of user interaction components, game logic processing, and feedback mechanisms integrated with melodic elements. Users interact with the system through a web interface, while the game engine manages word selection, scoring, and audio feedback. This structure supports interactive gameplay and enhances user engagement in the learning process.

Data Collection and Analysis

Data collection in this study was conducted during the system testing and evaluation phase to assess the functionality and usability of the developed web-based educational word guessing game. The collected data focused on user interaction outcomes, system performance, and feedback obtained during gameplay sessions. Observations were carried out to identify how users interacted with the game features, including word guessing mechanics, scoring responses, and the integration of melodic elements.

The analysis process emphasized descriptive evaluation to examine whether the system operated according to the defined design objectives. Functional test results were analyzed to verify that all features performed correctly, while usability-related observations were used to assess clarity of instructions, ease of navigation, and overall user experience. User feedback was summarized to identify strengths and potential areas for improvement in the system.

The results of the data collection and analysis provided evidence that the developed educational game functioned reliably and supported interactive learning activities. These findings served as the basis for presenting the results and discussion in the subsequent sections, focusing on system performance and user experience rather than statistical inference.

RESULT

System Implementation Results

The development process resulted in a web-based educational word guessing game integrated with melodic elements. The system was implemented according to the prototype design and includes several core features to support interactive learning. These features consist of word guessing mechanics, score calculation, user feedback, and the integration of melodic elements in the form of background music and sound effects.

The user interface was designed to be simple and intuitive, allowing users to easily understand the game flow without requiring additional instructions. The main game screen displays the word guessing area, score information, and navigation controls. Melodic elements are activated during gameplay to provide auditory feedback for user actions, such as correct or incorrect answers, as well as background music to enhance the gameplay atmosphere.

Overall, the system implementation successfully translated the prototype design into a functional web-based application. All planned features were implemented and integrated according to the specified requirements.

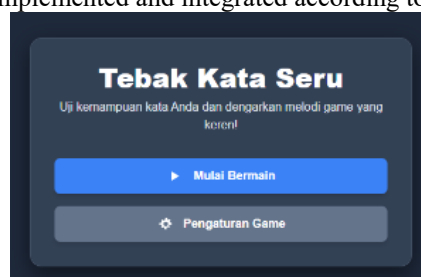


Figure 3. Gameplay flow of the web-based educational word guessing game

Figure 3 illustrates the gameplay flow of the web-based educational word guessing game. The process begins when users start the game and are presented with a word guessing task. Users then input their answers, which are processed by the system to determine correctness. Immediate feedback is provided through score updates and melodic responses. This gameplay flow is designed to support active learning and maintain user engagement throughout the learning process.



Figure 4. User interface of the web-based educational word guessing game

Figure 4 presents the user interface of the developed web-based educational word guessing game. The interface is designed to be simple and intuitive, allowing users to easily access game features, read instructions, and participate in word guessing activities. Visual elements and layout organization are implemented to support user focus, while melodic feedback enhances the overall learning experience. This interface design aims to improve usability and encourage active engagement during gameplay.

Functional Testing Results

Functional testing was conducted using a black-box testing approach to verify whether each system function operated according to predefined requirements. The testing focused on core functionalities, including word input processing, answer validation, score calculation, navigation controls, and the activation of melodic elements.

The results of the functional testing indicate that all tested features functioned as expected. Each input provided by the user was processed correctly, and the system responded appropriately by updating scores and providing auditory feedback. No critical functional errors were identified during the testing process, indicating that the system meets the defined functional requirements. The functional testing results of the developed system are summarized in Table 1.

Table 1. Functional testing results of the web-based educational word guessing game

No	System Function	Description	Expected Result	Test Result
1	Game Initialization	Starting the game and loading word data	Game starts successfully	Successful
2	Word Input	User inputs the guessed word	Input is accepted correctly	Successful
3	Answer Validation	System checks the correctness of the answer	Correct/incorrect feedback displayed	Successful
4	Score Calculation	System updates the score based on answers	Score updated correctly	Successful
5	Melodic Feedback	Background music and sound effects played	Audio plays as expected	Successful

Table 1 presents the results of functional testing conducted on the web-based educational word guessing game. The table summarizes the tested system features, including word guessing functionality, scoring mechanism, melodic feedback, and user interaction components. The testing results indicate that all system features functioned as expected and met the predefined requirements. These results demonstrate that the developed system is technically feasible and ready to support interactive learning activities.

Usability Evaluation Results

Usability evaluation was conducted descriptively to assess the ease of use and clarity of the developed game. The evaluation focused on user interaction, interface clarity, and gameplay flow. Users were able to navigate the system and engage in the word guessing game without experiencing significant difficulties.

The evaluation results show that the interface design is easy to understand and the gameplay flow is clear. Users were able to complete game sessions smoothly, and the integration of melodic elements supported interaction by providing feedback cues during gameplay. These results indicate that the developed system offers a usable and

accessible learning medium for users.

DISCUSSION

The results of this study indicate that the implementation of a web-based educational word guessing game developed using the prototype method was able to support interactive learning experiences. The iterative development process allowed continuous refinement of system features based on user feedback, resulting in improved usability and system functionality. These findings are consistent with previous studies that emphasize the importance of iterative and user-centered development approaches in educational technology to enhance learning effectiveness and system reliability (Cássia Sparapani et al., 2023).

The integration of gamification elements within the educational game contributed to increased user engagement during gameplay. Interactive mechanics such as scoring, feedback, and progression encouraged users to actively participate in the learning process. This finding aligns with earlier research highlighting that gamification positively influences learner engagement and behavior when appropriately designed within digital learning environments (Smiderle et al., 2020)(Rodrigues, 2020). Furthermore, learners' interaction patterns observed in this study support findings that engagement is influenced by how well game elements align with users' preferences and expectations (S et al., 2025).

In addition to gamification, the incorporation of melodic elements played a role in shaping the overall user experience. Background music and sound feedback provided auditory cues that enhanced immersion and sustained user attention during gameplay. These results corroborate prior studies that reported the influence of audio elements on emotional engagement and interaction quality in gamified and interactive learning systems (Matsumae et al., 2025)(de Freitas et al., 2024). The findings also support broader perspectives that consider music as a socio-affective component capable of enhancing user experience in digital environments (Trevor & Frühholz, 2024).

Compared to previous implementations of educational games that focus primarily on visual and interaction design, this study demonstrates that combining melodic elements with word-based gameplay can enrich the learning experience. Similar observations have been reported in studies on game-based learning instruments that emphasize interaction design and feedback mechanisms to support conceptual understanding (Nipo et al., 2023). Moreover, the flexibility of web-based platforms further supports accessibility and learning continuity, as noted in studies on digital learning media and educational game deployment (Mulasari, 2024).

Overall, the findings suggest that the prototype-driven development of a web-based educational word guessing game integrated with melodic elements provides a viable approach to enhancing engagement and interaction in digital learning. This study extends existing research by demonstrating how iterative prototyping, gamification, and melodic elements can be systematically combined within a single educational game application to support interactive learning experiences.

CONCLUSION

This study successfully designed, implemented, and evaluated a web-based educational word guessing game integrated with melodic elements using the prototype development method. The results demonstrate that the prototype approach effectively supports iterative system development and ensures that core functionalities operate according to predefined requirements. The developed game provides a simple and clear interface, enabling users to engage in gameplay without significant difficulty.

The integration of melodic elements contributes to user interaction by providing auditory feedback and enhancing the overall gameplay experience. Although this study does not quantitatively measure learning outcomes, the findings indicate that the developed system has the potential to serve as an interactive digital learning medium. This study contributes to educational game development by illustrating the application of the prototype method and the integration of melodic elements within a web-based learning environment. Future research may focus on evaluating learning effectiveness using quantitative measures and expanding system features to support diverse learning needs.

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