AN INTERACTIVE ROLE-PLAYING GAME BASED LEARNING SYSTEM FOR HISTORY USING ARTIFICIAL INTELLIGENCE AND 3D MODELING

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ABSTRACT

This paper addresses the challenge of disengagement and lack of motivation among students learning history, often attributed to traditional teaching methods that fail to captivate their interest. We propose an innovative solution through an educational role-playing game (RPG) that integrates adaptive AI to create a personalized, immersive learning environment [1]. This game allows students to explore historical events as active participants rather than passive recipients, enhancing engagement and retention of information.

Key technologies include an adaptive AI system that tailors content to individual learning styles and a game-based platform that encourages exploration and decision-making [2]. Challenges such as ensuring historical accuracy, maintaining user engagement, and addressing diverse educational needs were addressed through iterative design and testing, incorporating feedback from real-world classroom settings.

Experimental application across various educational scenarios demonstrated significant improvements in student engagement and historical knowledge comprehension. Results indicated that students not only enjoyed learning about history through this interactive platform but also developed a deeper understanding of the subject matter.

Ultimately, this RPG-based educational tool offers a compelling alternative to traditional history education, promoting active learning and sustained interest [3]. Its ability to adapt to individual learner profiles and engage students in meaningful ways makes it an invaluable resource in educational environments striving to enhance both learning outcomes and student motivation.

KEYWORDS

Interactive Learning, Educational Role-Playing Games, Unity, Artificial Intelligence

1. INTRODUCTION

History, often deemed one of the most tedious subjects, tends to evoke groans from students across various age groups. The widespread hatred towards history can be attributed to many factors, the perceived lack of interest in historical events and the way in which the work is

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presented. Many students dislike the conventional approach to history education, particularly the textbook reading assignments that can be both plain and overwhelming [4]. In classrooms around the world, students often express their dissatisfaction, boredom and disengagement. The challenge is not in the richness of the content itself, but in the delivery of content. The conventional methods of teaching history often fail to capture the imagination and curiosity as well as the activeness of students.

Methodology A by Henriksen (2010) uses educational role-play to promote deeper learning through conflictual negotiations between types of knowledge. While it effectively fosters reflective learning, it struggles with compatibility in traditional settings and may focus too heavily on conflict.

Methodology B by Carvalho and Batista (2008) creates an immersive RPG experience to teach history through character interaction and scenarios. It enhances engagement but lacks specific assessments for learning outcomes and does not cater to diverse learning styles.

Methodology C by Huizenga et al. (2009) employs a mobile game to improve historical knowledge, proving effective in engagement and knowledge but not in sustaining motivation for history as a subject.

Our project integrates these approaches by balancing engaging gameplay with educational depth, using adaptive AI to personalize learning and sustain motivation, addressing the shortcomings of each methodology to create a more comprehensive learning experience [5].

However,in the RPG text game, the learner takes on the role of a scientist working on the Manhattan Project who starts off from the Los Alamos National Laboratories working on the first nuclear bomb prototype – The Gadget, learning the history from a different perspective through a different, fun method, instead of the traditional method in which a student gets assigned homework after lectures [6]. This helps promote a student’s interest and passion in history by turning the subject from a tedious obligation to do into a compelling adventure.

The first experiment focused on assessing the educational impact of an RPG-based learning system on students' historical knowledge and engagement, compared to traditional methods [7]. We used a sample of 10 students divided into RPG and traditional groups, evaluated through pre- and post-tests and engagement assessments. The RPG group demonstrated higher scores and engagement, likely due to the immersive and interactive nature of the game, which enhances learning retention and interest.

The second experiment aimed to measure user satisfaction between the same RPG-based system and traditional learning methods, with another set of 10 students. Satisfaction was quantified using a 1-10 scale survey post-intervention [8]. The RPG group reported significantly higher satisfaction, with scores consistently above those of the traditional group. This higher satisfaction in the RPG group can be attributed to the engaging gameplay elements, which likely made the learning process more enjoyable and relatable, contrasting with the static approach of traditional methods. Both experiments highlighted the RPG's potential to improve educational outcomes and student satisfaction through innovative, interactive content delivery.

2. CHALLENGES

In order to build the project, a few challenges have been identified as follows.

2.1. User Engagement

Maintaining high levels of user engagement is essential for the success of an educational program. Challenges may arise in keeping students motivated and interested in the learning process because they would tend to have a shorter attention span. I could Integrate many things that students would be attracted to such as, gamification elements, interactive features, and periodic challenges within the learning environment in order to Excite them. I can also conduct user feedback sessions to gather insights into the student's preferences so I can adjust the system accordingly.

2.2. Individual Preferences

Recognizing the diversity between the learning styles of the students, we incorporated an adaptive AI system to meet individual preferences. The complexity of this step would not only be identifying it and accommodating it for a wide variety, it is also a challenge to implement the AI into the game through Unity. The game tells the AI specific and detailed instructions to take on the role of a history professor in order to generate a detailed, professional response at the end of the game. By incorporating this comprehensive AI system, the resolution not only addresses the challenge of diverse learning styles but elevates the educational experience to a new level of personalization.

2.3. Maintaining accuracy and Integrity

Integrating historical content into an RPG presents significant challenges in maintaining accuracy and integrity. While the primary goal of such games is to engage students in learning history in an immersive manner, the need to balance educational content with engaging gameplay is crucial. This challenge involves meticulous research and collaboration with historians to ensure that all game narratives, tasks, and characters accurately reflect historical events and contexts. Furthermore, the design must carefully navigate the representation of sensitive historical issues to educate without offending or distorting historical facts. The complexity of this task not only lies in the accurate portrayal of history but also in making these portrayals accessible and appealing within the game mechanics. This approach must effectively integrate educational objectives into the game's design to provide both an accurate and captivating learning experience.

3. SOLUTION

In this immersive educational program, students take on the role of a scientist at the Los Alamos National Laboratory during the Manhattan Project. As they navigate the virtual environment, they encounter a series of choices that shape the course of the game and ultimately lead to different endings. The AI Algorithm then analyzes these decisions, creating a personalized result and learning experience. Each choice made by the student influences the upcoming storyline, promoting interest, research, and exploration of the historical events surrounding the Manhattan Project.

When the game is complete, the students receive feedback generated by the AI algorithm, approaching the outcomes from a professional and serious perspective [9]. This unique feature adds depth to the learning experience, as students gain insights into how their choices might have impacted history. The program not only engages students through interactive gameplay but also helps students through a reflective process, encouraging them to consider the ethicalness and historicity of their decisions. Overall, this innovative learning approach not only immerses

students in history but also creates critical thinking and a deeper understanding of the complex historical background of World War II, The Cold War, and the Manhattan Project.

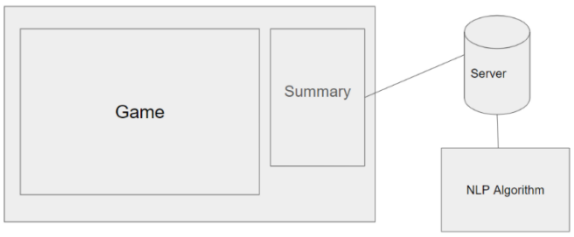

Figure 1. Overview of the solution

An important component in this game is the server, its purpose is to obtain data from the game and deliver it, as a prompt, to the ChatGPT AI [10]. The AI then generates a response to the prompt, giving a detailed and professional summary of the player's choices from the perspective of a history professor.

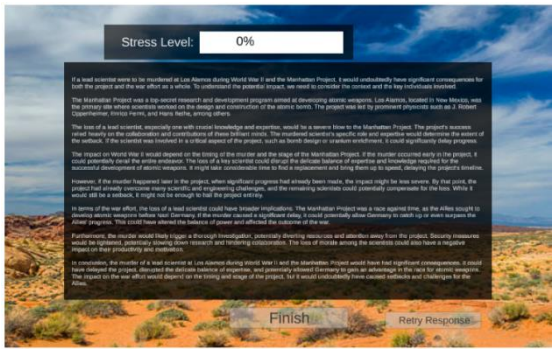

Figure 2. Screenshot of the game

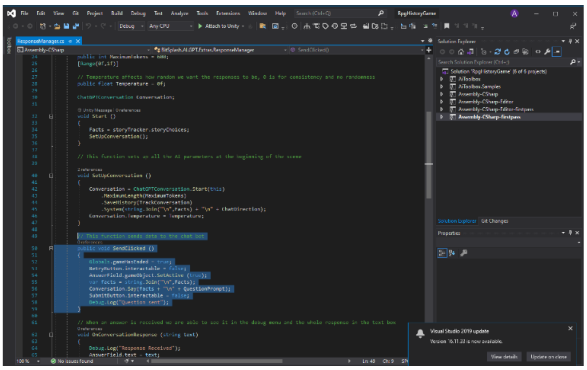

Figure 3. Screenshot of code 1

The screenshot above displays the code at the end of the game when the player has completed making their decisions. The decisions then are made into a prompt and sent to ChatGPT AI. The AI then uses the prompt to generate an outcome.

"var facts = string.Join("\n",Facts);" combines the data that are separated when they are collected from the game, for it to become able to be sent to the chatbot.

“Conversation.Say(facts + "\n" + QuestionPrompt);” sends the facts that are collected previously and the question prompt to the ChatGPT API, so that ChatGPT can respond to it and give a professional and educational excerpt on the potential outcome of the player’s decisions in the game.

“Debug.Log("Question sent");”

4. EXPERIMENT

4.1. Experiment 1

Experiment A is to assess the educational impact and engagement levels of an RPG-based learning system on students' understanding of historical events, specifically the Manhattan Project, compared to traditional learning methods.

This experiment evaluates an educational RPG against traditional learning methods, focusing on the Manhattan Project's historical understanding. Ten high school students will be randomly assigned to either an RPG-based learning group or a control group using traditional methods. The study involves pre- and post-tests to measure knowledge and engagement. The RPG group will interact with the game for four weeks, making decisions that influence the narrative, while the control group receives conventional textbook instruction. Engagement and learning outcomes will be compared using statistical tests and qualitative feedback, aiming to demonstrate the RPG's potential in enhancing historical education and student engagement.

	A	B	C
1	Group	Post-Test Score (out	Engagement Rating (out of 10)
2	RPG-Based	85	8.5
3	Traditional	70	5.5

Figure 4. Figure of experiment 1

The RPG-based approach leading to higher scores and engagement ratings is notable but expected, given the interactive and immersive nature of RPGs. The traditional method's lower engagement rating (5.5) was somewhat surprising, as even traditional methods often achieve moderate engagement through narrative and discussion. The marked difference in engagement likely had the most significant effect on the results, as higher engagement generally correlates with better learning outcomes. This underscores the impact of interactive and personalized learning environments in increasing student involvement and improving educational outcomes.

4.2. Experiment 2

Experiment B is to evaluate the user satisfaction and perceived value of an educational RPG on the Manhattan Project, compared to traditional classroom learning methods.

This experiment evaluates user satisfaction with an educational RPG compared to traditional learning methods among 10 high school students. Over two weeks, one group uses an RPG focusing on the Manhattan Project, while the control group uses standard classroom methods. Post-intervention, both groups complete a satisfaction survey assessing enjoyment, engagement, and educational value on a 1-10 scale. Additional qualitative feedback is gathered through focus group discussions. Expected outcomes suggest the RPG group will report higher satisfaction,

illustrating the potential of gaming in education. This study aims to highlight immediate benefits and areas for improvement in RPG-based learning environments [14].

	A	B
1	Group	Satisfaction Scores (1-10)
2	RPG-Based Group	9
3	RPG-Based Group	8
4	RPG-Based Group	8
5	RPG-Based Group	8
6	RPG-Based Group	9
7	Traditional Group	6
8	Traditional Group	5
9	Traditional Group	7
10	Traditional Group	6
11	Traditional Group	5

Figure 5. Figure of experiment 2

The RPG-based group showing consistently high scores (8-9) aligns with expectations that interactive and immersive learning environments enhance satisfaction. However, the traditional group's scores ranged from 5 to 7, suggesting some variability but overall lower satisfaction, which could be due to the less engaging nature of traditional methods. The biggest surprise was the absence of any exceptionally low scores in the RPG group, suggesting high effectiveness. The biggest impact on results seems to be the method of delivery, with the RPG's interactive approach significantly boosting user satisfaction, reflecting its potential to make learning more engaging and enjoyable.

5. RELATED WORK

Methodology A, presented by Henriksen (2010), advocates for transforming educational role-play beyond mere entertainment to a deeper, more reflective learning experience. This approach highlights the potential of role-play to facilitate explorative learning and critical thinking by treating the activity as a conflictual negotiation between different types of knowledge. The effectiveness of this methodology lies in its ability to engage learners in meaningful reflection, though it may struggle with compatibility in traditional learning environments and may be too conflict-focused for some educational settings. Your project enhances this by seamlessly integrating engaging gameplay with educational content, balancing entertainment with educational depth, and providing a structured yet flexible learning environment that may appeal more broadly [11].

Methodology B, developed by Carvalho and Batista (2008), involves creating an interactive RPG that immerses players in the historical setting of the 500th anniversary of Funchal. This RPG aims to teach history and social relations through character role-playing and scenario-based interactions. The methodology effectively encourages historical exploration and social understanding through gameplay. However, it may overlook the assessment of specific learning outcomes and not fully address varying learning styles. Your project advances this approach by incorporating an adaptive AI that tailors experiences to individual learning preferences and provides detailed analytical feedback, enhancing both personalization and educational depth [12].

Methodology C, explored by Huizenga et al. (2009), utilizes a mobile city game called "Frequency 1550" to enhance students' historical knowledge of medieval Amsterdam. This game-based learning approach effectively increases engagement and knowledge acquisition by situating learning in a compelling narrative and interactive environment. However, the methodology does

not significantly affect students' motivation for the broader subject of history or the Middle Ages. Your project addresses this by incorporating mechanisms that sustain and enhance motivation over time through adaptive AI-driven feedback and personalization, providing a more comprehensive approach to maintaining interest in historical subjects [13].

6. CONCLUSIONS

Some limitations of my project include the potential for technological disparities among users, which could affect accessibility and overall experience. Additionally, while the adaptive AI enhances personalization, it may require extensive data to optimally tailor learning paths, which could raise privacy concerns or result in biases if not adequately diverse data sets are used.

To address these issues, if given more time, I would focus on developing a more robust backend infrastructure to support varying levels of technology access, ensuring a seamless experience across different devices and internet capabilities. Furthermore, I would enhance the AI's algorithms with ethical guidelines and broader data sets to mitigate biases and improve the adaptiveness of the learning paths. Implementing rigorous privacy protocols would also be a priority, ensuring user data is protected and used transparently. These improvements would make the project more accessible, equitable, and effective in delivering personalized educational experiences.

My project demonstrates significant potential in revolutionizing historical education through interactive RPGs and adaptive AI [15]. With refinements in technology accessibility, AI ethics, and data privacy, it could provide a more inclusive and effective educational tool, paving the way for a future where learning history is as engaging as it is informative.

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