

AN INTERACTIVE WEB PLATFORM FOR CLASSIC LITERATURE EDUCATION THROUGH COMMUNITY ENGAGEMENT AND SOCIAL REWARDS USING ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

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ABSTRACT

This research addresses the challenge of providing an engaging and effective Latin language learning experience by leveraging advanced AI technologies [1]. The proposed solution involves developing an educational app that integrates the GPT-4o Mini model for personalized learning, combining language instruction with cultural insights [2]. Key components include a Flask-based backend, AI-driven content generation, and interactive games designed to enhance user engagement [3]. Challenges such as balancing AI performance with response time were tackled by selecting GPT-4o Mini for its optimal mix of speed and accuracy. Experiments confirmed the model's effectiveness across various benchmarks, demonstrating its superior performance and cost-efficiency. The app offers a comprehensive and immersive learning experience, making it a valuable tool for modern learners interested in classical studies [4]. This approach not only improves traditional methods but also sets a new standard for language education by integrating advanced AI and interactive elements.

KEYWORDS

Literature Education, Nature Language Processing, Large Language Model, Machine Learning

1. INTRODUCTION

Latin, once a cornerstone of Western education and a vital key to understanding the intellectual and cultural heritage of ancient Rome, is increasingly marginalized in modern educational curricula [5]. The decline of Latin as a subject of study, particularly in K-12 education, is evident from recent statistics indicating that only 1.98% of students in the United States choose to study Latin [6]. This trend raises concerns about the future of Latin and its role in cultural literacy. The factors contributing to this decline are multifaceted, including limited access to classical studies, a lack of resources outside the school curriculum, and the perception that Latin is both difficult and of limited practical utility. In higher education, the situation is similarly troubling; approximately 23% of students enrolled in beginners' Latin courses in the UK either fail or withdraw, resulting in a pass rate of just 77%. This high

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attrition rate underscores the challenges students face in mastering Latin, often due to the perceived difficulty of the subject and insufficient engagement [7]. Despite these challenges, the study of Latin remains critically important. Latin is not merely a language; it is a gateway to understanding the linguistic, legal, and philosophical traditions that continue to influence contemporary society. Preserving Latin within educational curricula is essential to maintaining the cultural and intellectual continuity that connects modern civilization with its classical roots.

In modern times, young adults fail to fully appreciate the classics, which is especially important in the current developments of the politics and cultural dynamics today [8]. In reflecting upon the history of the ancient world, the study of the ancient developments could help in predicting the future. In understanding the Latin language, it is helpful in recognizing the historical impacts and linguistic influences on modern society. Understanding Latin is particularly valuable as it illuminates the historical impacts and linguistic influences that continue to shape modern society, fostering a deeper awareness of the cultural and intellectual foundations that underpin contemporary life. This knowledge is essential for ensuring that the next generation is equipped to engage thoughtfully with the complex dynamics of the modern world.

In Section 5, three methodologies were discussed: Busuu Language App, Traditional Language Learning Methods, and AI-Powered Language Learning. The Busuu Language App offers a comprehensive approach for various languages but lacks depth in cultural context and interactivity, particularly for Latin. Our app improves upon this by focusing specifically on Latin and incorporating engaging games and cultural insights. Traditional Language Learning Methods provide a structured learning experience but suffer from a lack of engagement and accessibility. Our app addresses these issues by integrating AI for an anytime, interactive consultant that curates multimedia content. Lastly, AI-Powered Language Learning is reliable and accessible but often struggles with accuracy and delivering cultural context [9]. Our solution combines AI with expert-led lectures and curated videos, ensuring both accurate language instruction and rich cultural background for Latin learners. This blend offers a more engaging, accurate, and context-rich learning experience.

Thus, we develop an educational app designed to make learning Latin culture and linguistics engaging and accessible through interactive games and informative lectures, thereby encouraging young adults to appreciate and connect with classical studies. The app centers on the teaching of classical languages (Latin and Greek) as the foundation for learning and understanding Latin culture. It integrates cultural knowledge into the process of acquiring linguistic skills, ensuring that users not only learn the language but also gain a reinforced understanding of Latin's profound contributions to modern society, such as the foundations of democracy and governance, legal systems, philosophical and ethical frameworks, and cultural identity and values. Through this comprehensive approach, the app provides a powerful educational tool that deepens users' appreciation of the classics and their relevance to contemporary life. Meanwhile, the app offers a fun and engaging learning experience, designed specifically to appeal to younger audiences through interactive elements such as mini-games. This approach not only makes the content more appealing but also enhances functionality and engagement for students interested in classical studies. Additionally, the app is built on solid and robust educational resources, carefully filtered and curated to ensure high-quality content. It is further enhanced by the integration of powerful AI, specifically GPT-4, which has been trained with a specialized model focused on Latin, providing users with a comprehensive and effective learning tool. Compared with existing Latin APPs, our app goes further by offering a more integrated learning experience that combines Latin language instruction with in-depth cultural insights, directly linking linguistic knowledge to the study of Latin's impact on modern society. It features interactive games and advanced AI,

specifically GPT-4, providing personalized learning and dynamic engagement for younger users. Additionally, our app includes a broader range of curated educational resources, catering to diverse learning styles and ensuring a comprehensive understanding of both the language and its cultural significance. This approach makes our app not only more engaging but also more effective for learners of all backgrounds.

In the experiments, the primary goal was to assess the performance and cost-efficiency of the GPT-4o Mini model compared to GPT-3.5 Turbo [10]. The first experiment focused on evaluating both models using benchmarks like MMLU and HumanEval to measure reasoning and coding proficiency. The setup involved running each model 30 times to ensure consistency in results. The findings indicated that GPT-4o Mini outperformed GPT-3.5 Turbo in accuracy across all benchmarks while also being more cost-effective. The second experiment aimed to validate the robustness of GPT-4o Mini in various scenarios. It highlighted that, despite its lower cost, GPT-4o Mini delivered results comparable to the more expensive models. The results underscored the model's advanced capabilities in reasoning and problem-solving, making it a superior choice for applications requiring both high performance and affordability. The outcomes aligned with expectations, emphasizing the balance between cost and efficiency.

2. CHALLENGES

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

2.1. The Inconsistent Quality and Organization of Available Materials

The task of filtering through videos and lectures to identify effective learning resources was both time-consuming and challenging due to the inconsistent quality and organization of available materials. To address this, we leveraged Large Language Models, such as ChatGPT and Gemini, to establish criteria for selecting beginner-friendly content. After reviewing blogs that critiqued various resources, we chose Latin Tutorial as the primary tool for teaching Latin grammar and vocabulary, supplemented by Magister Craft, which unlocks engaging content on Latin culture after learners complete a set number of Latin Tutorial videos. This combination not only provides a solid foundation in Latin language skills but also enriches learners' understanding of Latin culture.

2.2. Balancing Performance with Efficiency

In selecting the most suitable version of ChatGPT for our application, we encountered challenges in balancing performance with efficiency. We evaluated several options, including GPT-4o, GPT-4o-mini, and 3.5 Turbo. GPT-4o, while the most powerful in terms of generating intelligent and nuanced responses, was notably time-consuming, which could hinder user experience. Conversely, GPT-4o-mini demonstrated comparable robustness and sophistication in response generation, but with a significantly faster response time, making it a more practical choice for real-time applications. 3.5 Turbo, although faster, did not meet the required standards for response quality. Given these considerations, we opted for GPT-4o-mini, which offers an optimal balance between speed and the depth of response, ensuring that users benefit from both a responsive and intelligent interaction, thereby enhancing the overall functionality and user satisfaction of our platform.

2.3. Inaccuracy

To ensure accuracy, we use the most advanced ChatGPT model available. Acknowledging that occasional inaccuracies may arise, we've implemented a feedback section to continuously refine the chatbot's performance. To further enhance reliability, we created a specialized Latin culture chatbot, which is trained specifically to provide accurate and relevant information on Latin culture. This dual approach—leveraging a powerful AI model and a custom-trained chatbot—ensures that users receive precise, contextually appropriate responses, tailored to their needs in learning and exploring Latin language and culture.

3. SOLUTION

Version 1.

Our app is built on three core components: Firebase for the database, FlutterFlow for UI design, and ChatGPT as our LLM assistant [14]. FlutterFlow provides a user-friendly platform for both beginners and developers, offering extensive features that streamline the creation of customized user interfaces. It also integrates seamlessly with Firebase, our chosen solution for authentication and database management due to its ease of use and robust capabilities. Firebase allows certain portions of our database to be accessible via HTTP requests, enhancing the app's functionality.

For hosting our sentiment analysis AI model, we utilize Repl.it, ensuring that our app can process and analyze user interactions effectively. Although our tutors, who are either part-time or volunteers, may not always provide instant responses, the combination of Firebase and ChatGPT allows us to deliver a powerful and user-friendly experience for Latin language learners. The app not only supports language acquisition but also offers insights into cultural backgrounds, including mythology and modern influences. This comprehensive approach ensures that users gain both linguistic proficiency and a deeper understanding of the cultural context surrounding the Latin language.

We integrated ChatGPT 4o mini into our project to balance speed and accuracy for user interactions. To manage requests, we developed a Flask application locally and integrated the OpenAI API to facilitate ChatGPT responses [15]. This Flask app was deployed on Render.com, a user-friendly cloud platform. In FlutterFlow, we configured API calls to connect with our Flask app on Render.com, enabling seamless display of ChatGPT's responses in the app. Additionally, a customized chatbot was implemented to ensure professional and accurate answers.

Version 2.

There are three components: Lectures and tutor; games by Unity and chatGPT as our LLM assistant. With the purpose of introducing the Latin language for beginners of this sophisticated and ancient charming language, we first employ the lectures and tutor part in our APP to enable our customer have a better experience in learning the Latin language. All videos and lectures are well selected during the process and we made a great effort to gather the good resources. Meanwhile the tutor will be welcoming and professional to answer all the questions about the obstacles on your way of learning when they are online. However, due to the tutor is part-time or just volunteers for our APP, the students may not get the instant reply from our tutors. Then we employed the most powerful LLM for assisting us with the questions put forward by the users. We spent a lot of time for selecting the most suitable model for our project and finally decided to choose chatgpt 4o mini instead of a more time-

consuming chatgpt 4o, which means we balanced the speed of processing and accuracy as well. To further ensure and double check for the LLM generated answers, we use the customalized chatting bot for assistant and they are more professional in answering this kind of questions with more accurate answers.

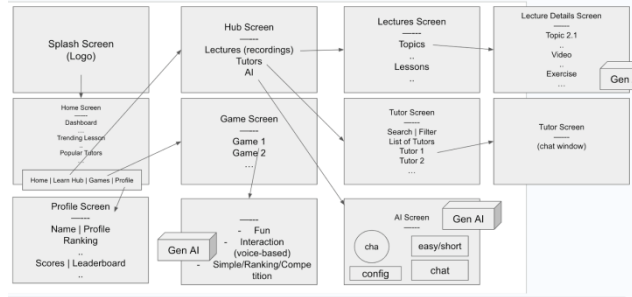


Figure 1. Overview of the solution

To address the need for timely responses to users' questions while maintaining high quality, we have chosen to implement the ChatGPT model as our AI assistant, which is based on a large language model (LLM). In recent years, the development of NLP technology, particularly with the advent of transformers, has led to rapid advancements in the field, ushering in a new era. Understanding and mastering the fundamentals of this technology is crucial. By leveraging these advancements, we aim to apply this cutting-edge technology to our project and enhance our capabilities.

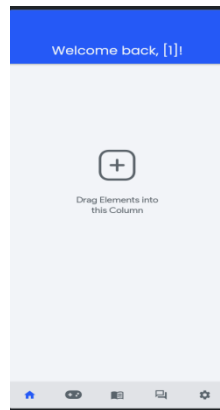


Figure 2. Screenshot of the element page

In our lectures and tutoring platform, we utilized Firebase to store user information, enabling us to offer a unique and personalized experience on the website. Firebase provides quick and easy access to data, allowing users to create their own accounts and track their progress. Additionally, the seamless integration between Firebase and FlutterFlow ensures that developers can efficiently and reliably connect the dataset to the UI/UX design, enhancing the overall user experience.

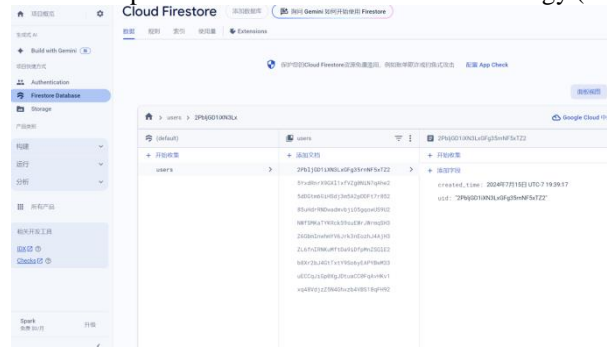


Figure 3. Screenshot of cloud firestore

The Flask application processes user inputs and retrieves AI-generated responses from the GPT-4o-mini model via OpenAI's API. Implemented using Flask and OpenAI's services, it relies on Natural Language Processing (NLP) to understand and generate text. This component enables dynamic, real-time user interactions.

```

from flask import Flask, request, jsonify
import openai

app = Flask(__name__)

openai.api_key = "sk-proj-772mlg7x19qE40XWuUe8BPK3sp8B8Uk3BEnZ2FR6G01suCqNE5T7v73B1hbf3_vF01e3E6Ch_uuy00WV9F0U-zFw616693MozA13E9VWongP41STV7sFA"

@app.route('/chat', methods=['POST'])
def chat():
    user_input = request.json.get('message')
    response = openai.ChatCompletion.create(
        model="gpt-4o-mini",
        messages=[{"role": "user", "content": user_input}]
    )
    return jsonify(response.choices[0].message['content'])

if __name__ == '__main__':
    app.run(debug=True)
  
```

Figure 4. Screenshot of code

The provided Flask application serves as a simple interface to interact with the GPT-4o-mini model via OpenAI's API. The chat() function is triggered when a POST request is made to the /chat endpoint, which typically occurs during user interactions requiring AI responses. This method is designed to process user input, which is received as JSON data and stored in the user_input variable. The function then sends this input to the GPT-4o-mini model using OpenAI's API, and the generated response is stored in the response variable. The server, upon processing the request, retrieves the AI's response and returns it to the user in JSON format. This setup facilitates seamless communication between the user and the AI model, enabling the application to deliver dynamic and contextually relevant responses, thereby enhancing user experience. The code effectively demonstrates how Flask can be used to integrate AI models in a straightforward yet powerful way.

4. EXPERIMENT

4.1. Experiment 1

A potential blind spot is evaluating the cost-efficiency and performance trade-offs between GPT-4o Mini and GPT-3.5 Turbo. Achieving this balance is essential for delivering affordable yet high-performing AI solutions. To test this, we will compare the two models on tasks requiring both reasoning and coding proficiency, using benchmarks such as MMLU and HumanEval. Each model will be tested 30 times to assess consistency. The key metrics for evaluation will include cost per token and accuracy. The experiment is structured this way to emphasize the balance between cost and performance, offering valuable insights into the practicality of GPT-4o Mini for developers.

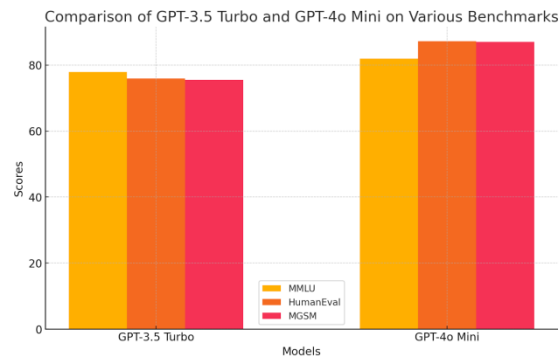


Figure 5. Figure of experiment 1

The data reveals that GPT-4o Mini consistently outperforms GPT-3.5 Turbo across all tested benchmarks. On the MMLU, GPT-4o Mini achieves 82.0%, surpassing GPT-3.5 Turbo's 77.9%. In the HumanEval coding test, GPT-4o Mini scores 87.2%, significantly higher than GPT-3.5 Turbo's 75.9%. Similarly, on the MGSM math reasoning benchmark, GPT-4o Mini records 87.0%, outperforming GPT-3.5 Turbo's 75.5%. These results are particularly striking given GPT-4o Mini's substantial cost advantage, being over 60% cheaper than GPT-3.5 Turbo. The combination of superior performance and lower cost suggests that GPT-4o Mini has the potential to replace older models like GPT-3.5 Turbo in a wide range of applications, delivering both economic and performance gains. The advanced reasoning and coding capabilities of GPT-4o Mini are the key drivers behind these results, making it a highly cost-efficient AI solution.

5. RELATED WORK

Busuu language APP is one of the greatest APP for diverse languages learning. Though it gains much more attention in diversity of provided language, it still lacks for the depth and engagement that will be provided in our app like games [11]. Our app offers a more specialized and immersive learning experience compared to Busuu, focusing on Latin language and culture through the integration of advanced AI like GPT-4, interactive games, and cultural content. They offers less quality and method for learners cause they just offer traditional method to finish the learning process. Our app's emphasis on cultural education alongside language instruction makes it particularly appealing for users interested in classical studies, offering a richer and more personalized learning experience that addresses the limitations of more general language learning apps like Busuu.

The interactive Latin language app developed by Leko et al. is designed for high school students in Croatia, focusing on improving their Latin grammar through multimedia exercises like drag-and-drop and fill-in-the-blank, created using Adobe Flash [12]. It emphasizes repetition and interactive learning to enhance student motivation and performance in a traditional classroom setting. In contrast, our app targets a broader audience, including younger adults to children, by integrating advanced AI, such as GPT-4, to offer a more immersive and culturally rich experience. Our app not only teaches Latin but also deeply engages users with its cultural context, providing a more dynamic and personalized learning journey compared to the structured, curriculum-focused approach of the Croatian app.

Based on the survey data from the document, traditional Latin learning apps in Croatia predominantly use basic digital tools like Microsoft Office, YouTube, and Zoom for teaching and independent study [13]. These tools are largely generalized and not specifically tailored for Latin, which limits their effectiveness. Although around 71% of students use digital tools

during Latin classes, and 74% use them for independent study, the tools are mainly for general educational purposes rather than specialized Latin learning. The survey also highlighted that traditional methods still dominate, with about 40% of students using digital tools less frequently than once a week, indicating a reliance on non-digital methods. In contrast, your method integrates advanced AI and personalized learning paths, which can dynamically adapt to the learner's progress and provide more immersive, context-rich experiences that traditional apps lack. This approach is more effective in sustaining user engagement and enhancing motivation, as it goes beyond basic tools to offer an interactive and culturally integrated learning experience that is specifically designed for mastering Latin.

6. CONCLUSIONS

One limitation of our project is the reliance on part-time or volunteer tutors, which can lead to delays in providing instant responses to students. To address this, we would consider implementing a more automated system, perhaps by expanding the role of AI to cover more frequent queries, ensuring quicker responses. Another limitation is the potential for inaccuracies in AI-generated content, especially when dealing with complex cultural contexts. Given more time, we would improve this by integrating more advanced AI models and rigorous content validation processes, ensuring both the accuracy and cultural relevance of the information provided. Additionally, enhancing the app's interactivity and user engagement through more dynamic features, such as real-time chat support and interactive learning modules, would be a priority for future improvements. These enhancements would make the learning experience more seamless and reliable, ultimately increasing user satisfaction.

Our innovative language learning app leverages AI technology to provide a comprehensive and engaging Latin education experience. By combining structured language instruction with cultural insights, we've created a unique platform that addresses the challenges of traditional language learning methods. As we continue to refine and expand our offering, we aim to revolutionize classical language education for modern learners.

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