GenAI + Learning Seed Grant Final Report
Museum in the Classroom | March 25, 2024

Background

With a major shift to remote learning in recent years, the need for innovative and interactive educational tools has become more prevalent than ever before. Augmented reality (AR) technology and generative artificial intelligence (AI) can revolutionize the way students learn and retain information regardless of their classroom setting. AR technology can make learning more interactive, immersive, and fun for students. It provides a unique solution to enhance classroom engagement by superimposing virtual objects into the classroom—this feature could help bridge the gap between classroom curriculum concepts and real-world applications, allowing students to visualize these concepts in a way that is more memorable than traditional teaching methods.

Similarly, the use of generative AI in the classroom has the potential to improve the quality of education by providing personalized and engaging learning experiences that are tailored to the curriculum that is currently being taught in particular classrooms. In addition, generative AI can help to address the challenge of limited resources. In fact, it can accelerate curriculum development without the need for additional resources or extensive planning, which can be beneficial for teachers as they may have little time to curate custom learning material.

However, not much is known about how to integrate generative AI into the classroom, how effective it is, and what new challenges it may introduce. While the potential benefits of using generative AI in education are vast, there is a lack of understanding on the impact of student learning outcomes. This knowledge gap presents a significant challenge in realizing the full potential of generative AI as an educational tool. Therefore, bridging this gap among educators, students, and researchers is crucial to unlock the power of generative AI and AR in the classroom.

Introduction

To address this challenge, we have built Museum in the Classroom (MITC), an educational app that leverages both AI and AR to increase classroom engagement. Educators can list what topics they are currently teaching in the classroom and the app will use these new technologies to display an exhibit filled with artifacts that are related to the inputted topic and can be represented through common classroom items. The app will guide teachers to lightly rearrange the classroom, hoping to emulate a museum experience for students. Then, students will use an iPad to scan the classroom items, which will be associated with the artifacts—students will receive information about them and generative AI-related reinforcement questions to test their understanding.

We investigate three main research questions:

1. What are the opportunities and challenges of combining generative AI, AR, and context-aware technology in the classroom?
2. How do high school students interact with this technology in the history classroom? What do they like and dislike about the experience?

3. Does applying generative AI and AR lead to more student engagement and satisfaction, as opposed to the traditional classroom setting (e.g. textbooks, pop quizzes)?

Based on prior research and initial scoping, we hypothesize that the use of generative AI and AR in the classroom will be more effective for both students' learning and engagement, especially in the history subject.

Timeline

To start, to test the validity of the project idea, we ran two studies. In our initial pilot study, we worked with three middle school/high school history teachers, two middle school students in the Bay Area, and two high schoolers in Seattle. Once we gathered their feedback, we began designing a mockup on Figma that would eventually be developed into an app. We completed the mockup in July 2023. During this phase, a major challenge we encountered was training ChatGPT to generate relevant artifacts about a subject. When we gave ChatGPT free rein and no constraints, it suggested unrealistic artifacts that could not necessarily be associated with common classroom items. To address this concern, for our classroom study, the team decided to curate our own exhibit based on one in the Cantor Arts Museum on Stanford's campus. We worked with the museum to find artifacts with similar dimensions and purposes to common items.

The final app with this updated exhibit was pushed onto TestFlight in September 2023. Since August 2023, we have been closely working with a 7th-grade history classroom in Palo Alto and officially conducted a controlled study with our complete app in November to compare the effectiveness of the MITC app versus traditional classroom methods. In the last few months, the team has been working on analyzing the collected data, which includes qualitative feedback and app usage.

Procedure

The team went onsite to a local middle school to conduct the study with 20 participants, ages 12-13. They received an iPad with our app installed on it. The app took them through a museum exhibit about Leland Stanford Jr., the son of the founder of Stanford University, who had collected many interesting trinkets before his early death. Over the course of the study, the participant learned about and engaged with the different historical objects collected by Stanford Jr. We first asked participants to complete a pre-survey measuring previous knowledge and general sentiment towards augmented reality and generative artificial intelligence, as well as other metrics. All participants experienced the same condition, in which they learned about half of Leland Stanford Jr.'s artifact collection through the modern condition, which required participants to learn about Stanford Jr. through the app, and the other half through the traditional condition, where students learned about the museum topic through written papers.

During the session, we collected logs through the app by recording the screen. We also took notes and video-recorded the entire session. The team acted as "moderators" who did not provide any guidance unless a participant was completely stuck and could not move forward with the study in the allotted time. Afterward, we administered a post-survey that gauged app enjoyment and engagement.

Finally, we released a follow-up assessment two days after the session to assess knowledge retention. Both types of participants had the same assessment on all of the artifacts—it included a mix of multiple-choice and written-response questions that covered all six artifacts.

Findings

Overall, the data suggests students are enthusiastic about using AR technology for learning, as interactive 3D visualizations make complex ideas and artifacts more accessible (Figure 1). The strong preference for AR apps over textbooks correlates to the desire to keep using MITC (Figure 2). This demonstrates clear student engagement with the interactive and immersive nature of AR for history learning specifically. While this app cannot replace a museum visit, we found that AR increases engagement, knowledge retention, and interest in subjects. Therefore, we believe that educational apps should strive to replicate experiential interactivity on a broader scale.

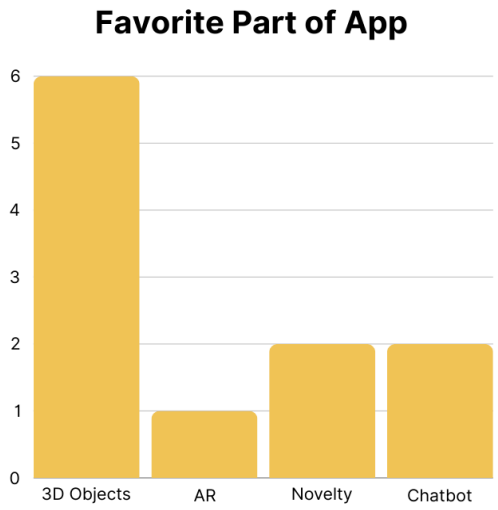

Figure 1: Participants' favorite part of MITC

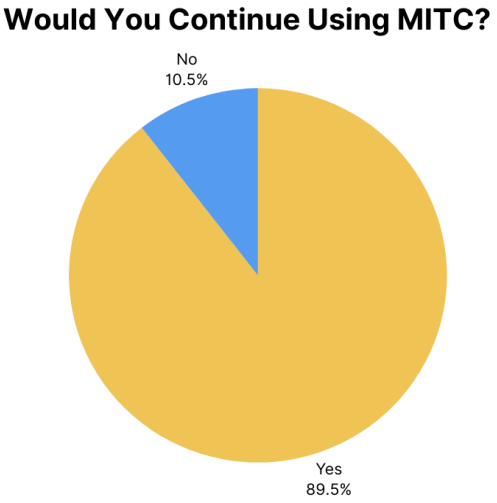

Figure 2: Participants' MITC preferences

Next Steps

While we have finished most of the study and building the app, the MITC team could benefit the most from research support, as we are interested in writing an official report/article to publish in a conference or journal. We would also like assistance in building a personalized website that highlights all the accomplishments MITC has been doing so accessing web designers would be helpful. Overall, we want the MITC project to gain more visibility so we can further develop this idea and hear new perspectives. Additionally, we would like to build a website to share our findings with the greater edtech community so others can learn from our idea and are hopefully inspired to implement generative AI and AR into classrooms.