Development of Financial Literacy Virtual Voice Assistant

(Technical Project)

Product Development Using the Power of Codesign Between Engineers and Other Experts

(STS Topic)

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By

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

Oftentimes, engineers work on projects that may be outside of their scope of expertise. They have the technical background, but not the proper experience to address wide, abstract problems. This idea pertains to my capstone team's work as we are working on a project that is a mix of education and technology, however our backgrounds are primarily in technology. Our goal is to develop educational technology that will improve financial literacy in American students using virtual assistant technology. Technology does not simply make teaching easier and devices are not a replacement for teaching for every student (Harris, 2016). This push for technology to bridge educational gaps may clash without the proper expertise from both backgrounds requiring collaboration. To develop an effective tool, it is important to explore what is good educational technology and the process of developing it. Developing effective educational technology is important, but due to our inexperience in education, we have to explore ways of taking educational values into consideration. Using the process of codesign, my STS research will investigate how engineers and experts in another field collaboratively work together to effectively complete projects.

Technical Topic

My team and I seek to address the lack of financial understanding among adult Americans by reinforcing financial literacy at an early age (Kindergarten - 12th grade students). Financial literacy is the idea of using financial knowledge to make better financial decisions (Financial Literacy 101, 2021). Currently, over 65% of Americans are financially illiterate and are unable to manage their finances (Sherwood, A. R., 2020). Under the guidance of Professor Tariq Iqbal, a professor in the Department of Engineering Systems and Environment, and

MITRE, my team and I are creating a virtual voice assistant who will educate/engage young American students on financial topics. The conversation will test a student's understanding, while teaching to fill in any financial knowledge gaps. The team is composed of five fourth year systems engineering students: Vinny Thota, Candace Miu, Niels Van Beek, Matthew Thompson, and Jesilyn Gopurathingal (myself). By targeting young kids and teenagers, they will ideally grow up with the essential knowledge needed to make wise financial choices.

Our team has taken several steps towards developing the financial literacy voice assistant. We meet weekly to discuss next steps for research and so far, we have determined what financial literacy is and what the general state of financial literacy is amongst Americans to understand where they are at in terms of skills. Documents provided by MITRE detail standards that students in each grade level should meet to be considered financially literate. We have also researched general best practices for developing conversational flow outlined by Deloitte (Vatatmaja, Gadewadikar, 2021). Since the conversation between the voice assistant and student will need to be outlined, there are several places where we could fail to accurately account for our audience. In order to counteract this potential for failure, we are in the process of finding a dataset that may provide better insight as to how students feel about their understanding of financial concepts and preferences in learning tools. The data will ensure that the tool developed has accounted for the audience's needs so it's both desirable and practical. Lastly, we are deciding between using Amazon Web Services or Google as the cloud platform that will allow the voice assistant to be accessible. Both platforms have their pros and cons in terms of pricing

structure, capabilities, and more, but regardless of which one we choose, we will utilize the platform to transform the conversational flow we develop into audible voice.

My work has been focused on creating the kindergarten script that will check off national standard benchmarks for financial literacy at different grade levels (Jumpstart, 2015)). This involves identifying existing lesson plans that address these benchmarks and translating it into conversational dialogue. This will be mapped out using voice threads to address various scenarios depicting what a user might say. Depending on what the student says, the voice assistant will verbally respond back and continue the conversation.

In terms of next steps, we intend on researching conversational dialogue flow that is suitable for each grade level and to outline the standards. Once the outline is developed, it is useful to gather feedback from our intended audience to ensure the practicality of the program. This may require an approval process on behalf of the internal review board as we would be using human subjects. After having the study approved, the developed dialogue will be implemented into the cloud platform of our choosing and converted in a text to speech process.

STS Topic

As technology continues to grow in complexity and appear increasingly within our daily lives, one can imagine how vastly the educational experience differs amongst newer generations versus older generations. With the recent Coronavirus pandemic, more than 1,300 schools were forced to switch to online teaching methods which can be seen as a huge technological jump (Smalley, 2020). Technology can be a powerful tool when it comes to learning. Since our project aims to be a useful educational technology tool, it is valuable to evaluate what is educational

technology and what factors make educational technology good. Educational technology can be defined as technology that utilizes available resources, human and material, provides a solution to an educational problem, and aims to "improve …education by getting maximum … output with the minimum input" (Mangal, S. K., 2009). An additional definition of educational technology is technology "that assists in the communication of knowledge, and its development and exchange" (Lathan, J., 2019). Good educational technology should target the appropriate audience. Research has shown that if the education is targeted to meet a student's learning level, it can be very effective in improving student learning (J-PAL North America, 2019). To summarize, technology that uses existing resources to solve an educational problem by improving the transfer of knowledge, while targeting the audience is good educational technology. It is not simply an audio-visual tool nor a computer-tool, but rather a tool that integrates these ideas in an effective system.

Working on a project without the proper expertise can yield an ineffective tool, so to counteract this lack of knowledge, we can consult other experts through codesign. Codesign can be described as the process of engaging people with differing skills, knowledge, resources, and interests in a project (Edmunds, 2013). An example of codesign can be seen in the joint efforts between the University of California, Berkeley's Community Assessment of Renewable Energy and Sustainability program and the Pinoleville Pomo Nation to develop housing that is sustainable and culturally appropriate for tribal citizens. It was believed that the housing could continue to uphold the tribe's cultural values and social norms, while improving upon it. The key setup in the group's dynamic is that the tribe is considered the housing experts, while the engineers and architects are the ones who will carry out the vision with some added suggestions.

This setup can serve as a model for engineering projects including my team's. My team currently does not have proper background knowledge in education, but working with teachers or faculty members from the Curry School of Education will allow the input of an educational expert. This ensures there will be a proper transfer of knowledge from the technological system to the student.

Another example of codesign can be seen in the collaborative effort between engineers and physicians to develop solutions to medical problems. "Approaches that combine the fundamental aspects of engineering with medicine are likely to yield a wealth of new directions for research and development" (Crawford, 2007). In this model, the two groups come together for brainstorming sessions to address interdisciplinary research problems stemming from a medical need (Crawford, 2007). The physicians discuss existing medical issues that could be solved with technology, and the engineers think of technology that could solve these issues. Using this model, the team has improved the precision of a spectroscopic tool, developed a noninvasive blood hemoglobin monitor, and has been working on a tool to determine the age of bruises. Without this collaboration, physicians would not have the technical background to develop these solutions, while engineers would not have the medical background to address these problems. A setup such as this would be beneficial to engineer projects including my team's. Instead of the team asking teachers for input on lesson plans and the tool overall, if we work as equals, then we can learn about issues they've experienced with teaching kids and adjust for this.

Next Steps

1) Financial literacy lesson plan

- Create a Gantt chart to show a detailed timeline of the expected process to ensure the team stays on track
- Communicate with current teachers to develop a financial literacy lesson plan for grades 1st - 12th and use the kindergarten lesson plan as the model template.
    - Use prior research on financial literacy lesson plans to make our own lesson plan
    - Understand how lesson plans must be tailored to different aged children
        - Games at younger ages
        - More regular exercises in high school
- Continue to implement the idea of codesign throughout the project journey to ensure expert opinions are included

2) Implementing lesson plan into virtual assistant

- Choose cloud service platform
    - Fulfills all functional requirements (security, storage, regulatory, cost)
- Formulate a flow process diagram for the user interface
    - How the user moves between each part of the interface as a whole
    - The progression through a singular lesson
    - Determine when and where the virtual assistant can make its own decisions (as laid out in our functional requirements document)

- Use current data (and potentially create data via interviews) that will inform the team on how to best implement the voice assistant
    - Different age groups will respond differently to similar question structures and conversation flows so understanding how different age groups will most effectively interact with the program is essential to creating a working virtual assistant

3) Testing and validating the platform (if applicable)

- If IRB approval is received, the team will test the platform and analyze its design
- Validation throughout the process is crucial to making sure:
    - Users will stay engaged
    - User will learn all conveyed information effectively
    - Want to continue to use the platform
- If approval for human subjects does not occur within the given timeline, the team will use public data and private datasets that may be provided to them

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